Co-presence and socio-emotional experience.

Investigating students' emotional experience during collaborative learning online.

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A Thesis submitted for the Degree of Doctor of Philosophy

Declaration

I, Kathleen Robinson confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

Multisensory information for example, facial expression, tone of voice, is used to infer, and respond to, the emotions of others and is considered integral to the quality of social interaction but when using computer mediated communication (CMC) at distance this information is not available. The question is whether co-presence and by implication, socio-emotional experience, is compromised.

A multidisciplinary toolkit of methods was developed using an Educational Neuroscience framework. The investigation of situated experience used survey responses collected from 256 students who had undertaken a group project at distance using CMC, and a comparison with an equivalent face-to-face experience (Study 1), then the interpersonal interactions of two groups who collaborated online were studied using a quantitative (Study 2) and a qualitative (Study 3) approach. For scholarship Study 1 demonstrates the value of including activities and spaces that are based within a wider online learning community while the findings of Study 2 and 3 show that students adapt to an online context by using the technology available and verbal immediacy practices. Narratives, that incorporate these practices, were developed to seed discussion amongst teachers about facilitatory practice.

In Study 4 embodiment was the focus, neural activity and facial expression were monitored using neurophysiological techniques while the participants (acting as teachers) took part in a simulation whose design was informed by the findings of Studies 1-3. The outcome was a coherent line of evidence subjective, behavioural and neural. A model of social interaction at distance using CMC was constructed that is plausible at three levels of description, student practice, Psychology and Neuroscience.

There is multidisciplinary evidence that the socio-emotional experience of students interacting at distance using CMC need not be compromised. Students and teachers are able to use a written form of communication to construct and experience a sense of co-presence.

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Chapter 1 Approach to the investigation of co-presence and students' socio-emotional experience during collaborative learning online

1.1 An introduction to the thesis and the literature review

The development of Distance Education (DE) spans more than a century. It has involved adapting to the most appropriate medium for communication between provider and student available at the time: correspondence, broadcast, teleconferencing, and the Internet (Moore & Kearsley, 2012). The impact of being able to use computer mediated communication (CMC) technologies via the Internet has been profound (Gaskell, 2009) distance students are now able to interact with each other on a regular basis and can have a stronger sense of being part of a learning community. It also means that they can be given the opportunity to learn collaboratively, to work with other students on a shared task (Weller, 2003). This is an important and significant development for DE; learning through collaboration is an esteemed pedagogical form while the ability to take part and contribute to group work is an essential professional competence.

There are other advantages of using CMC. There is time for reflection and a full textual record of both inter-peer exchanges and teacher contribution is available. This means that a student can review a complete record of the learning conversations and do so as many times as they wish and there is

time to reflect and to compose a response (Laurillard, 2002). There are also some practical advantages, students can engage in the discussion at a time and place that is convenient, and are able to self pace their session length (Weller, 2003). Taken together these advantages should engender a positive experience, and for some students this is the outcome. However a positive student experience is not guaranteed. There are reports that the interpersonal processes involved in group work online can result in a negative emotional experience (Capdeferro & Romero, 2012; Robinson, 2013). Research in other contexts, and when other pedagogical approaches to learning are applied, has concluded that the emotional experience of students can influence the learning outcome (Bandura, 1997; Cooper, 2011; Jones & Issroff, 2005; Linnenbrink, 2007; Pekrun & Schutz, 2007). Furthermore, it has been demonstrated that the decisions that a student makes about their engagement with learning are fundamentally emotional (Immordino-Yang, 2010; Jones & O'Shea, 1982; Kirkwood & Price, 2005). This evidence, that emotion and cognition are interrelated, and the research findings that students' emotional experience of group work online is not always positive, influenced the topic of the thesis: distance students' socio-emotional experience of doing group work remotely using CMC.

However, students have also described the experience of group work in negative terms when it takes place face-to-face (Burdett, 2003). For both contexts, online and face-to-face, the shared nature of the task has been identified as problematic with some students perceived by their peers as

insufficiently effortful. Therefore, to better understand the student experience of doing group work at distance using CMC an important first stage is an analysis of what it means for students to engage in group work per se. 'Learning through collaboration' involves a group of students working together on a shared task. The pedagogical value of 'learning through collaboration' depends on students sharing their developing ideas and practice with peers, and commenting on the ideas and practice of other students (Laurillard, 2012); a group of 4-6 students is optimal for the iterative and reciprocal interpersonal interactions involved. There will be occasions when members of a group will need to offer, or to receive, negative comments about a contribution. It has been proposed that the negotiation of disparate ideas and practices is mediated by the socio-emotional climate of the group; that, when the quality of interpersonal space (relational space) is appropriate, progress with the task is better supported (Barron, 2003; Van den Bossche, Gijselaers, Segers, & Kirschner, 2006). Relational space is constructed by the group and depends on each member of the group being aware of the emotional state of other group members (social cognition). Although socio-emotional experience will be unique for each student it will also depend on the quality of the relational space of the group and can influence the extent to which a student engages with the other members and by implication the work of the group. The socio-emotional experience of the individual student, the relational space of the group, and the cognitive aspects of 'learning through collaboration', are intricately interrelated. Understanding a student's experience with group work,

and their motivation to engage, will depend on knowledge of this complex interrelationship. When group work takes place remotely using CMC there are additional factors to consider. Students are not co-present in time or place which means that they do not have access to the embodied cues that are so important during interpersonal interaction face-to-face. The absence of such information could influence how other students are experienced (co-presence) and by implication, the quality of the learning experience. Furthermore, interpersonal interaction is through writing.

Untangling the many factors that can contribute to a student's socio-emotional experience of doing group work online is the challenge for this thesis. The role of this chapter is to explore the range of literature that could inform the approach to the investigation.

The research question and research aims are introduced in Section 1.2. The section begins by describing how emotion and cognition interrelate when 'learning through collaboration'. Then, what is experientially unique for students and teachers who undertake group work at distance using CMC is explained by examining the communicative context in more detail, and by contrast with a face-to-face experience. The theoretical background of the thesis, the question of whether the quality of interpersonal interaction is compromised when there is no sensory information about others, is introduced in Section 1.3. Section 1.4 explains why Educational Neuroscience was chosen as the overarching methodological framework and Section 1.5

explains Aim 1, how a multidisciplinary approach will be implemented. The rationale for Aim 2, to make a contribution to practice, is explained in Section 1.6. The contribution that three fields of study Learning, Emotion, and Communication, can make are then considered in Sections 1.7. Finally, an outline for the thesis is provided in Section 1.8.

1.2 Emotional experience while 'learning through collaboration'

It is not uncommon for the academic achievement that results from group work, whether undertaken face-to-face or online, to vary significantly between groups despite their access to apparently similar opportunities (Barron, 2003). To explain these findings Barron proposed a dual-space model of collaborative group learning whereby there are two interdependent components, the problem (task) space and a relational space

> consisting of interactional challenges and opportunities (Barron, 2003, p 310).

In this model an appropriate relational space is important for supporting and nurturing learning (Barron, 2003; Cooper, 2011; Linnenbrink, 2007; Van den Bossche et al., 2006). For this thesis it is assumed that the socio-emotional experience of the individual student will depend on the relational space of the group to some extent, and is why relational space is an important element of group work. The following considers relational space and socio-emotional experience when doing group work per se and group work online,

respectively, so that what is distinctive about group work online can be further clarified.

There are many sources of emotion when learning, for example: the perceived difficulty of the learning task, a student's appraisal of their academic competence. However there are some sources of emotion that are unique to 'learning through collaboration' irrespective of whether it takes place online or face-to-face. These include the psychological dynamics of the group (Bales, 1944, 1955) and a lack of autonomy due to being dependent on other group members for the achievement of the collaborative task (Burdett, 2003; Capdeferro & Romero, 2012). The emotions, for example, frustration, that ensue are due to group work per se, and arise irrespective of whether the group work takes place face-to-face or online.

When the interpersonal interactions involved in group work take place asynchronously and in online forums (the technology that is most commonly adopted for group work online) the multi-sensory information that is integral to the quality of face-to-face social interaction (Argyle, 1988; Argyle, Alkema, & Gilmour, 1972; Mehrabian, 1972), and to the processes involved in implicit social cognition (Blakemore & Frith, 2005; Frith, 2007, 2009; Frith & Frith, 2006), is not available to students and teachers. Writing rather than speaking is the mode of communication and so non-verbal communication (e.g. gesture, facial expression) and paralinguistic cues (e.g. tone of voice, inflection) are not available as cues to the feelings of peer students.

Furthermore, it is likely that distance students never meet face-to-face so the absence of this information may be particularly problematic. Therefore, the investigation of socio-emotional experience during group work online also involves an understanding of the way in which the presence of others (co-presence) is experienced in these contexts. For example, an issue that has been raised by students, and documented in the research literature (Bayne, 2008; Robinson, 2013) concerns the elusive sense of other members of the group.

> Working on-line with a group was a difficult experience; we never met on-line at the same time even when this had previously been arranged. I also found it hard to express myself and my opinions on-line as we had never met and knew nothing about one another. I felt that had we been working face to face we would have had a better sense of who each of us was and been able to discuss the project more openly (Student).

How students construct relational space and experience other students when they never meet face-to-face, they are not co-present in time or physical space, they use writing as the mode of communication, encapsulates the problem space for this thesis.

1.2.1 The research question

From this problem space the following questions about co-presence and the socio-emotional experience of the students and teachers who are involved in collaborative learning using CMC arise:

- How are emotions expressed and experienced, and the emotions of others recognised and responded to, in the absence of multisensory information?

- When the members of a group never meet face-to-face, and there are no identity cues or multisensory information, are they in some way perceived to be 'less real'?

- What is the impact of the mode of communication, writing, on co-presence and socio-emotional experience?

- How does a lag in response time influence co-presence?

Questions such as these define the overarching research question:

What are the consequences of doing group work online and asynchronously, using text-based forums, on co-presence and the socio-emotional experience of the students and teachers involved?

1.2.2 The research aims

To progress the idea of socio-emotional experience as influencing engagement with learning the thesis adopts a psycho-biological perspective on motivation while learning, a focus on intrinsic motivation and its interrelationship with emotion; that the motivation to approach an object or an event depends on the valence (positive or negative) of that emotion (Harmon-Jones, Gable, & Peterson, 2010). A psychobiological perspective assumes that the valence of an individual's experience of interpersonal relations within the group will influence their engagement with others in the group (negative-

withdrawal, positive-approach) and by consequence, with the task. The challenge for this view of motivation, and its relationship with emotion, and its effects during group work online, lies in taking into account that:

- The relational space of a group is co-constructed by the group members yet each individual within the group uniquely experiences it.

- A student's socio-emotional experience will depend on the relational space of the group and on the teacher's interactions with the group.

- Emotion is labile and is evidenced behaviorally and neurally, as well as subjectively.

- When group work takes place online using asynchronous CMC all interpersonal interaction takes place through writing and there is no multisensory information available.

This challenge will be met by adopting an Educational Neuroscience framework to investigate 'learning through collaboration' remotely using CMC at two levels, the group and the individual, and by investigating socio-emotional experience at three levels, subjective, behavioral, and neural. In addition the methodology will need to address the dispute about the quality of social interaction when using CMC (with the argument hinging round the impact of the absence of multisensory information about others).

Therefore the first aim for the thesis is:

Aim 1. To identify and develop a methodological toolkit for studying the socio-emotional experience of the individual student, the teacher, and the relational space of the group (as constructed by a group engaged in a shared learning task) at three levels, subjective, behavioural, and neural, and to formulate a model of social interaction at distance using CMC that is plausible from three perspectives, Education (participants' practice while learning using CMC) Psychology and Neuroscience.

Having worked with open entry and distance students in a variety of roles (support, guidance, teaching, development) and contexts (face-to-face, online) I have learnt that these students are not passive consumers of education, they invest time and emotion, and their decision about re-enrollment on subsequent courses will depend on the quality of their experience, emotionally as well as academically. Therefore the second aim of the thesis is to provide a better understanding of the contextual factors that influence their socio-emotional experience so that the findings can inform the future implementation of group work online.

Aim 2: To contribute to a better understanding of the experience of learning with others when using CMC for interpersonal interaction. This should inform the integration of forums and other technological tools into the design of online learning, and will enable us to improve our support for teachers in understanding the role of the

emotional climate when students are engaged in collaborative learning online.

1.3 Social interaction at distance during group work

Appropriate social interaction depends on co-presence, the experience of 'others' as having thoughts and feelings, as inferred from what they say and do. In turn the valence of socio-emotional experience will depend on the social behavior of others and by implication co-presence. For social learning all the above apply and can influence engagement with learning. To undertake group work successfully requires some sense of other members and their feelings so that students can manage discussion and debate sensitively whilst at the same time progressing the group task and their personal understanding. Although non-verbal cues to emotion may be expressed by a student when communicating with others remotely these are unseen. Therefore, the other students and the teachers may not discern a student's feelings unless these are communicated within the textual exchange. This is the major reason why the quality of emotional experience during social interaction at distance using CMC has been questioned throughout the previous three decades, the idea that CMC disrupts interpersonal interaction.

A negative view of social interaction online that pervaded early accounts of using CMC for social learning claimed that there is more aggressive, angry and abusive content in the exchanges that take place in computer mediated

communication than in face-to-face encounters. For example, a report from the Open University, a UK distance learning institution that introduced computer mediated communication (CMC) during the 1980s.

> [T]his medium afforded less emotional restraint and sometimes led to emotional, often angry message content, known as flaming (Jones and Issroff, 2005, p 403).

'Flaming' as a behaviour characteristic of interpersonal interaction online when using CMC received a substantial amount of attention during the two decades following the introduction of CMC as a way of providing for interpersonal interaction between students. Therefore, a short account of how 'flaming', as a relational behaviour typical of CMC has been described and researched, and how its contribution to the social-emotional experience has been evaluated, follows.

Although 'flaming' as a behavior is difficult to describe and therefore to operationalise (Joinson, 2003) there are empirical studies on its prevalence (Kreef-Peyton & Bruce, 1993; Sproull & Kiesler, 1986, 1991) its form, (Mabry, 1997; Thompson & Foulger, 1996), and causal factors such as anonymity (Siegel, Dubrovsky, Kiesler, & McGuire, 1986) and teacher presence (Kremers, 1993; Sirc & Reynolds, 1993). Mabry (1997) explored the way in which the functionality of CMC software influences the incidence of flaming, in particular the facility to 'reply with quote'. The majority of these studies did concur with the idea that a computer mediated mode of communication was more likely to lead to a negative emotional experience.

There is a counter view. That students can be particularly supportive of each other when using CMC remotely is well documented (Palloff & Pratt, 2007; Preece, 2000) and it has been my personal experience of learning and teaching in these contexts. However, it is important to provide sufficient time for interrelationships to develop online (Walther, Slovacek, & Tidwell, 2001) a finding confirmed by other studies; a meta-analysis of 21 studies (Walther, 1994) and a study based on a course where students were using a second language to communicate as part of language learning (Abrams, 2003). Therefore it is relevant that the course on which this thesis is based took this recommendation into account in its design; there was sufficient time allowed for a group to develop as a unit. Other research has shown that within group identity has more salience when interpersonal interaction takes place remotely (Lea & Spears, 1991, 1992; Lea, Spears, & Watt, 2007) as compared to face-to-face contexts, when perceptions of individual identity can have a negative influence for example, stereotyping.

The absence of multisensory information is the factor central to the debate about the quality of interpersonal interaction when using CMC. When students themselves were asked whether they would like to have access to visual information about co-students and/or voice their responses were mixed (Robinson, 2010). Therefore, the following two subsections address this debate by focusing on the processes of social cognition that are involved; a psychological perspective.

1.3.1 The role of multisensory information: an argument for disruption

The natural carriers of relational information are generally assumed to be non-verbal cues (NVC) (Argyle, 1988; Argyle et al., 1972; Mehrabian, 1972). Therefore, in 2009 when I began this thesis, the prevailing idea that communication in online text based forums is limited due to the absence of social, physical and non-verbal cues is unsurprising. For example, it was claimed that the absence of such information disturbs psychosocial experience (Joinson, 2003; Kiesler, Siegel, & McGuire, 1984) and compromises the formation of trustful collaborative working relationships (Bos, Olson, Gergyle, Olson, & Wright, 2002).

In face-to-face contexts non-verbal communication (NVC) such as facial expression, bodily movements, and paralinguistic signals are a potent way of expressing emotion and for others to perceive emotion (Argyle, 1988). Some are manifestations of emotion as spontaneously expressed while others are produced deliberately (Argyle, 1988; P. Ekman, 1985; P. Ekman, Davidson, & Friesen, 1990; P. Ekman, Friesen, & O'Sullivan, 1988; Parkinson, 2008; Zaalberg, Manstead, & Fischer, 2004). Although it is possible to control the spontaneous (involuntary) expression of emotion, it is difficult to do so. This means that mentalizing,

> the capacity to attribute wishes, feelings, and beliefs to
> other people in order to explain their behavior
> (Blakemore & Frith, 2005, p 97)

in face-to-face contexts will be facilitated by access to spontaneous expressions of emotion. During social interaction in text based forums online such information is not available and its absence has been used as an explanation for negative accounts of socio-emotional experience online.

1.3.2 The role of multisensory information: an argument for adaptation of practice

While it is undeniably the case that some elements that had hitherto been taken for granted in interpersonal interactions are missing in text based online contexts there is an alternative view; that students and teachers will adapt their communicative practices so that

> Impediments of communication technology are overcome by its users, people adapt semiotics as they move from one set of symbol systems to another, from speech to text (Walther, Loh, & Granka, 2005, p 385).

(Frith & Frith, 2012) have proposed a distinction between implicit and explicit social cognition that can be used in support of the argument for adaptation of practice. In face-to-face contexts learning by observing the actions of con-specifics, for example, gaze, facial expression, can involve any combination of the processes (for example, mimicry, imitation) that underlie social cognition that is implicit. However, this type of learning is not unique to humans; Frith and Frith provide several examples of observational learning in other species. The implicit processes that underlie observational learning are also apparent during the very early stages of human development. In contrast explicit social cognition is conceptualised as a metacognitive process that depends on the

human ability to use language and to reflect; explicit social cognition is a uniquely human capacity that typically develops by age 8 years (Frith, 2012; Frith & Frith, 2012). Frith and Frith contend that it is explicit social cognition that underpins cooperation and collaboration. Their argument is based on the premise that explicit cognition

> enables people to understand each other with a high
> degree of precision (Frith & Frith, 2012, p 63)

and that reflective self-awareness is a key mechanism allowing us to mediate the implicit processes that might otherwise compromise cooperation and collaboration. Based on this argument, two cognitive competencies (language, reflection) are more relevant for 'learning through collaboration'. The implication for the argument that is being debated in this section is as follows: provided students using CMC can communicate their thoughts and feelings through writing, and infer the thoughts and feeling of others through this mode of communication, there should not be a problem with using CMC for group work online. Furthermore an advantage of asynchronous CMC is that there is time to reflect and so modulate initial emotional response.

1.4 Educational Neuroscience: the methodological framework

The following list of considerations was taken into account when deciding on an overall methodological framework.

- A student's level of engagement with group work will be intrinsically motivated to some extent, and depends on socio-emotional experience.

- There are some unique features when learning using CMC that may impact on the quality of that experience. Students are not present in time or space therefore there is no multisensory cues to the thoughts and feelings of others, and all interpersonal communication is through writing.

- Some students and teachers have reported that 'others' involved in social interaction online can seem 'unreal'. The experiential accounts of some students about the 'realness' of others are reminiscent of a previous personal experience, albeit in a very different context. This personal experience was a significant influence on the direction taken for this thesis, including the intention to model social interaction at distance using CMC.

- Relational space has a role for group work. Two psychological concepts, inference and attribution, are the social cognition processes involved in the co-construction of relational space, and its interpretation by the individual student. These processes will depend on 'others' being perceived as 'real' and the outcome will be evidenced behaviourally and neurally.

- The distinction between explicit and implicit social cognition is relevant for remote interpersonal interaction using CMC. 'Realness' could

depend on the extent, and manner, in which thoughts and feelings are made explicit.

- The thesis will need to investigate the embodied manifestation of emotion alongside the subjective.

- Another psychological process, appraisal can moderate emotional experience and thereby influence the motivation to engage.

Consequently, there are three reasons why Educational Neuroscience, which embraces three distinct disciplines Education, Psychology and Neuroscience, was chosen as the overarching framework.

Firstly, the quality of the participant experience when interacting using CMC is debated. A deficit view of CMC implies disruption at a neural level whereas adaptation of practice by those involved is a positive view and implies an alternative neural pathway. A psychological concept, social cognition, is relevant for both views and is what links these views to an educational context that involves interpersonal interaction. Furthermore, recent developments in the methods of Neuroscience have led to useful information about the brain areas and processes involved in social cognition. Therefore, an Educational Neuroscience framework should enable us to assess these apparently competing claims.

Secondly, the aspect of emotional experience that has been targeted for this thesis is the influence of intrinsic motivation associated with socially induced emotional experience on a student's subsequent decisions about engaging

with their learning; emotional experience as embodied as well as situated. There is a suitable body of research to draw on. During the previous three decades a significant amount of research has been conducted on the neural processing of emotion and digital techniques for analysing the neural activity (as recorded by an electroencephalogram) have been developed (R. J. Davidson, 1992, 2004; Harmon-Jones et al., 2010). This research will be reviewed in Chapter 7 when the embodied expression of emotion is investigated in detail using neurophysiological methods.

The third reason was the potential relevance of a previous personal experience of 'uncanny' social interaction. It involved patients who had confirmed neural damage and provided a basis for comparing models of interpersonal interaction, face-to-face and at distance using CMC.

1.5 The first research aim: developing a methodology for a multidisciplinary approach

The first research aim has two components

1. The development of a toolkit of methods that draws on each of three disciplines, Education, Psychology and Neuroscience, in a principled way.
2. The construction of a model that encapsulates the debate about the quality of social interaction at distance using CMC.

1.5.1 Developing a toolkit of methods for a multidisciplinary problem

The methodological toolkit developed for this thesis involves four studies and uses a range of methods, some from Education, some from Psychology, and some from Neuroscience. The approach taken when choosing the methods used for each study was determined by fitness for purpose, applicability and pragmatism.

> [P]pragmatists do not care which methods they use as long as the methods chosen have the potential of answering what it is one wants to know (Feilzer, 2010, p 14)

Affect is an inherently subjective, complex and labile mental state that is dynamically organised and reorganised as an individual encounters the world (Scherer, 2005, Scherer, 2009) and so a unique range of methods was required in order to study its labile nature and its situated and embodied manifestation. Emotion and affect, as situated in the group forum, was studied first (Studies 1,2,3) and the findings were used to inform the investigation of its embodied nature (Study 4).

An *in vivo* approach to provide a holistic view 'encompassing the whole learning context' (Creanor, Trinder, Gowan, & Howells, 2006, p. 4) was adopted so that all the elements of the setting: student, group, teacher, technology, learning community, were included. Although it was recognized that an in vivo approach would be difficult to achieve there were two favourable circumstances: the course on which the thesis is based meets the specifications for 'learning through collaboration' in full, and the investigator

had the benefit of several years as a practitioner working with the course. Furthermore, there is support for taking an *in vivo* approach: Goodyear and Ellis (2008) claim that evaluating the place of technology in learning research has been

> bedeviled by processes of intellectual simplification in which some things are foregrounded and others pushed into the background (p142).

The investigation involved four studies conducted in three distinct stages and is illustrated in Figure 1.1.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

STUDY 1 (Chapter 3)

Study 1a: Virtual Residential School. A retrospective survey conducted online with students

Study 1b: Residential School. A diary study

STUDY 2 (Chapter 4)

A Quantitative approach

STUDY 3 (Chapter 5)

A Qualitative approach

STUDY 4 (Chapter 7)

Pilot Study: Evaluate the use of narrative as a simulation of context

Main Study: Teacher experience at three levels of description: subjective (thematic analysis), behavioural (EMG of facial muscles) and neural (EEG)

Stage 1

Student experience at module level.

Stage 2

Student practice within the 'group as a unit'

Stage 3

Teacher experience.

Studies situated in context

Context simulated by narrative

Figure 1-1 A multidisciplinary and holistic approach to the study of group work online and at distance.

A multistage approach meant that the students' situated experience could be studied at three levels: the individual, the group, and the learning community and from different perspectives (student, teacher, researcher). Stage 1 used the results from a student survey to model a course that was offered online at three levels, the individual student, the group, and the wider learning community and involved a comparison with a face-to-face equivalent (Study 1). Stage 2 used a content analysis approach (Study 2), and a qualitative approach (Study 3), for an in depth study of two project groups. The third stage comprised the investigation of the embodied manifestation of socio-emotional experience (Study 4) and was achieved by using neurophysiological techniques, the Electroencephalogram (EEG) to monitor neural activity, and the Electromyography (EMG) to monitor facial movement, specifically smiling behavior.

1.5.2 Developing a model for social interaction at distance using CMC

A credible model of social interaction at distance using CMC needs to represent interpersonal interaction at three levels, student practice, psychological and neural. A prior experience with a small cohort of patients who had undergone a leucotomy (surgical removal of frontal brain areas) was the initial trigger for the proposal to construct a model. That experience was

notable due to a total lack of affective[1] interaction between these patients, and with myself, despite the fact that we had sustained contact over a period of time. Nothing was communicated, either verbally or non-verbally, to indicate that there was any sort of interpersonal relationship. It was a unique phenomenological experience and a strong memory of that experience has persisted. There are parallels with the elusive sense of co-presence ('realness') described by some students when interacting with others online using CMC, and this led me to review current social neuroscience knowledge about the role of the pre-frontal cortex (the area of the brain that is removed during leucotomy). In a keynote speech, 2007, to revaluate the role of the pre-frontal cortex, Dolan provided evidence for

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[1] Russell and Feldman Barrett (1999) define emotion as a"complex set of interrelated sub-events concerned with a specific object" (p. 806),

(Ekkekakis, 2012) describes the relationship between emotion and affect as 'The co-occurring components that compose a prototypical emotional episode include (a) core affect, (b) overt behavior congruent with the emotion (e.g., a smile or a facial expression of fear), (c) attention directed toward the eliciting stimulus, (d) cognitive appraisal of the meaning and possible implications of the stimulus, (e) attribution of the genesis of the episode to the stimulus, (f) the experience of the particular emotion, and (g) neural (peripheral and central) and endocrine changes consistent with the particular emotion', (p. 322).

>an unambiguous testament to the importance of this
>cortical region in behavioural regulation and cognition in
>general (Dolan, 2007b, p1).

This research was not available at the time that the leucotomies took place and it provides an explanation for the phenomenological experience of interacting with patients who had undergone leucotomy. Surgical removal of the frontal cortex would 'damage' the social cognition processes involved in interpersonal interaction.

Recent research using neuro-imaging techniques and a range of experimental tasks has identified some of the anatomical areas of the brain, and the associated neural networks, that are involved in social cognition at a neural level. These include:

- Cortical areas (predominately frontal cortex) that are unique to man and associated with cognitive processes such as appraisal, decision making and social cognition
- Subcortical and primary cortical brain areas that monitor the incoming sensory stimuli, and are universal across species.

The connections between these areas (sub-cortical and cortical) have been mapped and illustrate how the neural activity that results from the processing of sensory information by sub cortical areas of the brain modulates the perception of an emotion and the arousing properties of incoming information. The neural activity that results is then mediated by neural activity in cortical areas (Blair & Cipolotti, 2000; Blakemore, 2012; Dolan, 2007a; Frith & Frith,

2006). These findings are relevant in that they differentiate the brain structures involved in the appraisal and *regulation of the emotion* from those involved with *emotion as initially perceived*. At a neural level it provides a plausible explanation for the behavior of patients who underwent a leucotomy. For those patients it would be mediation of the neural activity resulting from moderation of incoming information about others that would be disrupted. There is an interesting parallel with CMC used for interpersonal interaction, because it is the sensory input to the subcortical and primary cortical areas that is missing from the online experience. For this reason, I wanted to investigate whether Neuroscience knowledge and the contrasts between three contexts for interpersonal interaction (face-to-face, using CMC, face-to-face with leuctomised patients) could form a suitable basis for constructing and evaluating a model of social interaction at distance using CMC.

1.6 The second research aim: the practical implications of the findings

This research aim addresses two elements that could be informed by the findings of the thesis. The first is a design issue and will involve using the findings to inform contemporary design for remote and asynchronous social learning. The second addresses the facilitatory role of the teacher when supervising group work online by developing some resources for professional development.

1.6.1 Designing for remote and asynchronous social learning online.

In 2002, when the course on which this thesis is based was first offered, CMC was the only viable option for providing distance students with the opportunity to communicate with other students, with a forum providing an online space where the interaction could take place. In 2014 there are a growing number of technologies to choose from, as documented in the Horizon reports, (the Horizon report is a highly influential forecast about the likely impact of emerging technologies during the coming five years and is produced annually). Unsurprisingly, a prolific body of research on the implementation of digital tools for asynchronous communication (wikis, blogs, the cloud, google docs, facebook, twitter) has emerged during the period 2002-2014. However,'the boundaries between collaborative technologies are not always clear'(Laurillard, 2009, p 6) so that choosing appropriate tools and implementing them successfully can be challenging. Deciding on which technologies to use in a learning design and justifying their choice is important and requires appropriate knowledge and understanding of how a technology can contribute, or not, to the learning experience. For example, in 2011 the course, on which this thesis is based, moved from using the First Class software for computer-mediated communication to Moodle. Moodle is open-source software that has a communication feature that allows participants to automatically attach a photograph, or some other representation of self, to each forum message. Throughout the institution, researchers and practitioners alike considered this to be a useful facility that would be eagerly

embraced by students. By accessing the participant list of the 579 students who completed the course in 2011 I was able to see that just 28% had opted to represent themselves by attaching a photograph.

When a technological tool is optional it is the student's decision whether or not to use it. How students will use a collaborative tool is an important criterion when assessing its utility for 'learning through collaboration'. However, it is not uncommon for assumptions about the benefits of technology to be acted upon before appropriate research has been carried out i.e. technological determinism. For example, in 2009, when I started this thesis, most Higher Education (HE) institutions in the UK had invested in buying estate in Second Life (SL). SL is a commercially owned online platform that was launched in 2003 and provides users with access to a 3D virtual world. For educational purposes SL was deemed a superior technology when compared to CMC. It was argued that SL could provide an immersive online learning context where avatars capable of enacting movement, representing a physical self, and using voice could be used; that multisensory information could be communicated through an avatar. Despite the fact that in 2009 SL was evaluated as under-researched by a project on 'Virtual Worlds & Higher Education' at Coventry university (CURLIEW) significant investments were made by educational providers and researchers. By 2014, SL has been largely abandoned for educational purposes.

Currently it is the technologies and the platforms that are capable of supporting Massive Open Online Courses (MOOCs) that are at the peak of technology hype cycle (Fenn & Raskino, 2008; Gartner-Inc.) particularly in Higher Education (HE), despite the fact that, as with SL,

> there has been no time for systematic research (Daniel, 2012, p2).

Although the role and true value of MOOCS has yet to be established it is gratifying that a prediction made in 2009 when I began this thesis, that understanding the interpersonal dynamic of interpersonal communication based in a text-based online forum will remain relevant and important, has been affirmed. For those MOOCs with an interactive element writing is the dominant mode of interpersonal communication and the 'humble' text-based forum the context. The students who enroll on MOOCs are by definition open entry (there is no academic specification for joining) and distance students. Therefore, the findings of this thesis regarding the student experience of learning with others at distance and online will be offered, so that the perceived advantages of MOOCs from an institutional and policy perspective do not dominate the rhetoric about their place in educational futures.

1.6.2 The facilitatory role of the teacher

The pedagogical value of 'learning through collaboration' is based on a constructivist view of learning that 'discussing' and 'doing' together with other students leads to deeper understanding of an area of knowledge. This pedagogical approach has implications for the teacher who will need to

organise and facilitate the social nature of this form of learning alongside providing expert knowledge and guidance. For DE the role has been described as 'teacher presence' (Anderson, Rourke, Garrison, & Archer, 2001) and comprises three elements, instruction, organisation and facilitation with facilitation the element of relevance for the relational space of the group and the socio-emotional experience of the individual student. Although guidance is available for teachers who are required to manage these aspects of their role in online contexts (Jaques & Salmon, 2007; Salmon, 2000) it lacks sufficient granularity. The ambition is to develop resources for tutors that will enable them to better understand the socio-emotional experience of distance students doing group work online.

1.7 Fields of Study: Learning, Emotion, Communication

The choice of Educational Neuroscience as the overarching methodological framework for this thesis resonates with two recent calls for synergy one in Emotion research, the other in Learning research:

- The study of biological, cognitive, social, and cultural, influences on emotion should become more integrated (Pekrun & Schutz, 2007; Wetherell, 2012))
- Modern day learning science should look for 'conceptual collisions' between disciplines (Bransford et al., 2006).

When using CMC, all interpersonal interaction is by writing therefore; a third field of study Communication is also relevant. The contribution of each,

Learning, Emotion, and Communication are reviewed in Sections, 1.7.1,1.7.2, and 1.7.3, respectively.

1.7.1 Learning

As a scientific discipline Psychology is at least 100 years old and during that time three main theories of how learning occurs have been proposed, each of which is determined by a distinct strand of Psychology alongside influences from associated disciplines. These theories were developed sequentially; in part motivated by dissatisfaction with what went before. They are behaviorism (psychobiological influences), cognitive theory (influences from cognitive psychology and philosophy), and socio-cultural theory (psychosocial and anthropological influences). All three theories are implemented in practice as part of formal learning provision in modern day Western education systems. The Conversational Framework (CF) has been developed in order to specify the processes and practices (student and teacher moves) involved for each of the three theories and has the student as actively involved as a key focus (Laurillard, 2002, 2008, 2012). The CF model enables a teacher to visualize, design, plan, and evaluate a lesson or course so that it is based on learning theory and thereby provides a conduit between learning theory and practice. It is why the framework has been chosen to interrogate the pedagogical value of 'learning through collaboration' in more depth. Furthermore, by embracing a socio-cultural understanding of how students learn, the CF is relevant for investigating how students adapt to mediated communication and appropriate the technologies available.

1.7.1.1 'Learning through collaboration' – as represented by the Conversational Framework

For the CF a joint task that is clearly specified, and an optimal group size (usually 4-6) are the design components that differentiate 'learning through collaboration' from other forms of social learning for example, 'learning through discussion' (Laurillard, 2012). The CF specifies that for 'learning through collaboration' students should explain and review ideas with peers and teachers while at the same time making contributions and amendments to a shared task. At the level of the individual these two types of activity (doing and discussing) interrelate through the process of adaptation (evaluating the views of others and integrating them into conceptual knowledge) and reflection on practice. It is a cyclical process that allows for the student's ongoing adjustment of conceptual understanding and practice. The moves and processes undertaken by students and the teacher/s allocated to the group are shown in Figure 1.2. The diagrammatic representation of the Conversational Framework as originally described by Laurillard has been modified to show that, in the context of this thesis, teachers are encouraged to respond to the group as a unit.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
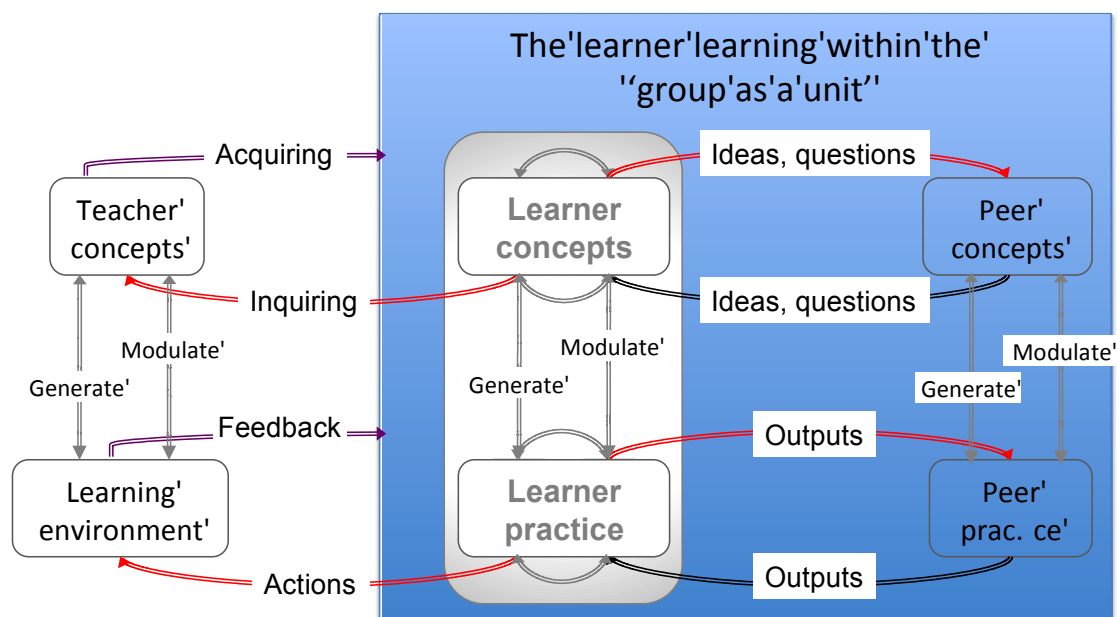
Instructivism - Social constructivism – Social learning – Inquiry learning - Constructionism – Collaborative learning

Figure 1-2 The Conversation framework modified from (Laurillard, 2013)

1.7.1.2 Engaging with learning: a cognitive perspective on motivation

The CF conceptualizes the motivational aspects of 'learning through collaboration' as follows. Each learning move (for example challenging the view of a peer student or offering a modification to the joint task) brings the student closer to their cognitive goal with peer students and the teacher operating as motivating agents by sharing, challenging, extending, justifying and enhancing each other's ideas and by jointly developing a sharing their contributions to the task artifact (Laurillard, 2009). However, the CF is focused on task space it does not contextualise where learning will take place, or suggest that the students' experience of context will be important, or consider the role of emotion when students interact, or the motivational influences that result from the emotional experience of interacting with others. Furthermore,

there is a significant amount of research evidence to suggest that a productive learning dialogue and a shared purpose is difficult to achieve (Annand, 2011; deLaat, Lally, Lipponen, & Simons, 2007; Ke, 2010; Murphy, 2004). This body of research highlighted a mismatch between what is theoretically expected in collaborative learning and the actual outcome. For example, when the inter-peer moves during collaborative learning were studied Murphy found that most members did not show any evidence of accommodating to the perspectives of others, they did not progress beyond the stage of articulating individual perspectives, despite the fact that all members of the group were professionally qualified (Murphy, 2004).

Therefore, it is necessary to consider what other factors, alongside the cognitive goal, are involved. One aspect that has been identified is the motivational power of ownership (Eales, Hall, & Bannon, 2002; Jones & Issroff, 2005; Tolmie & Boyle, 2000). For collaborative learning, whether or not it takes place online or face-to-face, there is a requirement for the group to collectively own the artifact and this may act as a demotivator so that at an individual level students become frustrated (Burdett, 2003; Capdeferro & Romero, 2012) and may explain why some groups who are required to engage in collaborative group work are unsuccessful (Barron, 2003; Pontual Falcão & Price, 2011). This thesis argues that another factor to consider is the socio-emotional experience of interacting with others during group work; a psycho-biological view of motivation as intrinsic. It is a perspective on motivation that is largely ignored in learning research. In order to progress this

idea it was necessary to interrogate in depth what the field of Emotion research can offer.

1.7.2 Emotion

Emotion receives serious attention from a range of disciplines but is central to none so that intradisciplinary and interdisciplinary conversations between researchers can be problematic (Stearns, 2009). To some extent this may explain why emotion has largely been neglected in learning research despite early attention from Vygotsky and Dewey (Dewey, 1895; Vygotsky, 1987). It is only relatively recently that the education community has paid attention to the part that emotion plays while learning that,

> students' efforts to learn are connected to emotions (Meyer & Turner, 2002, p 109).

> Negative experiences can lead to avoidance, while a learning experience which has evoked strong positive emotions is likely to be particularly effective in engaging interest (Hallam, 2005, p 15).

Taken together with other recent work (Cooper, 2004, 2011; Garrison & Anderson, 2003; Immordino-Yang, 2010; Jones, 2010; Jones & Issroff, 2005; Patten, 2011; Pekrun & Schutz, 2007) there is a growing body of evidence to suggest that the way in which emotional, social and cognitive elements interrelate is important for understanding engagement with learning.

Two aspects of emotion require attention. Firstly, how emotion and motivation interrelate and secondly, how emotion and cognition interrelate.

1.7.2.1 The interrelation of emotion and motivation when learning.

A psychological perspective, the circumplex model, has significant influence in emotion and motivation research. For the circumplex model two dimensions of emotion, arousal and valence (the intensity and quality of an emotional experience) have been identified as the core attributes of emotion (Russel, 1980) with the quality of the emotional experience determining the motivational outcome (approach or avoidance) (Lang, Greenwald, Bradley, & Hamm, 1993). In this account contextual (state) variables are privileged, as engagement is assumed to be motivated by positively valenced emotional experience while a negative valence results in avoidance or withdrawal, with the amount of action depending on the strength of the arousing stimuli.

For Education it is individual differences in the way that context is interpreted emotionally that has received attention, specifically that approach and avoidance behaviours are modulated by the disposition of the individual. For example, that individuals can vary in feelings such as control, confidence, and challenge (Keller, 1987) and that there are individual differences in emotional resilience (the way that strong feelings such as control, confidence and challenge combine in an individual has been labeled as a dominance trait) (Mehrabian, 1996). Furthermore, it has been proposed that mastery of learning is a part of identity and that an individual will see learning as a way to achieve a possible self and that this idealized goal is then a powerful motivator (Hallam, 2005).

A key challenge for understanding the interrelationship between emotion and motivation from a psycho-biological perspective involves achieving a better theoretical description of the relative role of the motivators that are contextually based, (the 'state' view) and those that arise from the individual characteristics of the student (the 'trait' view). The investigation of the dimensional perspective of emotion has led to two significant contributions that progress our understanding of how 'state' and 'trait' might interrelate. The first is the concept of motivational intensity, that events vary as to their effect on motivational intensity depending on whether a motivational goal is involved (Harmon-Jones et al., 2010). The second is the introduction of a third dimension, dominance/submission for the circumplex model. The dominance/submission dimension incorporates ideas about individual differences in emotional regulation and resilience: given the same context individuals within it can respond differently. This account of the interrelationship between 'state' and 'trait' determines the approach taken to the interrelationship of emotions and motivation for this thesis. Socio-emotional experience will depend on context, the relational space of the group, and the student's interpretation of context. Socio-emotional experience will be unique for each member of the group and it will be mediated by disposition to some extent.

1.7.2.2 The interrelationship of emotion and cognition when learning.

In Education, appraisal models have dominated theoretical explanations for the interrelationship of emotion and cognition. Using appraisal theory as a conceptual approach researchers have sought to explain how a student's perception of the cognitive and emotional aspects of the learning task and context combine to determine their approach (Frijda, 1986; Lazarus, 2001; Scherer, Schorr, & Johnstone, 2001; Wosnitza & Volet, 2005).

Based on two case studies, a classroom based mathematics class with eighth graders, and an online university course using computer mediated communication CMC, a claim for the mediating role of students' appraisal of emotional as well as cognitive factors on the process of learning was evidenced (Wosnitza & Volet, 2005). The authors conceptualise appraisal as a two-stage process with a description of the primary stage that suggests that when a task or context is either unfamiliar or challenging for a student then negative emotions are likely. After the primary stage of appraisal a student will go on to appraise the learning situation in terms of the need for action and the courses of action available; this is the secondary appraisal level. Based on this conceptual approach emotional valence and the appraisal of action will influence whether or not a student engages with learning and also on how they engage. There are individual differences, given a similar task and context students will vary both in terms of the selection of action and subjective report. This much has been evidenced (Wosnitza & Volet, 2005) and is consistent

with the findings of other researchers (Järvenoja & Järvelä, 2005; Jones, 2010; Jones & Issroff, 2007; Kirkwood & Price, 2005).

However, the motivational forces that operate during the history of a student's engagement with learning is complex for example, a positive experience for the distance student is a key factor influencing subsequent engagement (Weller, Pegler, & Mason, 2005); a previous experience that is negatively valenced could mean that a student's decisions concerning the nature of their learning pathway may not be optimal. Research from another interdisciplinary perspective (Neuroscience and Economics) provides a Neuroscience perspective on how previous emotional experience that is negatively valenced can affect future decision-making. It is another perspective of the interplay between emotion and cognition, and considers the potential of the memory of an emotional experience to outweigh the advantages of engaging in a current activity. To explain the interaction of emotion with cognition emotion has been conceptualized as acting like a heuristic, triggering a summary of previous similar episodes in episodic memory that feed into the current decision-making (Finucane, Alhakami, Slovic, & Johnson, 2000). This idea, that intense emotions are aroused by recall of an emotional experience during previous encounters suggests a source of vulnerability for optimal decision-making and may account for the findings that previous experience influences students' attitude and approach to engagement with technology (Jones & O'Shea, 1982; Kirkwood & Price, 2005). It is a view that endorses the second aim of

the thesis: how to optimise the design for group work online, and support teachers, so that socio-emotional experience is positive.

1.7.3 Communication

From a linguistic perspective moving group work online involves a change in the dominant mode of language communication from speaking to writing. However, it is possible to write speech. Section 1.7.3.1 includes a description of how participants communicating at distance and online adapt writing so that it is more speech like (Netspeak) and evidence that the style adopted for Netspeak can influence social cognition. In Section 1.3.2 the argument that explicit social cognition is a uniquely human attribute that depends on language was reviewed. In Section 1.7.3.2 language as a uniquely human competence is described by reference to Dunbar's psycho-biological account of why spoken language evolved (Dunbar, 1996). A description of the cortical brain structures that support the complex cognitive processes involved in language and social cognition are also included since neural activity in these areas will form part of the EEG investigation in Study 4 (Chapter 7) and will need to be incorporated into a model of interpersonal interaction as described in Chapter 8.

1.7.3.1 Speaking or writing as a means of communication online? - A linguistic perspective

Traditionally speech is characterised by a number of properties, it is time bound, spontaneous, face-to-face, socially interactive, loosely structured,

immediately reversible and prosodically rich, while writing is space bound, constrained, visually decontextualised, factually communicative, elaborately structured, repeatedly reversible and graphically rich (Crystal, 2006). However, when these criteria were applied to interpersonal communication online it became apparent that such a clear cut differentiation no longer applied leading Crystal to describe writing during social interaction online as Netspeak

> Netspeak (written communication online) is identical to neither speech or writing but selectively and adaptively displays properties of both (Crystal, 2006, p61).

Some characteristics of Netspeak are particularly speech-like:

- Spellings that reflect pronunciation, e.g. 'yep', 'nope',

- Multiple use of an ellipsis (.) or a dash (–) to indicate a pause

- Multiple use of an exclamation (!) as emphasis.

- Abbreviation, ignoring capitalisation, using multiple vowels or double use of a verb for emotional expression (termed 'lexico-graphological distinctiveness' by Crystal)

The style of presentation can vary. It can be typical of formal writing for communication for example, by using salutation and closing conventions, or it can be informal. Another significant observation made by Crystal concerned dialect

[C]ontributions progressively develop a shared linguistic character – the equivalent of a local dialect or accent (Crystal, 2006, p152)

This description of Netspeak suggests that it is communicative practice rather than the mode of communication that is important that; during interpersonal interaction using CMC participants adapt their style of writing to become more speech like and that some modifications are expressed and interpreted as paralanguage. There is independent experimental evidence to support the view that these practices have influence. The content of messages was delivered to a computer screen using four experimental conditions (misspellings, mistyping, adding either an exclamation mark or an ellipsis to the end of the sentence, and a control condition) and participants were asked to rate the message sender (Lea & Spears, 1992). The results demonstrate that participants had attended to the paralinguistic cues contained in the message when forming impressions and that inferences, based on language style, had been made about the sort of person who had written the message. These findings support the proposition that the receiver as well as the producer can adapt to a remote interaction through writing and imply that the style of communication online should be investigated in more depth.

1.7.3.2 Language and social cognition as uniquely human attributes – a psycho-biological perspective

For non-human primates social groupings are predominately built and maintained by grooming behaviours. Grooming takes time and requires

proximity. Human communities tend to be larger than is the case for non human primates therefore; Dunbar argues that language evolved as vocal grooming so that cohesion and reciprocity could be supported (Dunbar, 1996). Moving from grooming to language involved adaptations of the body. Of particular relevance for an Educational Neuroscience perspective is the development of a brain hemisphere (usually the left) specialised for language, the prefrontal cortex for executive function and social cognition, and the complex neural connections between them. The argument put forward by the thesis is that there is no reason why the brain should not continue to evolve, albeit slowly and subtly, to accommodate into the process of explicit cognition the digital fluency practices that develop for online communication.

1.8 Outline of the thesis

The thesis investigates the experience of distance students and teachers who are involved in group work online and use CMC to communicate with each other. It has an explicit focus on their socio-emotional experience as both situated and embodied. Educational Neuroscience is the overarching framework and draws on three fields of study, Learning, Emotion, and Communication.

 In Chapter 2 research concerning interpersonal interaction is reviewed in more detail by drawing on four examples from each of the three fields of study, Learning, Emotion and Communication. The Community of Inquiry (COI) is identified as a relevant strand of e-learning research and is also

reviewed. The reason why the methodology is based on a multidisciplinary approach, Educational Neuroscience, is then explained. To ground the approach to methodology interpersonal interaction is considered from both a psycho-social and a psycho-biological perspective.

There are four studies. Study 1 (Chapter 3) uses data from a student survey to investigate the student perception of group work online. A model is constructed that takes into account some of the characteristics that the students bring to their learning, their experience of group work and the student community (the cohort of students that are enrolled). In order to clarify what is distinctive about group work online a face-to-face equivalent is studied in situ for comparison. The dynamics of the 'group as a unit' emerged as a critical component of socio-emotional experience.

Therefore, for the next stage of the investigation Study 2 (Chapter 4) and Study 3 (Chapter 5) the interpersonal interactions of two project groups, 'the group as a unit' as situated in the online forum, is investigated. Study 2 involves constructing a social presence profile for each group, and a profile for teacher presence, using a content analysis approach developed for the COI (Rourke, Anderson, Garrison, & Archer, 1999). Study 3 uses an interpretive approach, a microanalysis of the flow of interaction for each of the two project groups involved in Study 2. The intention is to determine whether students adapt to mediated interpersonal interaction, and how they adapt. To develop our understanding of how relational space is experienced by the individual

student the interpretive approach will assess empathy amongst group members as well as social presence.

For chapters 6 and 7 the focus moves to the teacher. Chapter 6 considers the role of the online teacher as facilitator of the relational space of the group and the socio-emotional experience of the individual members. By response to Aim 2 the development of relational space narratives as a resource for the professional development of online teachers is proposed.

The first three studies focus on socio-emotional as situated. By contrast, Study 4 described in Chapter 7 has as its main focus the embodied nature of socio-emotional experience and at the same time evaluates the narratives developed as resources for teachers. Study 4 draws on Neuroscience methodology; neural activity and facial expression is monitored using neurophysiological techniques (Electroencephalography and Electromyography) while participants (acting as teachers) take part in a simulation of group work online. The simulation is an authentic representation of the relational space of the two project groups used for Studies 2 and 3; teachers are asked to read the narratives and engage with the relational space of the group while doing so. To achieve a subjective, behavioral and neural line of evidence, the views of the participants (acting as facilitators of the group work) will be sought at the same time as the neurophysiological investigation takes place. The assumption is that the teacher's role as facilitator depends on them being affectively involved within the relational

space of the group and therefore, that neural evidence for a sense of co-presence by teachers would also apply for students.

Chapter 8 will review Aim 1, the toolkit of multidisciplinary methods that have been applied across Studies 1-4 and evaluate the model for social interaction at distance using CMC that has been developed. Chapter 9 revisits the research question and the research aims in the context of the findings from the four studies. Some issues where a research synergy between Technology enabled leaning (TEL) and Neuroscience research could be of both theoretical and practical benefit are described and the application of the findings in practice (aim 2) are discussed.

Chapter 2 The conceptual basis of the thesis: a multidisciplinary approach to interpersonal interaction

2.1 Introduction

'Learning through collaboration' depends on a small group of students interacting with each other in order to achieve a shared task. The pedagogical aim for 'learning through collaboration' is that group knowledge, and by implication individual student knowledge, will progressively deepen as students reflect on the ideas developed during discussion with other members of the group and as they collectively progress the group task. This ideal is not always achieved. There are several possible reasons for example; a lack of commitment and/or ability of an individual student (Weller, 2003), or the relational aspects of group work may be the problem.

> [B]eing within a collaboration may provoke reactions of an affective nature; responses that are distinctive to that encounter. Such responses could then be relevant to the motivation of greater (or lesser) task engagement (Crook, 2000, p 163).

This problem, that some instances of 'learning through collaboration' are not successful, has been approached by adopting the proposal that group space consists of two elements, task and relational. (Barron, 2003). The thesis will develop this proposal by focusing on relational space in text-based forums online, and by investigating the interpersonal interactions of the group members from the perspective of socio-emotional experience and co-presence. This will involve a focus on the processes that underpin any form of

interpersonal interaction. Therefore, it is important to specify what counts as a interactive move at the outset.

In the context of 'learning through collaboration' the group functioning as a unit is a key element with knowledge emerging from the interactions between group members; the group builds it collectively (Stahl, 2011). The Conversational Framework (CF) specifies the interactive moves required from students and interprets the value of this pedagogy as follows

> [T]he group is valuable to each of its members because it makes demands on them to produce a contribution to the group goal. In the process of doing so the learner has to construct an idea, explanation, or description. The idea is then available to others to challenge or modify, and the originator to defend or redevelop. **Each member of the group reciprocates the demands and contributions of** others… (Laurillard, 2012, p 189 bold emphasis added).

The bold italics specify what is required of each individual member for building knowledge within the group. Participation and interaction are the student actions that underpin reciprocation, and socio-emotional experience arises out of the interpersonal interactions involved. Participation and interaction are sometimes used interchangeably in the TEL literature (Hrastinski, 2009; So, 2009). However, this thesis will argue that while participation and interaction are closely interrelated when considered in a social learning context, they are fundamentally different from the perspective of interpersonal interaction. During group work a student can participate in the learning by paying attention to the discussion and by observing the practice of the other members of the group. However it is a contribution to the 'group as a unit' that is the criterion

for an interaction and it involves either a contribution to the group task or an interaction with other members of the group. For a student to benefit from a pedagogy based on 'learning through collaboration' they will need to go beyond participation and interact with the other members of the group and with the task. The nature of the interactions between group members will determine relational space and by consequence the socio-emotional experience of the students involved.

To inform the detail for the investigation of students' moves during their interaction with other members of the group from a multidisciplinary perspective, this chapter will consider interaction, through a review of twelve Exemplars of research involving social interaction. To take into account the contributions of each of three key fields of study, Learning, Communication, and Emotion (identified as relevant in Chapter 1) four Exemplars will be drawn from each: Section 2.2 (Learning), Section 2.3 (Communication), Section 2.4 (Emotion). The Exemplars are situated in a range of social contexts, some online, some are face to face, and some involve learning. In Section 2.5 the Community of Inquiry (COI) framework is identified as research into remote social learning that has the most relevance for the thesis. The COI has value because it considers presence as a factor influencing learning in online contexts that use communication-mediated conferencing (CMC) (Garrison & Anderson, 2003; Garrison & Arbaugh, 2007). The review describes and assesses the value of the COI framework for collaborative learning contexts.

Then, based on the review of the twelve Exemplars and the COI framework, the approach to methodology is explained in Section 2.6.

2.2 Learning and Interaction

The setting for learning through collaboration should be designed for interaction, with the task, with other students, and the teacher. To investigate the pattern and quality of interpersonal interaction in practice four Exemplars of collaborative learning, drawn from a range of contexts, are reviewed collectively so that the key elements of collaborative learning can be identified.

2.2.1 Exemplar 1. Classroom based small group collaboration on a maths problem

In this study groups of school aged students were observed as they collaborate face-to-face on a math problem (Barron, 2003). Each group was provided with a shared workbook where every proposal was recorded. Four groups were selected for study based on the accuracy of their solution to the group task: two successful groups (100%), two unsuccessful (<50%). After confirming that the composition of the group was not a factor the groups were compared for the way that the members of each group responded to a correct proposal. To systematize the analysis the responses were classified into one of two categories: discuss/accept, reject/ignore. Then the relatedness of the proposal to the previous discussion was assessed. Successful groups were characterised by sustained attention, accepting correct proposals, a

willingness to negotiate, and by the relatedness of the discourse and the member actions resulting from the ongoing discussion. Although successful groups were not immune to problems the group recruited strategies such as huddling around the workbook, mutual gaze, and gesture to sustain collective focus on the collaborative task. In contrast, less successful groups engaged in interactions that were of a competitive nature and the members of the group employed problem solving trajectories that were predominately self-focused.

> Behaviourally these manifested as violation of turn taking norms, difficulties in gaining the floor, domination of the workbook, competing claims of competence (Barron, 2003, p 348).

2.2.2 Exemplar 2. Collaboration on a maths problem in an online chat room

This Exemplar is based on the Virtual Math Team Project (Stahl, 2011). The students are school aged, mainly strangers (in the sense they do not meet face-to-face), collaborating at a distance. The interactions with other students in chat forums are quasi-synchronous, and the students also interact with the task and the digital artifacts associated with the task, online. The researchers used Conversational Analysis (CA) to interpret the dialogue between students, describing the analysis of the dialogue as iterative,

> digging deeper into the data with increasing understanding (Stahl, 2011, p 36).

Some distinct interactional moves were identified: proposals, question and answer structures, and pivotal moments. The authors conclude that these

moves were of key importance to the way that the 'group as a unit' approached the task while the relational aspects of the group interactions are evidenced by the complexity of the conversational moves during negotiation and the use of inclusive pronouns. The importance of index and reference for sustaining the attention of the whole group was also highlighted.

The characteristics that result in a proposal being taken up by the group as a unit emerged and were compatible with the findings from Exemplar 1: a clear semantic structure, well-timed, firm, eliciting a response, supported by a plan for action, and presented by a group member with a history of helpful contribution.

2.2.3 Exemplar 3. Collaborative learning using a multi-touch table

The students who took part in this Exemplar are also school aged. The use of multi-touch tables to ' implicitly enforce collaboration', (Pontual Falcão & Price, 2011) provides a useful contrast in that collective focus is designed into the context. Each member of a group is supplied with a digital device so that they can access the table and interact with and manipulate the information that it represents. The interactions take place simultaneously so that each student needs to take into account the concurrent actions of other members of the group. The collective outcome is continuously displayed on a single output device. With this design, participation is synonymous with interaction as a contribution is a physical action. Students manipulate the information jointly so that a physical action of one group member can disrupt progress with the

task, as attained so far. Then the group needs to find a way to integrate this information. To study the interactions, video data was recorded and the pattern of interference moves was classified into one of the three categories: consensus building, integration-orientated, and conflict orientated (Pontual Falcão & Price, 2011).

The authors claim that interference (a move that changes the outcome) through a physical action is more powerful than dialogue and that the students achieved a higher level of integrative interaction. However, there were still some groups who were deemed unsuccessful. Ignoring an action is not an option with this design since the effect of an action is immediately reflected in the outcome. As a consequence the members of groups with a less successful outcome spent their time actively undoing actions and rebuilding a previous version rather than working collaboratively to integrate the recent information.

2.2.4 Exemplar 4. Blended Learning

This Exemplar illustrates the decision-participation-interaction process in an asynchronous computer mediated context when participation is not mandatory (So, 2009). Twelve groups of graduate level students undertook a complex task face-to-face. At the same time they were provided with easy access to a dedicated asynchronous online forum. All the students had sufficient previous experience of this mode of communication and a decision to use the online forum was entirely voluntary. Seven of the twelve groups did access the

online forums although 5 of these contained less then 5 postings at the end of the learning event. The students were interviewed about their reasons for using the online forum, or not. Three themes were identified from the interview data. Firstly, a member with a prior positive experience of social learning online might encourage other group members to trial the forum with a successful experience leading to continued use. Secondly, students weigh up the relative advantages (flexibility and the availability of a full textual record) and the disadvantages (the delay in response and therefore feedback) of this the mode of communication. The potential for a delay in response was weighted more heavily when the task was at a difficult phase as 'students felt they could achieve more and quicker during face-to-face' (So, 2009, p 152). There is some evidence for this interpretation. Based on a content analysis of the messages of the two active forums the authors concluded that 'indicators of critical discourse were rarely observed '(So, 2009, p 158).

An analysis of socio-affective content was also carried out using the social presence indicators developed by (Rourke et al., 1999). The findings from this analysis indicated that students in both groups scored relatively highly on this measure. However, despite an apparently comfortable group climate the students preferred to undertake critical discussion face-to-face. An explanation for this choice was provided by the third theme to emerge from the interview data. For reasons of politeness they did not want an expression of disagreement to be misconstrued and they felt that a face-to-face context

made it more likely that they would recognise a need for repair work furthermore, any repair work could be effected immediately.

2.2.5   Investigating 'learning through collaboration': Context

When investigating 'learning through collaboration' there are a number of factors that are specific to the context and they need to be taken into account when interpreting the findings. The design parameters are particularly significant. Five design elements emerged from the review of four Exemplars of collaborative learning with a number of options available when it comes to specifying each element. A summary of the design elements and parameters from the four Exemplars is provided in Table 2.1. To situate the 'learning through collaboration' on which this study is based the design parameters for the course on which this thesis is based are indicated (*). However, it is important to emphasise that this analysis is based on just four examples and so the list of elements is likely incomplete.

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Table 2.1 Designing for interpersonal interaction. Factors and parameters

Design element	Parameter
Mode of communication	Speaking
	Writing *
	Both
Timing of an interaction (The time frame)	Synchronous (* optional)
	Quasi-synchronous
	Simultaneous
	Asynchronous *
Setting	Face-to-face
	Online – distant *
	Online co-located
History of face-to-face contact	None *
	Some
Shared artifact for recording progress with the task	Workbook
	Text corpus *
	Whiteboard
	Touch table display

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2.2.6 Investigating 'learning through collaboration': determining the

key processes

The four Exemplars of learning through collaboration were chosen to study interaction during group work. When the Exemplars are considered collectively four processes that are relevant for the investigation of learning through collaboration emerge: joint attention, coherence, negotiation, and time frame (asynchronous, synchronous, simultaneous). These processes pertain irrespective of whether the group work takes place online or face-to-face and all are interrelated to some extent. The following subsection will assess the contribution that Exemplars 1-4 make to our understanding of each of these processes and the interrelationships between them.

2.2.6.1 Joint Attention

Joint attention has emerged as important for ensuring that the group takes a coordinated approach, that the 'group as a unit' is co-orientated towards the task. The course designers can provide tools to enable this process, a workbook (Exemplar 1), a digital 'white board' (Exemplar 2), a space online for the text corpus (Exemplar 4), a visual display (Exemplar 3), were provided so that the group could summarise their progress. The 'group as a unit' also find ways to achieve joint attention, for example 'huddling', around the workbook, using gesture and gaze (Exemplar 1) by appropriating the functions of the software, colour, formatting, to add emphasis (Exemplar 2), using the threading facility of the CMC software (Exemplar 4). The methods

adopted depended on context. For the face-to-face studies (Exemplar 1 and 3) physical action was a distinct element. There were no visible physical actions available to the online groups who similarly need to achieve joint attention on the task. However, there are ways in which students appropriate the technology (for example, styling, titling) to focus the attention of the group, as exemplified by Exemplar 2 and 4.

2.2.6.2 Coherence

To some extent coherence depends on how the group use and share index, and reference, and is linked with joint attention. The coherence of an interaction depends on its relatedness within the sequencing of the collaboration. Based on the four Exemplars of learning through collaboration, the form that this takes is unique to the group. In Exemplars 1 and 2 a proposal, as an example of a coherent interaction, was a characteristic format for achieving coherence. A proposal is a contribution that is focused on the task and the groups endeavor towards progressing to a satisfactory outcome. It picks up on the ideas embedded in the preceding discourse and suggests ways to develop. To determine when a proposal will be taken up by the group the researchers (Exemplar 2) used Conversation Analysis (CA) to examine the detail of the interpersonal interactions involved. The granularity afforded by this method allowed them to construct a detailed description of a coherent proposal as carefully timed, firm, and progressive, and having a clear semantic and syntactic structure (Stahl, 2011). However, a reasonably

coherent proposal can fail due to perceptions about the proposer; that the proposer is not collegiate in approach (Exemplars 1 and 3) or the individual's communication skills may not be sufficiently developed (Exemplar 2). Progress with the task can be compromised by interpersonal factors that are not directly related to the task.

2.2.6.3 Negotiation

Academic conflict, conflict between group members as to their current state of understanding or acceptance of an idea, is an essential component of learning through collaboration.

> The tension arising from conflicting or ungraspable
> interpretations in place of harmonious shared meaning
> fuels the creative work of constructing innovative group
> understanding (Stahl, 2011, p 286).

The rejection of a proposal after discussion by the group can be an indicator of successful learning provided that its value has been negotiated appropriately (Exemplars 1 & 2) and the students involved are emotionally comfortable.

> The result of the resolution of differences can be an
> expansion of the joint problem space; group participants
> build a richer shared understanding of the object of their
> collaborative undertaking (Stahl, 2011, p 328).

However, a coherent proposal may fail because it is not take up by the rest of the group or it may gradually weaken during the subsequent discussion (Exemplars 1, 2 & 4). Progress with the task, and the socio-emotional experience of the individuals involved, can be particularly susceptible when

participants need to negotiate disparate ideas. A proposal that is ignored or a negotiation process that is conducted inappropriately is unfortunate as it can lead to isolation and withdrawal for individual members (Exemplar 2) and is likely to impact negatively on relational space. This was inherently recognised by the groups studied in Exemplar 4 who resorted to face-to-face meeting for discussion that involved critical comment. Recourse to a face-to-face context is not an option for distance students and is why it is important to understand how relational space can support the group in times of conflict and negotiation, and how the process and outcome of negotiation within a group can in turn impact on relational space and the socio-emotional experience of the individual members. Progress with the task can both depend on, and influence, relational space.

2.2.6.4 The time frame (synchronous, asynchronous, simultaneous) of the interpersonal interactions

That a group will resort to face-to-face contact when contributions to the discussion could be construed as negative (Exemplar 4) is consistent with other research (Kear, 2010); using asynchronous CMC for negotiation can be problematic. Providing a Live Chat facility alongside asynchronous CMC has been suggested as a way of mitigating this problem (Haythornthwaite, Kazmer, Robins, & Shoemaker, 2000; Kear, 2010). A Live Chat facility alongside asynchronous CMC is a common design feature and was available

to the groups on which this thesis is based. Therefore the next section will work through the implications of the time frame for CMC.

When group work takes place face-to-face the discussion and action usually develop sequentially with each contribution confirming, challenging, or extending the current formulations. Whilst parallel discussion threads can and do develop they can be instantly challenged. When interpersonal interaction is asynchronous there are implications for conversational coherence. It is not uncommon for a single contribution to attract multiple responses, for several simultaneous discussion threads to develop, and for a single message to refer to more than one discussion thread. Although there are functions available 'reply with quote' to identify the target position of a contribution within the conversation, and 'titling' to identify the discussion topic, the way that this functionality is appropriated by students does not always match its intended purpose, for example, titling may be used for salutation or to attract attention. Multiple threads are cognitively challenging and can mean that the pedagogical aims of the group are disrupted and relational space compromised. During negotiation that takes place synchronously repair work can be effected immediately. In contrast an asynchronous arrangement will mean that personal circumstances will govern when each individual is able to go online and therefore when repair work can take place and who will do it. Relationships with the group member who responds, and perception of the quality of the response, can have an emotional impact on the original

contributor, as can the time lapse between a contribution being posted and a response being made.

While asynchronous technologies provide flexibility and pedagogical advantages (e.g. time to reflect) for the individual student it is not without cost for both the individual and the group (Weller, 2003). Whether to provide technology that will allow for synchronous exchange (Live Chat) alongside asynchronous communication is a relevant issue for the second aim of the thesis:

> *to inform the integration of forums and other technological tools into the design of online learning*

2.2.7   Investigating learning through collaboration: Methods

To address the research question it will be necessary to study how students interact during group work. Taken together the four Exemplars provide an opportunity to assess some methods that may be of value for the thesis.

All four Exemplars involve ''observation' of student interaction, albeit broadly defined, by replaying the video (Exemplars 1 & 3) and using the transcript of the text (Exemplars 2 & 4), and then undertaking a content a content analysis of the observed data. Deciding on an appropriate unit of analysis and criteria for measurement when undertaking content analysis is critical (Naidu & Järvelä, 2006). The two studies that involve face-to-face group work (Exemplars 1 & 3) chose a contribution as the unit of analysis, whereas for the

study involving online collaboration (Exemplar 4) the unit of analysis was an item (or items) of content from a contribution, and thereby recognised that a student can use a contribution to do more than one thing. All four Exemplars applied a classification system to quantify the data, (Exemplars 1, 2, & 3) as a method for assessing knowledge construction, while for Exemplar 4 it was used to assess relational issues as well as learning. The researchers in Exemplar 2 also used Conversation analysis (CA) and an iterative approach to data analysis, with the interpretation from each cycle of analysis informing a subsequent cycle. By using CA the granularity of the analysis is enhanced and allowed the researchers to interpret the discussion from the perspective of meaning making as situated within the 'group as a unit'. It is clear that to study how the members of a group construct meaning a qualitative approach to analysis of the discourse is necessary. Furthermore, for discerning whether, and how, participants adapt their communicative practice in this context a sufficient level of granularity is required.

2.2.8 Investigating 'learning through collaboration'

Exemplars 1-4 show that three processes are required for successful group work, joint attention, coherence, and negotiation. The four Exemplars also demonstrate that the context of group work results from design decisions that involve a wide range of choices and by implication both challenge and endorse the intention to take a holistic approach.

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2.3 Communication and interaction

This thesis considers the claim that interpersonal interaction conducted using asynchronous CMC is less satisfactory. Three properties of this form of interpersonal interaction, which make it distinct from the more usual face-to-face interaction, the time frame (asynchrony), the mode of communication (written), and that participants are not physically co-present, could be relevant. Four Exemplars of research in the field of Communication have been chosen to investigate these properties and their influence on relational space.

2.3.1 Exemplar 5. Interpersonal interaction by writing: a perspective from Linguistics

From a linguistic perspective computer mediated and asynchronous communication using text is interactionally incoherent (Herring, 1999). Face-to-face conversations rely upon a strict protocol for turn taking, no gaps and no overlap. There are several ways in which the patterning of interaction can be disturbed during asynchronous CMC. Turn taking and the continuous nature of conversation are both violated, the response of one participant during a conversation to the contribution of another, an adjacency pair, is disrupted. Also, a relatively high proportion of contributions do not receive any response or acknowledgement and several topics can be underway simultaneously.

Yet communicating asynchronously is an extremely popular social activity. Herring sought to explain this apparent paradox by undertaking a study of

social exchanges online. She found that when users of CMC appropriate the functionality of the CMC software for communicative purposes they use *addressivity* (quoting directly from a previous message), *titling* (indicating the subject of a message in its title*)* and *threading (*collecting of messages under an unique heading*),* and that ignoring spelling and grammatical rules is common. Although conversation in CMC is a qualitatively different interactive experience it does not follow that social experience is in any way inferior (Herring, 1999).

2.3.2   Exemplar 6. The mode of communication and its influence on socio-emotional experience

In this Exemplar cause and effect relationships between mode of communication (writing, speaking) and context (face-to-face, online) were manipulated experimentally (Walther et al., 2005). Pairs of participants were asked to take part in a discussion about some scenarios that were provided by the researchers. One member of each pair took on the role of accomplice, they were aware of the manipulation. At the end of the session the naive participant was asked to rate his/her relational experience of the encounter. 28 pairs discussed the scenarios face-to-face and 28 used computer-mediated communication. For each mode of communication half the confederates were instructed to express affinity towards their conversational partner and the other half disaffinity. There was a 100% agreement between relational outcome (as reported by the naive partner) and the intended

outcome; irrespective of the mode of communication relational information was conveyed successfully.

The transcripts from both CMC and the face-to-face encounters were then analysed, specifically for the verbal behaviors that convey relational information. Offering personal information was identified as an important factor for both modes of communication. For the face-to-face conversations the majority of the relational information was conveyed by non-verbal behaviors. For CMC the confederates tended to be indirect when expressing disagreement and at the same time find a way of praising the partner. For this Exemplar the participants were asked to take part in discussion only however, the fact that the confederates who used CMC tried to avoid confrontation when negotiating disagreement is significant and is consistent with the findings from Exemplar 4. Academic disagreement is an inherent component of group work and is why it is important to ascertain whether using CMC compromises the process of negotiation and by implication, 'learning through collaboration'.

2.3.3 Exemplar 7. Lexico-Grammatical style and socio-emotional experience

Exemplars 5 and 6 provide evidence that participants make subtle adaptations in communicative style when using CMC for interpersonal interaction; Exemplar 7 describes an investigation of the form that adaptation takes. In a study where participants were asked to present either a negative

or a positive impression to a naive partner during an instant messaging (IM) exchange evidence was collected from three perspectives: that of the sender, an account of how they had communicated the relational stance they had been asked to adopt, and from the perspective of the receiver. A third view, an objective view, was provided by a computerised analysis of the text corpus (Hancock, Landrigan, & Silver, 2007). The analysis of the self-reports showed that the positive group reported using more typographical marks, more expressions of agreement and responded more quickly than the negative group. When the corpus was analysed using linguistic analysis software (LISC) some additional information about the style adopted was obtained, participants who adopted a positive relational stance were six times more inclined to use typographical marks and their messages tended to be longer. In contrast the participants who adopted a negative relational stance were characterised by more frequent use of affect descriptors and negations. Analysis of the reports from the perspective of the naive participants suggest that negations and exclamation marks were the cues they used when making inferences about their partner's relational stance. These findings provide useful evidence about adaptation of writing style, in particular the use of typographical marker to convey relational meaning as well as grammatical structure.

2.3.4 Exemplar 8. Identity and dialect

The idea that adaptations in writing style occur, as evidenced in Exemplar 7, and could evolve dynamically during social interaction online, was

investigated further; specifically by exploring the relationship between writing style and within group identity. The development of a within group identity, that it is the group that is salient rather than the individuals within it, was introduced in Chapter 1 Section 1.3.

The first contribution is from an experimental study where the participants were organised into groups of three and provided with a discussion topic while the salience of the group was manipulated by the researchers (Lea, O'Shea, Fung, & Spears, 1992). At the same time half of the groups were physically isolated whilst half were not. The results showed that the use of typographical marker was similar in each group. However, when participants were asked to rate their colleagues based on measures of attraction and affect there was a positive correlation with the use of typographical marker in the high salience groups whereas in the low salience groups this was not the case and for some items there was a negative correlation. These findings support the view that the way communicative style is interpreted depends on the salience of the group.

In a further study the pattern of interaction, as it evolved organically (without any form of manipulation by the researchers) was investigated (Postmes & Spears, 2000). These researchers studied the interpersonal interactions of 87 students who took advantage of an in-course emailing system to interact socially. Based on the patterns of interaction, 25 distinct groups were identified. There were 11 groups with 4 members or more and these were

selected for further study. Quantitative data were collected about the length of messages, use of typographical marker, and the number of self-referents. The content and form of the messages was classified into one of 15 categories; a between group analysis of variance confirmed significant differences between the groups. The results of this study support the view that a prototypical way of communicating can develop and that it is distinctive to the group; a within group dialect.

A model for the development of dialect, and its relationship with the dynamics of a group was tested using a simulation (Nettle & Dunbar, 1997) . The simulation involves a timed task, accumulating wealth, where giving costs one unit while the receiver's wealth increases by two units. Each organism in the simulation has an initial dialect, made up at random, and represented by a string of six numbers. The initial wealth and the memory span of each organism are identical. The simulation involves four types of organism, COOPS, CHEATS, POLYGOTS, and MIMICS, each with its own distinctive exchange strategy. The results of this simulation were as follows: in a population of COOPS, a COOP always gives unless it can remember giving and not receiving, and therefore does very well. Introducing five or more CHEATS, free riders that never give to anyone, is disastrous. When all the organisms are POLYGOTS, CHEATS are unable to invade in the long term although they may dominate initially. POLYGOTS only give gifts when the recipient has a near identical dialect. When a POLYGOT receives a gift it changes its dialect to that of the benefactor and it may change one of the

digits that define its dialect with a parameter, CHANGERATE, determining the probability of this occurring. The success of MIMICS, free riders who change their dialect to be like that of the benefactor when they receive a gift, depends on the CHANGERATE of the POLYGOTS. For the teacher with experience of CMC, CHEATS, POLYGOTS, and MIMICS will be characterisations with which they are familiar.

Although this simulation represents a simple system Nettle and Dunbar claim that it demonstrates that cooperation can evolve more easily in a group

> where social marking is present than in one where it is absent (Nettle & Dunbar, 1997p, 98).

Taken together with the evidence that groups online adopt forms of writing that is characteristic for the group there is a strong indication that dialect is an important element of the group identity. Although a group dialect may not be specific to groups online, the way that the 'group as a unit' adapts writing to be more speech like may be an important component for developing dialect online.

2.3.5 Writing as a mode for social interaction: Implications for collaborative learning online.

Exemplars 5-8 provide a broadly based set of evidence that using asynchronous CMC for social interaction need not compromise the communication and perception of relational information. The idea that the salience of the group is a positive feature of group relationships online has

been reinforced. The four Exemplars draw attention to how writing style online is adapted so that meaning and relational stance is communicated. Sometimes it is the functionality of the conferencing software that is appropriated to convey meaning, as in Exemplar 5. Furthermore Exemplar 8 has illustrated how within group identity might be supported by dialect with the simulation proving some indication as to how dialect develops, and that the dynamics of the group and the development of a within group dialect might be associated.

2.4 Emotion and Interaction.

While the theory for task space during group work is well developed, theory relating to relational space tends to be fragmentary and on occasion contradictory. In this section another set of four Exemplars are reviewed, all foreground relational space and the experience of the individuals within it. Two (Exemplars 9 and 11) are drawn from the literature on group work online; Exemplar 9 considers relational space from a teacher perspective while Exemplar 11 reviews the theory that within- group identity has particular salience online (as outlined in Chapter 1, Section 1.3) in more depth. For the other two Exemplars s in this section the interrelationship between relational space and task space is examined in other contexts. Exemplar 10 is drawn from a training and therapy context and describes the developmental stages of a group, while Exemplar 12 looks at teamwork from an organizational perspective. Exemplar 11 and 12 develop relational space at a conceptual level.

2.4.1   Exemplar 9. The teacher experience of group work at distance using CMC

For this Exemplar the developmental stage of a learning group was taken into account, demarcated as beginning, middle, and end of a learning event (deLaat & Lally, 2003). Using a content analysis approach based on four categories: cognitive, metacognitive, affective, and miscellaneous, the contributions to a text-based forum were mapped across the three periods. The number of affective contributions was higher at the early stages, with the cognitive and then the metacognitive occurring in the latter stages. At the same time the authors conducted a critical incident recall interview with the teacher. In their research report they include some illuminating quotes from the teacher as follows. For the middle phase

> I was conscious of sitting back, I was tracking it, like a hawk really, but I was in a more relaxed mode.
>
> I started to focus more on the dynamics within the group
>
> A sense of two groups forming
>
> [T]wo, maybe three cracking on whereas the others were more shadowy figures.
>
> Kate struggled the most and seemed able to find a niche, she articulated her struggle, Andrea responded academically, Pauline gave a more emotional response […] seemed to respond to her more as a person.

(deLaat & Lally, 2003, p 26). This research highlights the challenge for teachers. Alongside supervising the learning, a teacher also needs to monitor relational experience at the level of the individual group member as well as the 'group as a unit'. While the developmental nature of knowledge

construction has been central for research on 'learning through collaboration', this Exemplar highlights that the way in which the relational space develops, and is experienced by the individual student, is also important. This example of the reflection of an online teacher endorses the second aim for the thesis, that teachers will need to be supported with professional development opportunities that can help them to monitor and manage interpersonal interactions amongst group members.

2.4.2 Exemplar 10. Group dynamics: the development of a group over time

The concept of group dynamics, as a group developmental process, provides a description of how engaging with the group task and the interpersonal are interrelated and extends our understanding of how this interrelationship develops over time (Tuckman, 1965; Tuckman & Jensen, 1977). This work involved a systematic review of fifty articles each with a focus on how groups develop over time in face-to face contexts and is based on observational studies in therapy and training, based on natural or experimental group settings. Four key developmental stages were identified from this review: forming, storming, norming, and performing, with the labeling of each stage describing the processes involved. Interpersonal relationships dominate the first two stages and the task the latter two. During the forming stage members of the group explore the boundaries of interpersonal behaviours alongside becoming familiar with the task. The next stage, storming, is characterised by conflict, hostility, benign regression, unacceptable behaviours, and

defensiveness. A group member may try to dominate the other group members and subgroups may form. During this stage the task can be viewed with heightened emotionality and there are barriers to effective group dynamics in two realms, the task and the interpersonal. The group gradually develops a degree of cohesiveness, the norming stage. A sense of 'we' develops and a group culture of norms and values emerges. The group settles down and begins to focus on the task with less emotionality. Effective groups achieve a fourth stage, performing. At this stage the socio-emotional dynamic of the group is unlikely to be disruptive and most groups are able to engage in collaborative work in a productive way.

> [T]he interpersonal structure becomes the tool of task activities. Roles become flexible and functional, and group energy is channeled into the task. Structural issues have been resolved, and structure can now become supportive of task performance (Tuckman, 1965, p 386).

This idea of the 'group as a unit' progressing through a series of stages has been extensively adopted by organisational science, applied to work teams, and the findings validated. Based on this description the socio-emotional experience of the individual student will depend to some extent on the stage of development and is why this research is pertinent. It has implications for the form that this investigation for this thesis should take, that preferably there should be a microanalysis of the group interactions over the entire period.

2.4.3   Exemplar 11. SIDE: a theoretical perspective. Developing a within group identity

The social identity model of deindividuation effects (SIDE) theory is compatible with the idea that a newly formed group will go through a norming process. The idea of a within group identity was first introduced in Chapter 1, Section 1.3. Early e-learning research had focused on the potential for anonymity and a reduction in identity cues during CMC as impacting negatively on relational communication in online text based forums. (SIDE) developed the idea of within group identity as a counter view (Lea & Spears, 1991). The theory for SIDE is that social cognition processes based on the group, rather than the individual member, is more likely in CMC as the absence of identity cues allows participants to focus on building an identity for the group. Identity as a member of the group becomes salient and group members self-refer against a prototype of the group. Evidence to support the idea that a strong within-group identity is characteristic of group work online was provided, and its association with the development of a within-group dialect proposed. Within group identity, that a sense of identity comes from the 'group as a unit' rather than the individuals within it, foregrounds group cohesiveness as an important element when it comes to conceptualizing what is meant by relational space and facilitating the student experience of that space.

The idea that a strong within-group identity is a unique feature of groups online has implications for designers and teachers in DE. Critically, the

development of a secure within-group identity will only happen if there is some point of joint focus from the outset and is why a clearly defined task is as important for relational space as it is for knowledge construction. At the same time, the students should be advised of the pedagogical value of collaboration as a way of learning, supported by advice on how to take part. The facilitative role of the teacher is also important for the establishment and maintenance of a within-group identity. If members of the group do not have a sufficiently secure social identity, the de-individuation aspects of anonymity may not be counteracted, with a consequent risk of a negative socio-emotional experience for one or more of the group members. The teacher needs to remain vigilant in this respect.

2.4.4   Exemplar 12. Teamwork and group work. A view from organisational psychology.

This research involved identifying concepts developed for teamwork in organisational science that could be usefully applied to group work in formal education (Van den Bossche et al., 2006). Four concepts were identified: *psychological safety, cohesion, interdependence,* and *group-potency.* Interdependence encapsulates the interactive processes required to achieve a shared outcome and *cohesion* the manner in which the sharing is achieved. *Group potency* is a construct that aligns with the idea of a within group identity, as described in Exemplar 11, Section 2.4.3, in that the 'group as a unit' is central albeit in terms of a *potency* belief; the belief that it is the 'group as a unit' that is most efficacious. The value of *group potency* is that it

engenders confidence in the ability to achieve for the individuals concerned. *Psychological safety* is about the group being perceived as psychologically safe, a facilitative interpersonal context, so that the individuals within it will be less concerned about how others will view their contributions and are more likely to take risks.

These four constructs were incorporated into a model as mediators of team learning behaviours (constructive conflict and co-construction) and tested using questionnaire data collected from each individual member of 75 groups. The resulting model shows that all four constructs mediate the team learning behaviours and that in turn team learning behaviours mediated the mutually shared cognition. The model also confirmed that design of the task (as a collaborative endeavor) is important for i*nterdependence* and *cohesion* within the group.

The *cohesion* construct is complex. Research in organizational science has identified two distinct components, *task cohesion* and *social cohesion* (the emotional relationships amongst team /group members). A path analysis of the model supports this dichotomy, it was only *task cohesion* that contributed to team learning behaviours and it was the only construct to have a direct effect on mutually shared cognition. There is research that specifically focuses on the complex interplay between these two components, social and task *cohesion*. Based on research on decision making in teams it has been demonstrated that interpersonal liking is a good thing when there is a strong

focus on the task. However, without the anchor of a well-defined task a highly developed social *cohesion* within a team can lead to groupthink; the decision making of the group, as critical and conflictual practice, will be compromised by their concern to maintain social cohesion (Janis, 1972).

2.4.5 Relational space and its contribution to group work

Exemplars 9-12 confirm the interrelationship of relational space and task space and demonstrate that the cohesiveness of the group is a key element of relational space; that cohesiveness is important for the functioning of the 'group as a unit'. Furthermore, these Exemplars develop theory in three ways that are of relevance for a facilitatory role for the teacher. Firstly, a positive relational space will engender the trust that empowers constructive conflict. However, there is the danger that a relational space that is too positive will lead to uncritical acceptance of ideas and thereby compromise those processes that lead to a better outcome and deeper understanding. Secondly, these Exemplars provide a characterization for a positive relational space as supporting identity and efficacy issues alongside a positive socio-emotional experience. Thirdly the developmental nature of 'the group as a unit' was exemplified.

2.5 The Community of Inquiry (COI): its contribution to the investigation of socio-emotional experience and co-presence

The students and teachers who are the subjects of investigation for this thesis are required to undertake group online, at distance and to interact with other students and the teachers asynchronously by writing using CMC. They are mature students enrolled at a national university with an open entry policy (no prior academic qualifications are required). Taken together with the research focus and the aims of the thesis, these parameters mean that the Community of Inquiry (COI) was selected as a framework of relevance for this thesis.

The COI framework was developed specifically for investigating the use of computer-mediated communication by distance students and has specified three forms of presence: cognitive, teaching, and social, with a conceptual space at the intersection of these where optimal epistemic engagement is achieved (Anderson et al., 2001; Garrison & Anderson, 2003; Garrison, Anderson, & Archer.W., 2000; Rourke et al., 1999). The authors argue that when social and teaching presence are satisfactory then the student learning experience is both emotionally satisfactory and pedagogically productive (Garrison & Anderson, 2003; Garrison, Anderson, & Archer, 2004; Garrison et al., 2000; Rourke et al., 1999) i.e. the COI is relevant because it attests to the influence of affect and the importance of teaching. Furthermore, the COI's conceptuallisation of social presence is of value because it draws attention to what is different experientially about social learning online. The thesis

investigates co-presence (a sense of others) when communicating remotely using CMC and its impact on relational space. Therefore, it is necessary to ascertain whether the COI conceptualisaton of social presence is sufficient as a representation of a sense of others and by implication, for investigating relational space in these contexts.

2.5.1 Social presence

The COI defines social presence in the context of interpersonal interaction mediated by a computer.

> the ability of learners to project themselves socially and affectively into a community of inquiry (Rourke et al., 1999, p 50)

Social presence as a conceptualisation of how a sense of presence might be achieved when communication is mediated by technology (including the telephone) is attributed to (Short, Williams, & Christie, 1976). These authors defined it as follows.

> [T]he degree of salience of the other person in the interactions and the consequent salience of the interpersonal relationships (Short et al., 1976, p 65)

a definition that implies a sense of the 'realness' of others when interpersonal interaction is mediated by technology and is why this concept is of relevance for this thesis. When assessing the quality of interpersonal communication using technology it was surmised that intimacy i.e. a close personal encounter for example, between family members or friends, could be compromised by the medium of communication (Short et al., 1976). A contemporary example

would be using Skype to connect with family living in a geographically distant country. However, Short and colleagues argued that a working or temporary relationship need not be compromised when using technology to communicate, provided that immediacy is achieved. If individuals in these contexts make adaptions that overcome the limitations of the medium i.e. communicate closeness to others, it is sufficient for the needs of a relational context that does not seek intimacy. Based on this a sense of others in text based online forums will depend on the form and quality of the communicative acts by the people involved rather than the medium. Immediacy, as it pertains to interpersonal interactions online, has been developed and variously described as mediated immediacy (O'Sullivan, Hunt, & Lippert, 2004) or verbal immediacy (Delfino & Manca, 2007; Walther et al., 2005). Verbal immediacy is defined as an adaptation of communicative style that participants employ when writing is used for interpersonal interaction.

However, some researchers who use the COI as a framework for investigating remote social learning using CMC do not address a distinction between collaborative group work and discussion learning. 'Learning through discussion' can occur when students have the opportunity to hold a discussion around a common topic, a form of social learning that typically involves many more participants than is the case for group work, and it does not involve students in sharing responsibility for achieving the task. Therefore, to comprehensively assess the contribution of the COI (and the research that

coheres around it) for this thesis, its pedagogical credibility will be evaluated from the perspective of the Conversational Framework (CF).

2.5.2   Frameworks for learning: COI and CF

The CF and its relationship to learning theory was described in Chapter 1, Section 1.7.1, it covers all the main theories of learning and the roles of all kinds of digital technologies in learning (Laurillard, 2009). Therefore the CF is helpful as a way of evaluating the COI from a pedagogical perspective and at the same time making explicit what is distinctive about collaborative learning. The authors of both frameworks, COI and CF, acknowledge the influence of Dewey, who argued for a view of learning as primarily social and interactive: that students benefit from the opportunity to take part in both their own learning process and also that of other students (Dewey, 1933, 1959). Based on this view, discussing and sharing ideas with peers whilst engaged in action supports the co-construction of knowledge, critical thinking, and creativity, and are precisely the processes that can be supported by providing distance students with access to online text based forums. The CF models the iterative nature of the processes that are involved in collaborative learning: the continual iteration between student and teacher, student and peers, and between the concepts and actions of each individual student. The CF makes clear that the requirement to collaborate on a learning task, as represented by an outcome that is achieved jointly, is what distinguishes collaborative learning from co-operative learning or learning that takes place during discussion with peers. Therefore, a point of contrast between the CF and COI

is that the CF makes explicit the processes involved when 'learning through collaboration' whereas the COI is less explicit about 'learning through collaboration' as a pedagogy that is distinct from 'learning through discussion'.

The role of the teacher as critical is incorporated into the models of both the COI and the CF. By using the CF a generic example for fostering best practice, and for progressing the conceptual understanding of a student, can be specified as a pedagogical pattern (Laurillard et al., 2012). A pedagogical pattern for group work will represent the activities: monitoring progress, providing guidance, evaluating outcomes, providing feedback, that the teacher will need to engage in when supervising collaborative learning. The value of the COI for this thesis is that it recognises that the teacher has another role: facilitating the group's relational space alongside monitoring progress and providing feedback, and has developed a template for describing and measuring this role. The COI describes the influence of the online teacher as teaching presence, with their role prescribed by three areas of activity: 'design and organisation', 'facilitating discourse', and 'direct instruction' (Anderson et al., 2001). It is the role of the teacher as facilitator of the relational space of the group and the socio-emotional experience of the individual student that is assessed and developed during this thesis.

Although some research using the COI does not make a clear distinction between 'learning through collaboration' and 'learning through discussion'

nevertheless, the COI is of value for this thesis specifically, the concept of social presence and its impact on socio-emotional experience.

2.6 Methodological implications of the literature review

The thesis will investigate learning and teaching during a Virtual Residential School (VRS) that has been offered so that distance students can undertake a group project remotely. Exemplars 6, 8, and 12 from the literature review confirm the value of a student perspective of interacting with others using CMC. Therefore, Study 1 (Chapter 3) will use the responses to a survey by students who had taken part in a VRS to model the distance student as situated both online and at distance, and will take into account some characteristics of the individual student that could be relevant. For comparison, a face-to-face equivalent, a Residential School (RS) taking place over a 6 day period, will be studied in situ.

 The 'group as a unit' is a key construct (Stahl, 2006, 2011) for 'learning through collaboration' and will be the main focus of Studies 2 and 3. A considerable amount of the research that has investigated how a sense of others is constructed and experienced online has drawn on the COI framework. Presence, social and teacher, are the elements of the COI that are of value for this thesis and are the focus of Study 2. Templates have been developed for 'measuring ' social and teacher presence using a content analysis approach (Anderson et al., 2001; Rourke et al., 1999) and these have been extensively validated. Therefore, for Study 2 the interpersonal

interactions of two project groups and their teachers are analysed by drawing on this methodology.

The review of twelve Exemplars from three fields of study Learning, Communication and Emotion have led to the identification of five key processes: joint attention, coherence, negotiation, cohesiveness, and group norms (within group identity) to be investigated alongside social presence. Exemplars 1-4, demonstrate that joint attention, coherence and negotiation are necessary if the group is to achieve a shared task; a key criterion for 'learning through collaboration'. Exemplars 5-8 and Exemplar 2 involved a review of social interaction online by writing and provide evidence of how verbal immediacy is achieved by students when using CMC, the way they adapt their writing style (for example, the use of typographical symbol to nuance meaning i.e. verbal immediacy) and appropriate the functionality of the software (for example, styling, using colour). Exemplars 9-12, a review of research on interpersonal interaction selected from the field of Emotion, show that for the group to function as a unit achieving a within group norm and cohesion is necessary. Although the COI does investigate interaction during social learning online it is not specific to the interactions required for 'learning through collaboration'. None of the three processes that are essential for achieving the group task (as identified from the review of Exemplars 1-4) are specifically targeted by the COI. Therefore a qualitative approach is adopted for Study 3, (Chapter 5); a microanalysis of the flow of interaction within two project groups that will investigate how the processes that underpin task

space and relational space (as identified from Exemplars 1-4, Learning, and Exemplars 8-12, Emotion) are achieved. The analysis will focus on student practices, adaption of writing style and appropriation of the technology (as identified from Exemplars 5-8, Communication).

Socio-emotional experience is the realm of the individual; it is embodied as well as situated. Therefore, the fourth study will involve the application of methods from Neuroscience so that its labile and embodied nature can be investigated. This will be achieved by monitoring neural activity and facial expression (specifically smiling). Study 4 will use a simulation of group work online with participants acting as teachers and has three purposes:

1. To assess the valence of the experience at a neural, behavioral, and subjective level.

2. To assess co-presence while interacting with others remotely at a neural, behavioral and subjective level.

3. To evaluate a set of resources developed for teachers.

 Research to guide the use of neuroscience method to assess the valence of emotional experience at a neural level will be reviewed in Chapter 7.

2.6.1 Interpersonal interaction: Patterns of affective practice and a mental model of other minds.

The four studies should be grounded by theory that encompasses both the affective practice of the group and the socio-emotional experience and socio-

cognitive processes of the individual members. Furthermore, it should address both the embodied and situated aspects of affect and thereby integrate the disciplines that comprise an Educational Neuroscience approach. Accordingly, a psycho-social concept *patterning of affective practice* (Wetherell, 2012) and a psycho-biological concept *mental model of other minds* (Frith, 2007) were used to integrate the approach to the four studies.

In a book on 'Affect and Emotion' Wetherell identified some wrong turns in previous research on affect that she wanted to correct, specifically, the sterility and methodological blocks that arise when affect is packaged between the theoretical areas traditionally associated with emotion as embodied and as socially constructed. In response she proposed the concept of *patterning of affective practice* as a way of combining psychological, social, and physiological influences on emotion.

> The body in social practice is a flow immersed in other flows. We can begin to ask about the process of mashing as the flowing body connects with the unfurling flow of social interaction, the composition of social spaces, and the comparatively glacial flows of individual life trajectories and social formations (Wetherell, 2012, p 31).

For collaborative learning participants are required to situate their learning in a social situation, a group of peer students, ideally with relational moves distributed amongst the members of the group. The *patterning of affective practice* within the group will depend on the individuals who make up the group, the way in which they individually experience and manage their

emotional experience, infer the emotional experience of others, and express empathy towards their peers. Inherent in Wetherell's approach is a description that we can apply to relational space as constructed by a group of students

> We create contexts as we act. Then, in reply, the other we have addressed orients to what is taking shape and remakes the context again (Wetherell, 2012, p 87).

Conceptually *patterning of affective practice* embraces all the elements that are required for this thesis, a social space, and an individual as situated in that space, the characteristics that the individual brings, and the embodied nature of emotional experience.

From a psychobiological perspective Frith focuses on the individual and the brain based socio-cognitive processes that occur during social encounters. Frith argues that all interactions, whether taking place in the physical or the social world, are mediated by the brain, and that during a social interaction the brain is continuously updating a mental model of others by a process of inference and error adjustment, at the same time as all other participants are similarly engaged (Frith, 2007). The brain creates an illusion of direct contact with the mental world of others.

> [M]ost of our interactions with other people are interactions between minds, not between bodies (Frith, 2007, p16).

At any point in time a mental model of the other mind is unlikely to be perfect. To adjust one's mental *model of another mind* an ongoing interaction between minds is required, an iterative cycle of evidence gathering and inference. For

these processes to pertain when interpersonal interaction is remote, online, asynchronous, and by writing, it will be necessary for participants to develop the appropriate digital fluency.

Neither approach, using inference to build a brain based *mental model of other minds* or *the patterning of affective practice* draw on examples of social interaction online yet both are appropriate for that context. Wetherell' s ideas about the patterning of affective practice accommodates the semiotic, how material objects are recruited into semiotic practice and how semiotic modes develop and play a part in the patterning of a social system. This draws attention to the semiotic in online contexts, how appropriation of the technology becomes part of patterning. For a mental model of other minds whether or not others are physically present is irrelevant providing that the flow of interaction is preserved. While language is important for explicit social cognition processes, the form that language takes (speaking or writing) should not matter. Furthermore, Frith has speculated on how prejudice, the preconceived judgments we hold about others, may prime the brain's mental model (Frith, 2007). This is a point of integration with ideas of within group identity Chapter 1 Section 1.3 and Exemplar 11, Section 2.4.3; the force that opens up the communication loop to the inference and evidence gathering cycle of a mental model.

2.6.2   Interpersonal interaction at distance using CMC: the debate

When using CMC for interpersonal communication there is no multi-sensory cues for how other group members are feeling and questions about the impact of these conditions on the quality of interpersonal interaction have been posed. The thesis investigates two competing arguments:

- Students will adapt to interacting 'virtually' using writing rather than speaking.

- Interpersonal interaction is disrupted/disturbed.

In Chapter 1 Section 1.5.2 the intention to model these competing claims from a Neuroscience and Psychology perspective was outlined. These models are presented in Chapter 8 alongside an evaluation of the methodology described in this section. The contribution that the collective findings of the four studies make to the evaluation of the model is also assessed in that chapter.

2.7   Conclusion

This thesis arose through practitioner experience, from being involved in a VRS and its alternative, a RS, at the Open University UK (OUUK). Studies 1-3 and the pilot for Study 4 are based on data collected at that time. The students learn at a distance and most are studying part-time; internet based communication technologies have made it possible for them to engage in social learning. The design of the course specifically requires them to form into groups to collectively design, carry out, and present the findings from a

group psychology project. For the VRS a text-based forum is the context for group work and the students and teachers use CMC to communicate. Therefore, there are no physical cues about the identity of the other members of the group or non-verbal cues to what they are feeling and thinking; the only mode of communication is written text. Furthermore, these students never meet face-to-face. An issue of debate is whether these factors compromise the quality of the learning experience. To contribute to this debate the thesis focuses on students' socio-emotional experience and co-presence in these contexts.

Socio-emotional experience is a property of the individual but at the same time it will depend on relational and task space, as constructed by the group. Sfard's account of the theoretical distinction between an acquisition metaphor of learning and a participatory (socially based) metaphor is a useful way of analysing what is expected from these students and how they might individually experience the encounter (Sfard, 1998). The students are formally assessed on an individual report of the group based project. Therefore, from a student perspective, what is required fits with both metaphors. The fact that the course carries a high stakes outcome for the student conforms to Sfard's description of knowledge acquisition as property, learning as a commodity, and dependent on a value judgment by the student. The motivational forces are complex; a student's engagement will depend on more than one source of emotion. To address this complexity the methodology aspires to a holistic

approach so that the usefulness of the findings for informing the design for, and facilitation of, group work online is not compromised.

In Chapter 1 the approach that the thesis will take to the study of socio-emotional experience and co-presence was outlined. The influence of emotion on intrinsic motivation; a psycho-biological approach to motivation to learn that will be investigated within an Educational Neuroscience perspective. This will be achieved by grounding the investigation from both a psycho-social and a psycho-biological perspective. To expect that combining these two approaches will enhance theoretical understanding and inform methodological approach is not unrealistic; there are points of integration. Both perspectives (psycho-social and psycho-biological) highlight the limitations of any procedure that does not involve analysis at the level of social and over time. Wetherell accepts the need to incorporate ideas about mental appraisal into her concept of *patterning of affective practice* and so the idea of a brain based mental model that is continually updated is not an incompatible concept. The *mental model of other minds* provides a knowledgeable explanation for the parsing of the psychological processes that are involved in affective practice and the factors that can influence the associated neural patterning. The contrasts and similarities that emerge from a comparison of salient factors from each perspective should provide a useful basis for investigating relational space and socio-emotional experience. Crucially, adopting both ideas (*patterning of affective practice, and a mental model of other minds*) will mean that empathy, a process that psychologists and educationalist would

argue is fundamental for peer to peer interaction, teacher-peer interaction, relationships, and socio-emotional experience can be defined and operationalised so that the interrelationship between the motivational outcome of emotion and cognition can be more fully understood. Empathy, as a process of key importance for the quality of interpersonal relationships will be investigated alongside the other processes that are fundamental for successful group work (as identified through the literature review) namely, joint attention, coherence, negotiation, group norms and cohesiveness.

Chapter 3 Study 1 Distance students' experience of doing group work

3.1 Introduction

An argument considered in Chapters 1 and 2 is that emotion and cognition are inextricably linked when learning. Although Stahl argues that there is a motivational force that is distinctive of group work,

> it is in the intense interactions within such small groups that knowledge is likely to be constructed and shared (Stahl, 2011, p. 21).

and implies that it may involve an emotional component

> one is motivated by the group effort (Stahl, 2011, p.22).

the interrelationship of cognition and emotion for 'learning through collaboration' and the role of intrinsic motivational forces remain underdeveloped, irrespective of whether the group work takes place online or face-to-face. Stahl also recognised that social influences outside of the group have a part to play, that a student may be engaged with several communities and has commented on the limitations inherent in most research that it is focused on just one level of activity (i.e. the individual or the group or the community).

> To the extent that researchers discuss the connections amongst levels, they rely on commonsensical notions of socialization and enculturation- popularizations of traditional social science. There are few explicit empirical analyses of the connections (Stahl, 2012, p.1).

The research question for the thesis situates the distance student taking part in group work online. Therefore the aim for Study 1 is to disentangle the various sources of emotion that can contribute to a distance student's experience of a learning encounter that involves other students and includes doing group work. It is proposed that a module from a Psychology degree program that is offered in two formats: online, a Virtual Residential school (VRS) and face-to-face, a Residential School (RS), will be an appropriate setting. For every student attending either the VRS or the RS there will be multiple sources of emotion but the socio-emotional experience of each student will be unique. The source can be the interpersonal interactions with other group members (how a student experiences the relational space of the group), with the teachers or within the wider learning community (students in the same cohort who are working in other groups), and some will be associated with the personal circumstance of the student. Other elements that can influence the experience of group work include the size of the group, task clarity, and ownership of the task (Tolmie & Boyle, 2000). These authors discuss the methodological problems involved in studying such a complex process as collaborative learning online particularly when it comes to making meaningful comparisons between learning contexts that differ on one or more of these elements. The task and group size is the same for both formats of the module (VRS and RS) and other key elements are similar. Therefore there is an opportunity to compare the same group project when undertaken face-to-face or online, by students who are drawn from the same degree programme.

For the VRS there is an additional and significant factor to take into account, the mediating effect of technology on interpersonal interaction and engagement with the task. In Chapter 1 what is distinctive about remote and asynchronous interpersonal interaction for socio-emotional experience and co-presence was determined; since students are not co-present in time or place, there are no visible identity cues or multisensory information that could provide cues to the presence and emotional state of other group members. The quality of the student experience when such information is missing has been debated extensively however; a comprehensive understanding of the student experience when others are 'unseen' remains elusive.

The 'unseen' nature of remote interpersonal communication is not the only aspect of the online context to consider. It is well documented that any form of online learning, whether social or not, has the potential to evoke negative emotion. Students need to use a digital device to access module content and/or their teacher and peer students and this device may malfunction or there may be problems with access to the Internet (Jaques & Salmon, 2007). Students can become frustrated because of software compatibility issues or they may lack some of the necessary digital skills (Ala-Mutka, 2011) or confidence in their digital skills (Jones, 2010). Occasionally students will be inconvenienced when the service provided by the institution is interrupted or they may become irritated because they encounter broken navigational links or a poorly designed interface (Hara & Kling, 1999). All these technical issues require digital skills and experience and constitute additional sources of

emotion. Also, the forum structure of the VRS is complex and a significant amount of digital competence is required to navigate the online spaces, and to take full advantage of the functionality of the CMC software.

The focus of this thesis is students' socio-emotional experience and co-presence during group work online. From the literature review we know that the students themselves are an important source of evidence. Therefore, a survey (Study 1a) was conducted with a cohort of students who had completed the VRS. Disentangling socio-emotional experience from other sources of emotion is the challenge. Therefore, the opportunity to compare a face-to-face mode of delivery (RS), when many of the key elements are matched, is proposed for Study 1b. Taken together Study 1a and Study 1b should enable us to form a better understanding of the distance student's experience of doing group work as part of a programme of academic study, and of what it means to undertake it remotely.

The module, task, and teaching and guidance arrangements for both the VRS and the RS are described in Section 3.2. The design for the VRS and the software used for interpersonal communication is described in Section 3.3. Study 1a is described in Section 3.4 and Study 1b in Section 3.5. The methods used in Study 1 are evaluated in Section 3.6 and the collective findings (VRS and RS) in Section 3.7. In Section 3.8 the implications of the collective findings are discussed.

3.2 The learning context

The module studied for the thesis is presented as a Virtual Residential School (VRS) by the Psychology department at the Open University. It is offered online as an alternative to a 6 day long Residential School (RS). The module content and assessment for the VRS and RS are identical and the outcome for each (as measured by grades achieved) is the same. It is a module in the BA/BSc Psychology program at the Open University UK. For those students who wish to obtain professional accreditation by the British Psychological Society (BPS), and progress to post-graduate programs leading to chartered status, it is a compulsory component. A successful outcome is critically important for the students involved. It is expected that students will have completed at least 240/375 credit points of the program and for many students only the 15 points remain[2].

3.2.1 The students

The students are all studying at distance and they vary in age from 22 – 70 plus years. Some are employed; either part time or full time, and some have caring responsibilities. From a demographic analysis we know a proportion of students have a disability and/or an additional requirement (DAR) and that English is a second language (ESL). The Open University has an open entry policy, it is a national university, and it recruits students from Continental

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[2] An open access policy meant that this level of academic development is advised but could not be enforced. There would be some students enrolled on the module who did not meet this requirement.

Europe. Taken together this means that students will vary in a number of ways that can impact on their learning experience. For example they vary in academic profile, some are already graduates in other disciplines whilst the academic achievement of others, before joining the Open University, was minimal. They vary in the time they can make available for study, in their confidence and competence with language, their personal circumstance and relevant experience such as group work and technology. They are a useful cohort to study in that they reflect the demographic predictions for the global university of the future (British-Council, 2012; Grove, 2012) and are likely to reflect the diversity of students who enroll on MOOCs.

3.2.2 The module structure

<u>Preparatory activities</u>: (Weeks 1-4 (VRS), pm Day 1, Days 2,3 (RS))

Students revise and extend their knowledge of psychological method through six activities (preparatory activities); they also have a session on ethics, and a session on literature searching using the online library at the Open University. These activities take place within sets of 16-25 students and involve a 'learning through discussion' format (VRS) and an instructional format (RS). At the end of this period the students choose a project type (there is a choice of 8). The eight project options are loosely defined, there is ample scope for project groups to develop an innovative research project; four require quantitative method and four qualitative. For the VRS the students are

allocated into groups of 4-8 students (4-5 preferred) by the administrative staff. For the RS the students themselves mostly effect the groupings.

<u>Project work.</u>

There are four main stages

1. Weeks 5,6 (VRS) Day 4 (RS). During this period each group chooses a topic for study within the area of the project option, prepares a draft research proposal, acts on feedback from a teacher panel, and then submits a final proposal. The project proposal is submitted as a word document, a project proposal form (PPF) [3] is provided for each type of project, quantitative and qualitative (Appendix A). At this stage each project group receives feedback from teachers who have not been involved with the preparation of the PPF.

2. Weeks, 6-9 (VRS) Day 6 (RS). During this period the students collect and analyse the data and make a start on a group presentation.

3. Week 10 (VRS) Day 7 am (RS). Students are involved in presenting the research to a plenary session. At this stage each project group receives feedback from the students in other project groups and from teachers who have not been involved with supervising their project work.

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[3] A pre-formatted wiki has replaced the word version of the PPF in more recent presentations of the module.

4. Weeks 11 and 12 (VRS) 3 weeks post RS. During this period the students are required to write a project report individually. This report represents the summative assessment for the module.

3.2.3 Teaching and Guidance

The task is an important element of group work. For this module the task is clearly specified and supported as follows. The task and its assessment are described in detail in a Study guide, a time table (weekly for the VRS, daily for the RS), a detailed explanation of why the module requires group work, how to achieve it, how to write up a project report and information about how it will be assessed are also provided. The Study Guide for the VRS also contains advice on how to use the technology and on how to navigate the forums.

 Progress with the task is supported in a number of ways, a set or preparatory activities, a detailed pre-forma for the project proposal (Appendix A) and teachers are available throughout to advise and clarify.

The teachers work as a team during the preparatory activities and as a pair during the project group work. In general a pair of teachers will opt for a lead teacher with the other member of the pair providing backup. Their remit is to advise, provide instruction if the student discussion is too far awry, to check that calendar deadlines are being met, to support the motivation and cohesion of the group, and to take a facilitatory role if the relational space of the group appears to be disturbed. The teachers also act as a panel to provide detailed feedback on the draft PPF and on the group presentation in the plenary

forum. During weeks 11 and 12 of the VRS when students are writing up their individual reports about the group project a set of frequently asked questions (FAQs) are made available to them, and a panel of four teachers monitor the end of course (ECA) support forum for any student questions about the report writing, and its assessment, that are not included on that list. Teachers at RS provide a dedicated session on report writing.

3.3 The Virtual Residential School (VRS)

Prior to 2000, the Open University, whose students are all studying at distance, had provided collaborative activities by organising Residential Schools hosted on the campuses of other UK universities. However, not all students are in a position to take advantage of this experience. Therefore, in 2000 the Psychology department started to provide collaborative activities online. Since that time the proportion of students opting for the Virtual Residential School has gradually increased so that by 2007 50% of eligible students enrol.

The VRS takes place in text-based forums online and lasts for 12 weeks. CMC is used for interpersonal communication between students and between students and teachers. There were 738 students enrolled on the VRS studied for this thesis.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

3.3.1 The setting for the VRS (the forums)

The students are allocated across 15 sites (A-O) with 45-60 students at each site. This number of students meant that learning and teaching was hosted across 325 individual forums. Each student had access to just 22 of these.

The forums available for the module activities are arranged hierarchically (to a depth of two) with the web page mapping the top layer as shown in Figure 3.1 which represents the view of a student's access to 22 forums. DZX222 is the module code, 07 the year, J the month in which the module commenced, and G the site code.

There are also forums that can be accessed by any student enrolled on the module a help forum, forums for optional activities and a chat forum. The purpose of these forums is to provide a dedicated space where students can find support, social engagement with other students and enhancement opportunities; activities that we know are especially valued by the students who attend Residential school.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
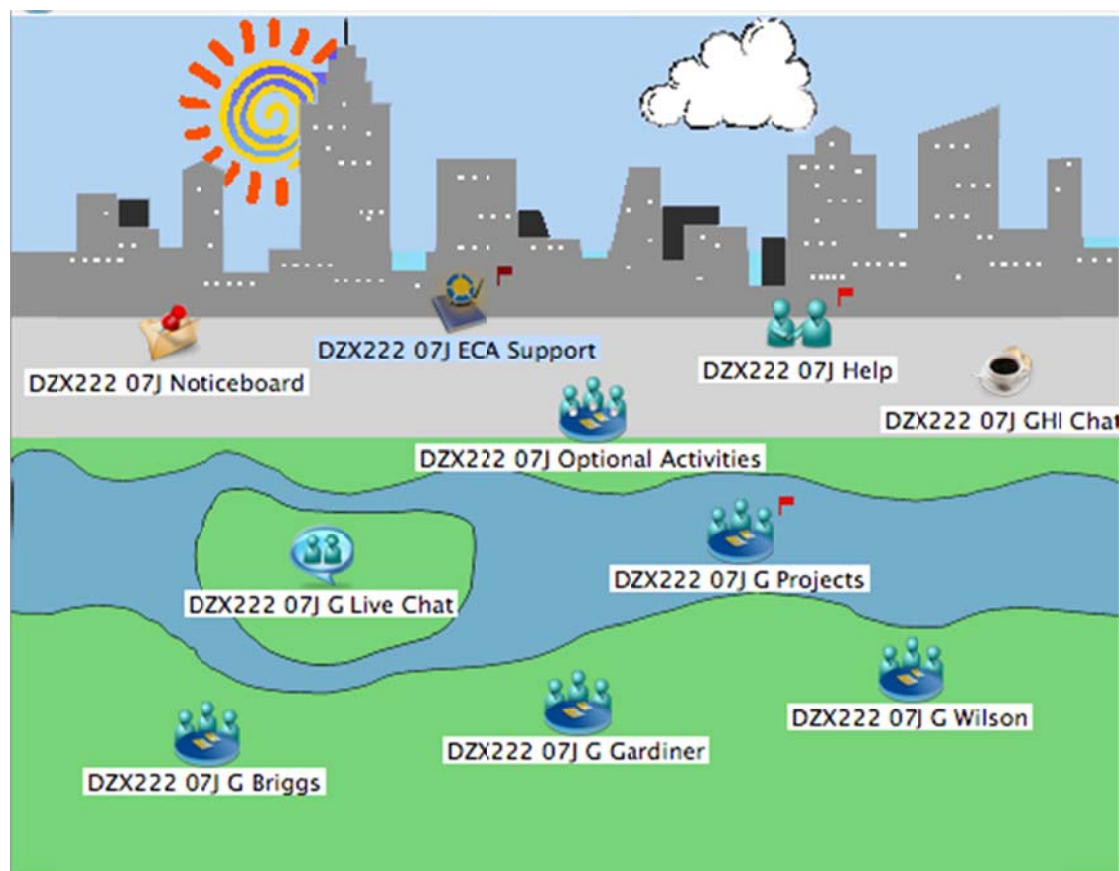
Figure 3-1 A map of the Virtual Residential School forums

The students undertake the preparatory activities in three main forums, Briggs, Gardiner and Wilson (named after buildings on the OU campus). For these activities the students at each site are randomly divided and sub-divided to 15-20 students for each of the preparatory activities. Three of the preparatory activities run concurrently in the sub forums of Briggs, Gardiner, and Wilson. Each week a notice is placed in the main forums (Briggs, Gardiner, and Wilson) giving students an allocation to a named sub forum for the week. During the first three weeks the activities at each of these forums is refreshed on a weekly basis and the students re-allocated to the sub forums. Therefore students get some contact with most of the other students at their

site before project groupings are formed, however it also means that there can be navigational challenges, practical and conceptual, for students at this stage [4].

During week 5, after students have chosen a project option and been allocated to project groups, they have access to a dedicated forum for their project group and also a private (to the group) Live Chat facility.

At end of week 10 students reassemble in the Briggs main forum for a site based plenary forum.

3.3.2 The software supporting group interactions

The students used proprietary software (most used Microsoft Word and Powerpoint) to prepare the project proposal [5], collate results, and present their findings at the plenary session. This information was exchanged through attachments to messages posted into the appropriate forum (project group or plenary). All students are provided with SPSS to be used for any activities that require statistical analysis.

The computer conferencing software, First Class ® (OPENTEXT) was used to support the text based asynchronous online discussion. This meant that students had access to a range of useful functions that were organised into

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[4] In 2011 the forums were embedded in the VLE so that the practical aspects of navigation were automated. However, the students still needed to construct a conceptual map of the teaching and learning spaces.

[5] In 2011 a pre-formatted wiki for the project proposal form was provided to each group.

one of three categories Message, View, Collaborate. By using the pull down menu for each category the functions for that category are made available. The functions relating to each category are shown in Table (3.1).

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

Table 3-1 The FirstClass software functions

Message	View	Collaborate
New (compose) Reply Reply with quote Reply to sender Reply to forum Forward Send Mark as read Insert signature Spell check Unsend History Summarise	Change view properties to: • Name • Subject • Last Modified • Attachment • Size • Flag Filter • All incoming • Unread	Navigate forum messages by thread: • Up one level • Next • Previous • Next unread • Previous unread Who's online

The functions filed under Message covered most of those available for email systems. That list also includes three functions that are less common, History (a list of who has read a message), Unsend, and Summarise (a function that allows the user to summarise a set of messages). An extensive range of editing features and formatting features were also available from this menu. An example of how styling functions were used is provided in Chapter 5, Section 5.4.4.

When a forum is accessed using First Class a list of the most recent 42 messages are displayed. There are functions available under the View menu that allows students to choose how these (and the other messages in the forum) are displayed. In Chapter 4 Section 4.7.2 we describe a situation when appropriating this function can be problematic.

The functions available under Collaborate allow students to navigate the messages by thread and, by implication, read all the messages on a topic of discussion before moving onto a different topic of conversation. A thread is defined as a set of messages that share a common title. In Chapter 5 Section 5.5.5 there is an example of when these functions are appropriated for benefit, and when they are misused. There is also a function available from this menu that can be used to check who is simultaneously online.

3.4 Study 1a: The student experience of the Virtual Residential School

As already described in Section 3.1 a number of sources can contribute to emotional experience during group work online, as illustrated in Figure 3.2.
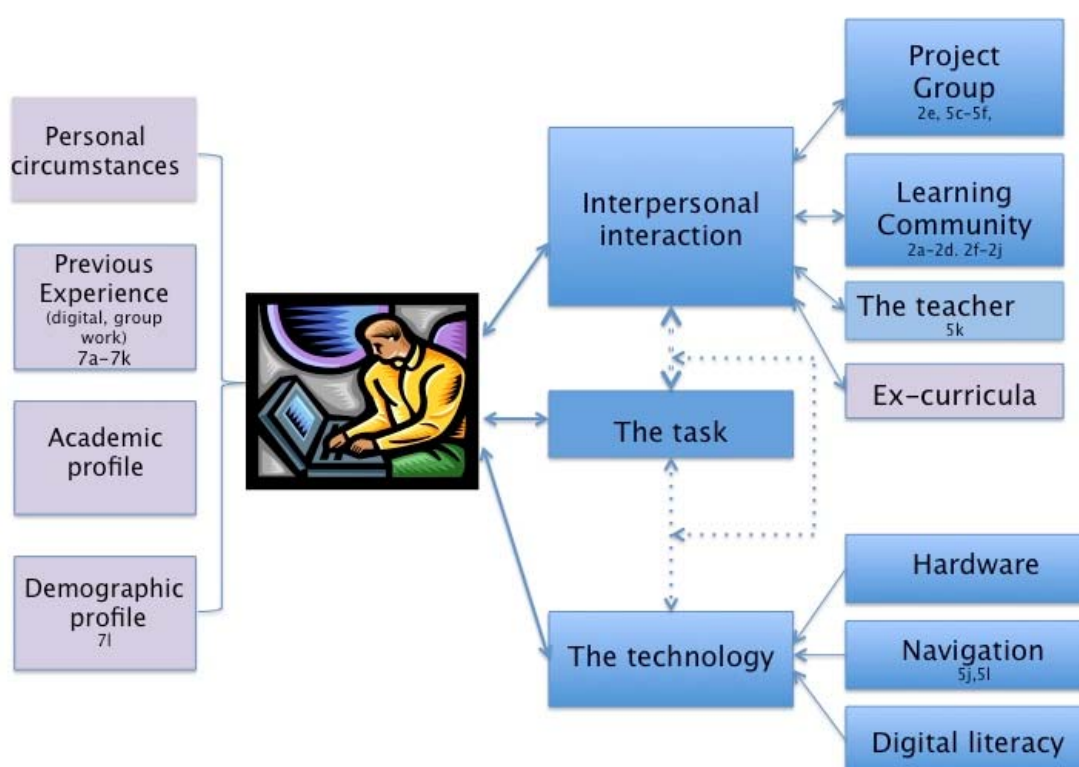
Figure 3-2 A situated view of the distance student engaged in a Virtual Residential School (survey items are indicated)

To discern how these interrelate, and the extent to which emotion induced during interpersonal interactions within the group contributes to the student experience, the survey was designed so that it targeted these other sources for example, questions about the experience of interacting with students in other contexts (the support forums and enrichment forums). Data about some

personal characteristics that might be relevant are also collected. The aim for Study 1 is to disentangle the various sources of emotion that can contribute to a distance student's experience of doing group work remotely, therefore, the research question for Study 1a is as follows

> *What is the experience of the open entry student, learning at distance and using CMC to communicate with other students and the teachers, as situated at each of three levels of activity: as an individual, as a member of a group who share a common assessment task, as a member of a student cohort (with access to a wider learning community).*

3.4.1 The design of the survey

The development stages of the survey were influenced as follows.

In my role as module leader for both the VRS and RS I knew that there were some concerns, specific to the format of the VRS that cropped up on a regular basis. The survey was scheduled to take place prior to the mid term review of the module and a group of teachers with experience of both the VRS and RS were invited to a workshop to discuss the upgrade[6]. The outcome from the discussion confirmed that the following could be problematic:

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[6] The Open University actively encourages researchers and practitioners to show restraint in the amount of surveys directed at students. Therefore, the survey conducted for Study 1 contained questions that targeted both research and practice (specifically, the mid term upgrade). This approach was consistent with the second aim of the thesis to use research to inform practice.

- Student expectations about the delivery of the module (they come to the module assuming that they will have autonomy over their study pattern and that they will have a dedicated teacher throughout who they can contact by telephone, as had been the case for previous modules on the program).

- The range of competencies and experience amongst students for example: with using   communications technology, experience with group work.

These observations by experienced teachers concur with those of Weller and his warning that

> group work online is not without its pitfalls (Weller, 2003, p.70).

Therefore these characteristics of the individual student were targeted by the survey.

The Residential School format has been offered since the early days of the Open University (more than 3 decades). In a survey of the student experience of face-to-face opportunities for 45 courses residential schools obtained the highest ranking for helpfulness (Burt, 1997). Therefore some elements of RS that students value for example, access to advice about careers and study skills, were incorporated into the VRS. Forums dedicated to the following activities have been provided:

- Support. A space where students could seek advice on a range of issues for example: technical, study skills.

- Careers. Discussions with a guest psychologist targeted at a specific career path in Psychology. These were seeded with a podcast featuring a prior interview with the guest.

- Enrichment. A discussion forum seeded with a podcast that described and summarised a joint inaugural lecture given by three of the professors in the Psychology department.

- Social. In order to provide a social space for students the sites were amalgamated into groups of three. This meant that up to 180 students had access to each of five social spaces.

Survey questions were developed that targeted the student experience of these opportunities to take part in activities outside of their project grouping.

Other questions targeted the student experience of group work and also the online nature of group work. The items that make up the survey questions target three levels of experience, as an individual student (characteristics and experience), with the learning community and the group work.

Students were also asked about their overall experience of the module from three perspectives:

- Satisfaction.
- Sense of belonging to a wider community of students.

- Future engagement with an online format of learning.

A full range of questions is available in Appendix B[7] and is linked with Figure 3.2 when appropriate.

3.4.2   Conducting the survey

Participants for the survey were recruited by an email sent after the deadline date for submitting project reports. A reminder email was sent out to students after one month. The information for participants is available in Appendix C. 738 students enrolled on the module, approximately 520 completed. Every student who enrolled was included in the survey. 256 students took part in the survey representing approximately 48% of students who submitted a project report and therefore completed the module.

3.4.3   Analysis of the survey responses

Data reduction methods were used to analyse the data collected from the 256 students who responded so that latent variables (commonalities in the relationships between the student responses to the survey items) could be identified and interpreted. A model of the VRS was then constructed. The statistical packages SPSS and AMOS were used for these analyses. The first stage involved an analysis of the 42 survey items using two data reduction techniques Principal Components Analysis (PCA) and Factor Analysis (FA).

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[7] The term 'course' as used by the Open University was replaced by 'module'. However, at the time that the survey was conducted 'course' was the term used.

Seven latent variables emerged and these were interpreted and then incorporated into the model of the module when it was offered as a VRS

3.4.3.1 Data reduction

The PCA reduced the 42 data variables (survey items) to seven latent variables (coherent subsets). The results and the parameters adopted for the PCA are shown in Table 3.2

The latent variable structure of the PCA was then tested using Factor Analysis (FA). Inspection of the scree plot (see Table 3.2) from the PCA confirmed the PCA results (7 factors) and therefore this was the parameter used for the FA. The same 42 survey items were analysed. The results are shown in Table 3.2. The survey items had a loading of at least .450 and most loadings were above 0.55.

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**Table 3-2 Data reduction of the survey data**

	Step 1 Principal Components Analysis (regression)	Step 2 Factor Analysis (maximum likelihood estimate)
No of respondents	256	256
No of complete data sets	135	135
Rotation	Varimax	Direct Oblimin
Cases with missing data	Excluded	Excluded
Eigenvalues extracted from PCA analysis	7	
No of factors tested using exploratory factor analysis		7
Variance after rotation	67%	59%
Suppress absolute values	<0.3	<0.3
Latent variables **(Interpretation)** **only values > 0.450 included at this stage**	1. Sense of a learning community 2. Indicators of project group work	1. Indicators of co-presence 2. Sense of a learning community 3. Indicators of

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	3. Experience of barriers 4. Indicators of co-presence 5. Precourse expectations 6. Team teaching 7. Previous experience	project group work 4. Pre-- expectations 5. Previous experience 6. Team teaching 7. Experience of barriers Note: For all other modules studied by these students they are learning independently. Therefore they can work at a pace they choose. They have a named teacher who they can contact for help and advice. Therefore the intense pace, the need to keep to schedule and the team approach to teaching are all very different for students.
Relationship between latent variables & the survey items	1) 2b, 2h, 2f, 2i, 2c, 2a, 2e, 2d 2) 5e, 5d, 5f, 5c 3) 5l, 5j, 1h(-), 5h, 5k,	1) 1o, 1n, 1p 2) 2h, 2b, 2i, 2a, 2f, 2c, 2e, 2d, 1e, 1d,

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	1d(-) 4) 1o, 1n, 1p 5) 1c, 1a, 1b, 5h 6) 1f, 1e, 5k(-) 7) IT, online collab, groupwork	1q, 1f 3) 5e, 5d, 5f, 5c, -2e 4) 1c, 1a, 5h, 5i 5) IT, online collar, 6) 1f, 1e, 5k(-), 2a, 2e 7.) 5l(-), 5j(-), 5h(-), 1h(+), 5k(-), 5i(-)
Kayser-Meyer-Olkin measure of sampling adequacy	N/A	.827 (meritorious)
Bartlett's test of sphericity	N/A	2388.46 df 465 Sig .000
Adequacy • **(p/5<factors<p/3)** • **p for each factor >2**	N/A	• No of parameters in the analysis = 42 6 < 7(factors) < 10 • Each factor

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		determined by at least 3 variables
Scree plots		
Goodness of fit	N/A	Chi square 327.832, df 269, Sig 0.008

3.4.3.2 Interpretation of the latent variables.

The next stage involved interpreting the 7 latent variables from the Factor Analysis (FA). These seven latent variables, and their associated survey items, were interpreted and named as follows.

1. *Indicators of Co-Presence, preferred/not*

2. *Sense of a Learning Community, experienced/not*

3. *Indicators of Project Group Experience, poor/good*

4. *Pre-course Expectations, appropriate/not*

5. *Previous Experience, relevant/not*

6. *Team Teaching, satisfactory/not*

7. *Experience of Barriers, a lot/little*

The survey items associated with each latent variable are listed in Table 3.3.

Four latent variables, *Indicators of co-presence, Indicators of Project Group Experience, Pre-course Expectations*, and *Previous Experience,* were clearly defined by their item membership. Most of the survey items that probed the student experience of being part of a learning community contributed to the same latent variable, *Sense of a Learning Community*, however, there were some additional survey items (2e, 2d, 1q, 1f) in this subset that, from a researcher perspective, were not explicitly linked. The other two latent variables, *Experience of Barriers*, and *Team Teaching* are consistent with students feedback during previous presentations of the VRS, that the intensive nature of the module, the organisational requirements involved in collaborating with others on a shared task, navigational issues, and teaching arrangements that are unfamiliar can be problematic for the individual student. However, survey items that contribute to the latent variable *Team teaching* do not have face validity, from a practitioner or a researcher perspective. Furthermore the survey items involved had higher loadings on other latent variables. Therefore, the latent variable *Team Teaching* was omitted from further analysis. From both a research and a practitioner perspective it is reasonable to incorporate the remaining six latent variables and their associated survey items into the modelling process.

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Table 3-3 Interpretation of the latent variables of the survey data

1. Indicators of co-presence, preferred/not	2. **Sense of a Learning community, experienced/not**
1o. In my online learning I would like to have access to some extra cues about my fellow students such as a digital photograph, voice recoding or video.	2h Listening (reading) to the DZX222 conversations (see Website link) increased my sense of engagement with the online community. 2b Access to the pre-course conference facilitated my engagement with the online community.
1n. In my online learning I would like to provide some extra cues about myself such as a digital photograph, voice recoding, or video.	2i Being able to comment on the issues raised in the DZX222 Conversations increased my sense of engagement with the online community.
1p Overall by using Computer Mediated Conferencing (CMC) to communicate and learn I was disadvantaged due to the lack of non verbal cues.	2a Working with other students on the preparatory activities increased my sense of engagement with the online community
	2f Taking part in the optional activities increased my sense of engagement with the online community.
	2c Access to the Help conference facilitated my engagement with the online community.
	2e Working within a group to design and carry out a research project increased my sense of engagement with an online community.
	2d Access to the asynchronous chat conference with fellow students increased my sense of

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	engagement with an online community. 1q Overall the facility to access a complete textual record of all the discussions advantaged my learning.
3. Indicators of project group experience, poor/good 5e Working with other members of the group to analyse data/evidence 5d Working with other members of the group to collect data/evidence. 5f Working with other members of the group to present the project outcome. 5c Working with other members of the group to construct a project proposal.	**4. Pre-course expectations, appropriate/not** 1c Overall the pacing of the study program was faster than expected. 1a Overall the workload on the Virtual Residential School was higher than expected. 5h Managing your time 5i Sustaining involvement in the course
5. Previous experience, relevant/not IT experience (email at work, email at home, internet browsing, use computer at work, use internet at work) Online collaboration (online forums, MSN, OUSA-OU student association, social networking)	6. Team teaching, satisfactory/not satisfactory 1f Overall I was satisfied with how the project work was facilitated by the teacher team 1e Overall I was satisfied with how the online preparatory activities were facilitated by the teacher team 5k Working with a team of teachers rather than an

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	individual teacher
Previous experience of group work	2a Working with other students on the preparatory activities
	2e Working within a group to design and carry out a research project increased my sense of engagement with an online community
7. Experience of barriers, a lot/little - 5l Finding the information you need - 5j Identifying the relevant conference for each task during the preparatory activities. - 5h Managing your time. -5k Working with a team of teachers rather than an individual teacher	**(An additional variable for the model)** **Student Evaluation of the Learning Experience, positive/not positive** 1j Overall I was satisfied with my study experience on the Virtual Residential School 1i Overall I now have a greater sense of belonging to the Open University 1r Overall if I was making the choice between Residential School or the Virtual Residential course I would choose the Virtual Residential course again

3.4.3.3 Constructing a model for the VRS

The interrelations between these latent variables were then modelled. Structured equation modeling (SEM) using AMOS was applied in order to construct a model of the relationship between six of the seven factors (latent

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variables) identified by the PCA, and confirmed by the FA. The final model was achieved through an iterative process and assessed from a practitioner perspective. An additional latent variable, defined as *Student Appraisal of the Learning Experience positive /not positive* was included. Three survey items were used as indicators for this factor

- Ij Overall I was satisfied with my study experience on the Virtual Residential School
- 1i Overall I now have a greater sense of belonging to the Open University
- 1r Overall if I was making the choice between Residential School or the Virtual Residential course I would choose the Virtual Residential Course again

Four of the latent variables *Experience of Barriers, Previous Experience, Pre-course Expectations, and Co-presence* depend on the unique circumstances and characteristics of the individual student and have been assessed as potentially problematic by the teachers who attended the workshop; these latent variables have face validity. The community elements are designed to mitigate these effects. Therefore in the initial phase of the modeling process *Sense of a Learning Community* was positioned as a mediating variable for these latent variables.

Although there were sufficient survey items to be able to estimate the parameters required for the model, there was a problem with under-identification. Very low parameter estimation is likely to be the cause.

Therefore the variables that had low factor (latent variable) loadings, survey items 1e, 1d, 1f, were removed from the latent variable *Sense of a Learning Community* and this solved the problem. Interestingly, from a practitioner and researcher perspective these survey items do not easily fit with the interpretation of the latent variable as *Sense of Learning Community* but could be construed as another potential latent variable *Enabling Learning, yes/no.* However since these survey items were not identified as a distinct latent variable in the data reduction process they were removed entirely.

In the subsequent iteration of the model the mediating effect of *Community* on *Co-presence* was low and there was no mediating effect of *Community* on *Group work*. Neither of these findings is surprising. Once group work begins the students and teachers in each project group tend to become a self-contained unit operating within a dedicated forum space. Therefore a direct causal effect of both *Co-presence* and *Group work* on the course appraisal was assumed for the next iteration. The structure of the resulting model is illustrated in Figure 3.3 (the AMOS model on which this figure is based is provided in Appendix D). The goodness of fit measures and the regression coefficients for this model are reported in Table 3.4.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
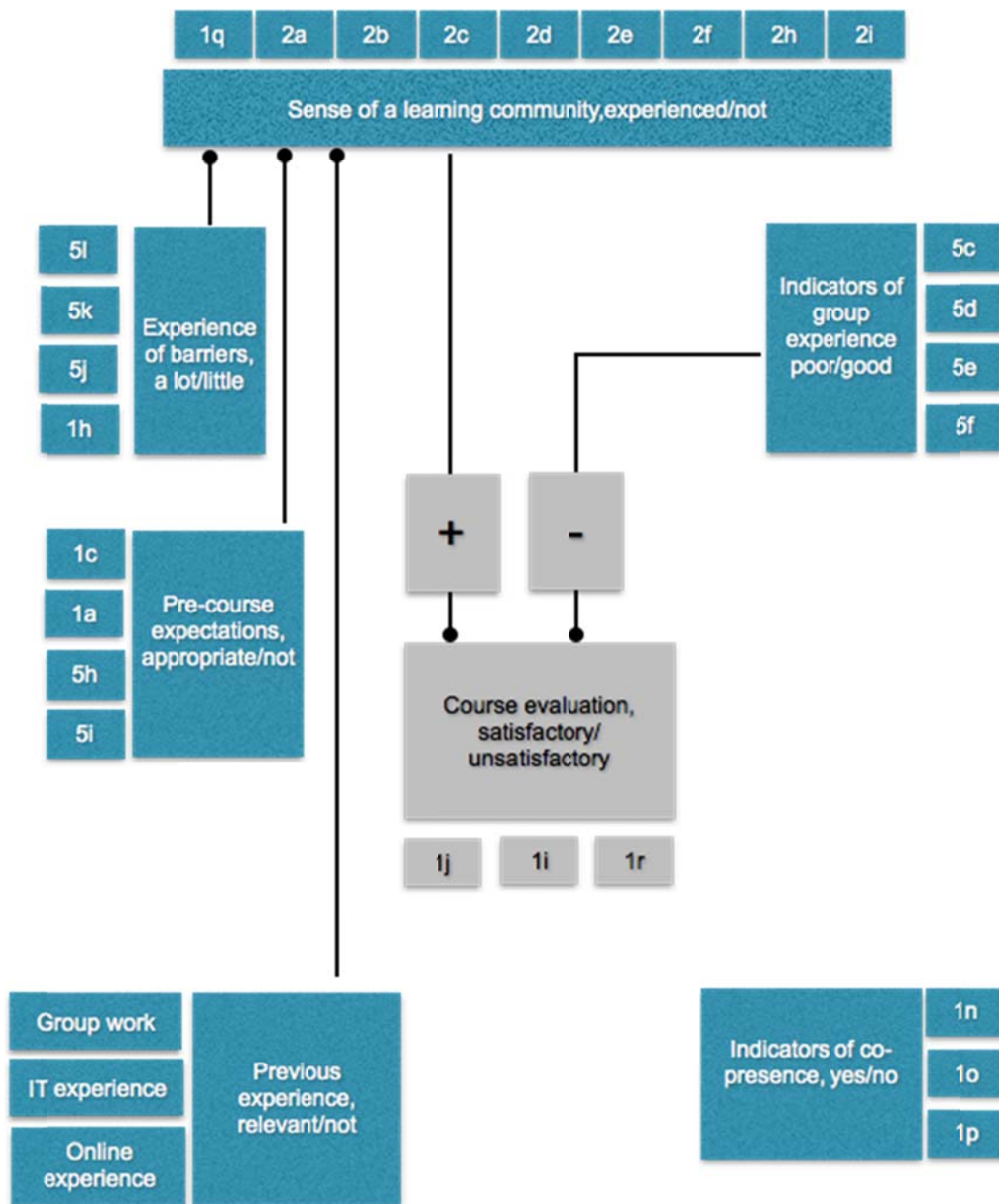
Figure 3-3 A model for the student experience of a VRS

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Table 3-4 Pathway analysis and regression coefficients for the model of the VRS

Pathway	Regression co-efficient
Sense of a learning community > Experience of barriers	0.60
Sense of a learning community > Pre-course expectations	0.44
Sense of a learning community > Previous experience	0.88
Sense of a learning community > Student appraisal of the learning experience	1.98
Indicators of project group experience > Student appraisal of the learning experience	0.34
Indicators of co-presence > Student appraisal of the learning experience	-0.03

3.4.4 The findings (Virtual Residential School))

The noteworthy features of the model are as follows.

The characteristics of the individual student (the survey items associated with the latent variables *Experience of Barriers, a lot/a little*, *Pre-course expectations, appropriate/not*, *Previous experience, relevant/not*) that could limit the learning experience can be mitigated by providing forums where students can access support and optional activities and by consequence, peer students and teachers. Providing these forums is worthwhile when designing modules that involve group learning.

The latent variable *Indicators of project group experience, poor/good* has a negative effect on the overall appraisal of the module. This is consistent with other research (Burdett, 2003; Capdeferro & Romero, 2012) and the student reviews of the module (written by current students for students who are at the stage of making a choice between the VRS and the RS[8]).

However, the latent variable *Indicators* of Co-*presence, preferred/not* has no effect on the overall appraisal of the module. This latent variable is distinctive by its independence. It is not mediated by the design for community nor does it have a causal effect on group work.

3.5 Study 1b: The Residential School

The aim for Study 1 is to disentangle the various sources of emotion that can contribute to a distance student's experience of doing group work remotely therefore, the research question for Study 1b is as follows

> *In what way does the distance student's experience of doing group*
> *work face-to-face differ from the experience of doing so remotely*
> *using CMC?*

A comparison between the RS and VRS should mean that the effect of doing group work remotely could be differentiated from doing group work per se,

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[8] http://www3.open.ac.uk/coursereviews/course.aspx?course=dzx222)

http://www3.open.ac.uk/coursereviews/course.aspx? course=dxr222

whilst factors at other levels of engagement may be operating in both contexts.

3.5.1 Methodological approach

A decision was made to use the findings of the survey, the knowledge from the literature review, and the advice of Tolmie and Boyle

> be open to any activity (Tolmie & Boyle, 2000, p. 136)

to guide the approach to data collection. Three options were considered:

- Study a sample of individuals in depth.

- Study a group in depth.

- Study the RS community.

Given the high stakes nature of this module for the career progression of students, and the enormous commitment that attending Residential School involves for some students, and their families, options 1 and 2 were not feasible ethically as I could not guarantee that the process would be without consequences for the students involved. As Module Director for the RS I did have the opportunity to keep a record of occurrences that might be informative. Therefore the approach adopted was to keep a diary for the RS week and to be open to any activity, or source of data, that could be useful for furthering the development of methodology for the thesis. Five sources of data contributed to the findings:

- The administrative records for the module.

- A research project conducted by one of the student groups.

- A facilitatory role that I undertook involving three project groups.

- A diary record of the RS.

- Teacher feedback (at the end of the RS teachers are required to formally feedback on the groups that they have supervised).

The Residential School community that was studied formed during a RS held at the University of Bath campus in 2009; 92 students, 74 female and 18 male, age range approximately 22 to 72, attended. It took place concurrently with two other Open University Residential Schools.

3.5.2 The findings (Residential School)

The findings relate to five topics: the learning community, project group membership, the dynamics of group work, identity, sharing a task. Collectively they target the learning experience of the students who attend RS at three levels, the community of OU students on campus, interactions within the project group, and the characteristics of the individual student

3.5.2.1 The Learning community

This description is based on my personal diary entries about the learning community that formed during the RS.

Approximately 75% of students attended the optional icebreaker on Day 1 despite it being held in a somewhat dreary venue and at the end of a long day

for students including traveling. There was a good atmosphere and no lone students. There was good attendance at other organised social activities. Also, at least two of the teacher team were accomplished chess players and they played during the evenings; they were joined by at least 12 students as the week progressed (in my experience   the organic development of an activity, unique to a cohort, is a common feature of RS). There was excellent attendance at the optional evening talks given by teachers; particularly those that were career related. Several mothers talked about their feelings at being separated from their young children but also admitted to enjoying the opportunity to indulge in being a student. Students used social times to share experience, both academic and personal. At this level of analysis the RS was typical of many others that I have taken part in; part-time distance students value and enjoy the opportunity to 'be a full-time student' and being able to interact with other students and with the academic staff. The question that arises in the context of the VRS is whether the experience of the wider learning community is as satisfactory. An important factor to bear in mind is that the VRS takes place over a 12 week period and the students who enroll on that version of the module have to manage their time alongside their other everyday commitments.

3.5.2.2 Project group membership

Familiarity, developed through physical proximity, engendered a sense of affiliation and was a factor implicated in project group membership. On arrival

at Residential School the first thing that students do is register. At that time they are randomly allocated to one of 6 registration groups (15 to 16 students in each group). This determines who they will spend time with during the preparatory activities (18 hours over the first 3 days). After three days of preparatory activity the students form into project groups, the membership of these groups is mostly self-determined by the students. 20 individual project groups were formed at this RS. The following list shows that registration group membership influenced the subsequent project group membership.

- 72% of students joined project groups where the majority membership had belonged to the same registration group.
- 16/20 of the project groups had a majority membership that matched the registration grouping.

3.5.2.3 The dynamics of group work

Taking part in group work RS can be challenging especially in the early stages, as evidenced by feedback from one pair of teachers at the end of the RS week

> This group took a while to sing from the same hymn sheet student G, particularly….   In the final presentation student G produced a brilliant outline of the whole difficult and confusing process and showed that the group made it. Had all other project groups laughing! A great change.

This evidence accords with the description of group dynamics as a four stage process, forming, storming, norming and performing (Bales, 1955; Tuckman, 1965; Tuckman & Jensen, 1977) as previously described for Exemplar 10,

Chapter 2, Section 2.4.2. Four other examples that illustrate the developmental nature of groups are provided in Appendix E. All four examples also illustrate how the individual characteristics of a student may impact on the group climate during critical times.

3.5.2.4 Identity

There was some evidence that identity (gender, disability, nationality, lifestyle) is conspicuous and can influence group membership and supports the proposal that cues to identity have discriminatory influence in face-to-face contexts (Billig, 1985; Tajfel, 1969) and that identity cues are salient when group work takes place face-to-face. The relevant literature on the influence of identity cues during group work online was reviewed in Chapter 2, Exemplar 11, Section 2.4.3. An important proposal to emerge from that review was that group work using CMC could be advantaged due to the fact that some cues to identity are 'unseen'.

Two sources contributed to the data on identity, a student project and teacher feedback. Whilst checking the viability of the individual project group proposals I became aware that one was of potential of interest. The research question for this student project was

Why do individuals identify with certain groups?

Their intention was to collect data from a focus group consisting of four volunteer students. From the perspective of this thesis one of the questions used to prompt the student focus group discussion was of particular interest [9].

Can we please ask you to discuss how you felt when you came to residential school. You may have felt uncomfortable at the time you didn't know people so, who did you gravitate to?

The student responses were as follows

Participant A:

Three people met on the plane it gelled us together quite a bit actually, 3 of us have sort of stuck together in a little group (lines 53,54,55)

Participant B:

Another female (Greek lady) who participant B sat next to me while waiting to be registered.

Also three of us that had gelled we're in the same bit in halls (lines 91-93)

Participant C:

Gravitated towards another male student weird for me as I don't have any other male friends, it mainly women I get on with (line 66)

Participant D:

---

[9] Permission was obtained from all concerned for me to have access to the transcript of the focus group.

> I sat with other smokers (females) but then gravitated towards another male (line 72)

The end of module feedback from teachers also made reference to identity issues. In their opinion students with a disability could be marginalised by the group thus supporting the view that it is society's discriminatory attitudes to disability that is the problem. Feedback from two project groups evidence this view

Group 19

> Generally worked well together but C and J tended to marginalise S who had mobility (wheelchair bound) problems (Teacher)

Group 11

> The group worked well, but A had problems following all discussions due to hearing difficulties. This problem did not seem to be fully accommodated by the group (Teacher)

Identity cues are clearly salient when group work takes place face-to-face. From these observations at RS it would seem that being physically present can disadvantage some students for example, those with a disability. Also, it would seem that identity issues rather than interest in a psychological topic might have influenced project choice.

3.5.2.5 Sharing a task

During the focus group discussion, that occurred during the student project (described in the previous subsection), some students made observations about how sharing a task was a unifying influence on the group.

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Participant A:

> working with potentially complete strangers ………maybe because we know we have got a point to work towards (lines 79,80)
>
> there's no real conflict (line 81)
>
> cos we are working towards a point (line 85)

Participant D:

> We're on the course and chose to do the subject, we have all got something in common (lines 82-83)

This accords with the findings of Tolmie and Boyle who studied group work online and concluded that; when the task is clearly specified, and its shared nature is understood, students 'will make it happen' (achieve the task) and that potential barriers (using CMC for interpersonal interaction) will be overcome (Tolmie & Boyle, 2000). However, it seems that the implications of a shared task are complex and wide ranging. Student P in group 11, described in Appendix E is an example. During the early stages of group work on the RS it was observed that some students have a compelling desire to implement a personal project. This situation can cause conflict within groups it is not until these students 'let go' of their choice of topic area, and personal ideas that are so important to them, that the group can move on from the 'storming' stage. It is at these times that the facilitatory role of the teacher is crucial and also, that all the students continue to interact with the group.

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3.6 Study 1. Comment on the method

Study 1 is an investigation of the sources of emotion that can influence the distance student's experience of a learning encounter with other students and involved conducting a survey with students who took part in a Virtual Residential School, and a comparison with a Residential School (when students meet face-to-face), so that what is unique about doing group work remotely using CMC can be more clearly delineated. The findings of Study 1 are based on quantitative and qualitative data and both an exploratory and a confirmatory approach to analysis.

The construction of the survey (VRS) and the identification of data sources (RS) were strongly influenced by practitioner experience. Although the data sources, and approach to data collection, differ for the VRS and RS; systematic for the VRS, opportunist for the RS, the data collected from each context was representative of the whole learning event and therefore fulfilled the intention to take an in vivo approach to the study of the student experience. Furthermore, by comparing modes of presentation for the same module many of the elements identified as influencing group work online for example, the task, the size of the group (Tolmie & Boyle, 2000) have been viewed from both perspectives, group work online and group work face-to-face.

The data collected for the VRS was quantitative. The survey data was collected retrospectively and thus allowed for a period of reflection by the

student although this means that their responses are inevitably summative. Furthermore, surveys, however well designed, are restrictive in that responses are constrained by the questions constructed by the researchers. Despite these generic limitations the use of statistical methods (data reduction and modelling) provide a model of the student experience that develops the version constructed from a practitioner perspective (as was illustrated in Figure 3.2). Specifically, the model provides some information about the interactions between the elements that comprise each level (the individual student, the 'group as a unit', the learning community).

The data from the RS was collected from a range of sources. This means that the meaning and the reality of the learning encounter for the students and teachers concerned is illustrated as it took place albeit from an observer perspective. The study of the RS took place during the early stages of my research and it influenced the development of the thesis at that time by identifying sources of data that could illuminate what elements are different for the online experience of group work.

3.7 Study 1. Comment on the findings

In response to the research question for Study 1a the model constructed to represent the student experience of the VRS took into account some elements that could conflate a student's account of their learning; their individual characteristics and the extent they engaged with the community based activities (support, enrichment and social). In social learning contexts

other students can be a resource; the model demonstrates that some of the barriers, such as a lack of previous experience, can be mitigated by the provision of appropriate facilities that are shared with the wider student cohort; *Sense of a learning community, experienced/not* was represented as a latent variable that mediated some potential barriers for example, pre-course expectations and/or previous relevant experience.

Indicators of group experience, poor/good is another distinct variable, but is represented   as having a negative effect on the student's overall appraisal of the learning encounter. By contrast, and in response to the research question for Study 1b, although problems could occur during the early stages of group work at RS these resolve; feedback from teachers at the end of the RS was extremely positive, as are the student reviews of RS. This discrepancy between findings from the RS and VRS is support for the argument that the quality of the student experience is compromised when interpersonal interaction takes place online using CMC.

An element that has been identified as particularly important for successful group work online is the task; that the task and its shared nature should be clearly specified and meaningful, and that CMC is more likely to be embraced when participants can see its value for achieving a shared goal (Tolmie & Boyle, 2000). The task is an aspect of group work that has been identified as problematic in other research specifically, that depending on others for achieving the task can be frustrating (Burdett, 2003; Capdeferro & Romero,

2012; Robinson, 2013). However, the task, and the support for achieving the task, was the same for both contexts, VRS and RS, so that we need to look at other factors for an explanation for why some students evaluate group work online negatively.

The discrepancy between the student experience of RS and VRS may be explained by three findings from Study 1b

- There is within group conflict during the early stages at RS but it is usually resolved.
- Physical proximity at RS is an opportunity for affiliation.
- Identity characteristics that are 'visible' at RS can enable affiliation.

It is much easier for students taking part in the VRS to withdraw from participation and interaction at times of conflict (for example, the group tension that can arise due to an individual student's enthusiasm for personal ideas). If students do withdraw from the group at such times, even temporarily, they will miss the opportunity to move through the 'storming' phase of group development together with other members of the group. It is why it is important for teachers who manage group work online to be aware of this possibility and to have easy access to the participation patterns of individual students, an observation that is explored further in Study 2.

Study 1b shows that when students are physically co-present affiliation is achieved through proximity and shared identity characteristics. Being

physically co-present with the same students during the preparatory activities, being co-located in halls, travelling together, or sharing habits and interests, provided students with an opportunity to get to know each other and indeed influenced their choice of project group membership. By contrast, when students on the VRS choose a project option they are then allocated to a group by the administrative staff. Although, membership of subgroups for discussions during the preparatory activities is managed so that students will have met other members of their group for the VRS they may not have shared personal information. Physical proximity and shared identity characteristics that are 'seen' are important for affiliation at RS and prompts a question about affiliation when these are 'unseen'. However, it has been claimed that students interacting remotely do develop other behaviours, specifically ways of communicating, that lead to affiliation although it will take longer to achieve (Walther et al, 2001). The time available for group work during the VRS should be sufficient for affiliation to occur. Furthermore, the arrangement for preparatory activities during the VRS (mixing up discussion group membership) and the opportunity for community activities mean that two criteria for affiliation to occur (opportunities and time) have been met.

Identity characteristics that are not shared can have a negative effect on group cohesion in face-to-face contexts for example, disability, as was reported at RS. By contrast when identity characteristics are 'unseen' there is good evidence that a strong within group identity develops as illustrated in Exemplar 11 described in Chapter 2, Section 2.4.3. Yet the model constructed

from the survey data shows that the experience of group work, as measured at the level of the student cohort, is negative.

The comparison between the RS and the VRS supports the view that the quality of a learning experience is compromised when using CMC although; the debate about the factors involved remains unresolved. However, there is one other factor of consequence to consider, the absence of multisensory information when doing group work remotely using CMC. The latent variable Indicators of Co-Presence, preferred/not occupies a position of independence in the model for the VRS, a finding that justifies a focus on the absence of multi-sensory information in this thesis so that we can better understand the influence of this factor when students do group work remotely.

3.8 Conclusion

The findings of Study 1b (RS) have meant that an evaluation of what is 'missing ' when group work takes place remotely could be achieved. Of particular significance is that when identity characteristics are shared there is advantage if these are visible whereas if they are not shared there can be negative effects, for example discrimination. Although identity is not the focus for this thesis these findings, and the discussion of associated research, does clarify the debate about what is 'missing' to some extent and endorses the intention to target the absence of multisensory information and what it means for socio-emotional experience and co-presence.

The model for the VRS is based on data collected to reflect the student experience of engaging with a learning event including collaborative group work online. It supports the view that learning research based on just one level provides only a limited perspective (Goodyear & Ellis, 2008; Stahl, 2013; Tolmie & Boyle, 2000) and that

> the levels of individual, small-group and community phenomena are inextricably intertwined (Stahl, 2013, p 10).

It also supports the view of Weller

> Allowing students to participate in conferences and discussions beyond the specific course is a good means of creating a sense of online community (Weller, 2003, p.87)

Frustrations and challenges of collaborative group work can occur in face-to-face settings but seem to be confined to the early stages, the findings from the VRS suggest that students doing group work online may have problems progressing through this development stage and endorse the ambition to understand more about how students construct and experience relational space online. Although the model constructed for the VRS indicates that the majority of the cohort evaluated the group experience as negative, the students who responded to the survey may not be representative on this issue. From other sources we know that the experience of some individual students can be rated highly. Therefore, the aim is to compare two project groups selected so that the experience of a student from each contrast, one negative, one positive. For Study 2 (Chapter 4) the methodology developed

for the COI to investigate social and teaching presence of the online group, 'the group as a unit' will be applied. For Study 3 (Chapter 5) a microanalysis of how group members negotiate conflict, attend to the task jointly, achieve a coherent approach to the task and cohesiveness as a group and whether there is any evidence for a sense of within group identity, will be undertaken. The model constructed for the VRS has confirmed Stahl's ideas about the need for the group to operate as a unit and thereby be studied as a unit. Therefore the 'group as a unit' will be the subject of the remaining three studies alongside a focus on co-presence (a sense of others) and the socio-emotional experience of the individual student.

Chapter 4 Study 2 'The group as a unit': a quantitative approach.

4.1 Introduction

According to Stahl the 'group as a unit' is where collaborative learning takes place; knowledge emerges from the interactions between group members, the group functioning as a unit builds it collectively (Stahl, 2011). The model of the VRS constructed for Study 1a (Chapter 3) was based on evidence from the students who had taken part in a module that involved doing a collaborative project online and supports Stahl's view. Therefore, the next phase of the research was to investigate the 'group as a unit'. Studies 2 and 3 investigate the relational aspects of the 'group as a unit' in more detail by accessing the forum transcripts of two project groups. The two groups studied have been chosen based on contrasting experience of a student from each, one positive (the Mandevilles), one negative (the Wenlocks).

Study 2 takes a quantitative approach to the analysis of the forum transcripts using the methodology developed for the COI. In the Literature Review, Chapter 2, Section 2.5, the Community of Inquiry (COI) was identified as a useful framework for investigating social learning using computer mediated conferencing (CMC). The COI was specifically developed to guide the use of asynchronous computer mediated conferencing to support critical thinking. As originally formulated the COI conceptualised learning as taking place at the

intersection of three forms of presence: social, teacher, and cognitive with the discourse practices that construct social presence supporting both affective and cognitive objectives (Anderson et al., 2001; Garrison et al., 2004; Garrison et al., 2000; Rourke et al., 1999). A multi institutional collaboration has validated the presence constructs. Surveys conducted with different cohorts of students using identical methodology confirm the three distinct forms of presence, cognitive, teaching and social presence (Díaz, Swan, Ice, & Kupczynski, 2010; Garrison, Anderson, & Archer, 2010; Shea et al., 2010).

The rationale for Study 2 is that social presence and teaching presence, as conceptualiesd by the COI, are potentially relevant for the study of the relational space of the group and the socio-emotional experience of the individual student interpersonal interaction takes place at distance using CMC. Therefore, Study 2 will investigate the following question.

To what extent are the presence constructs (social and teaching) of value for the thesis?

The Literature Review in Chapter 2, Section 2.1 drew attention to 'participation' and 'interaction' as distinct student actions during collaborative learning. In Chapter 3, Section 3.7 the implications if members do not sustain an appropriate pattern of interaction was discussed. Teachers need to be aware of any changes in a student's pattern of interaction. Therefore, the contribution pattern (number of postings by individual students) will also be investigated.

The same two project groups are used for Studies 2,3, and 4 therefore, the sampling process is described at the outset in Section 4.2. The methodology used for the quantitative analysis of the 'group as a unit' (Study 2) is described in Sections 4.3 and the findings in Section 4.4. Profiles for the contribution of individual students and the patterning of those profiles are illustrated in Section 4.5. Section 4.6 contains an evaluation of the method and Section 4.7 an evaluation of the findings.

4.2 Selecting two project groups to study.

From the survey conducted with students who chose the VRS (Study 1a), and the student reviews of the course, we know that the student experience of group work online can impact negatively on their overall appraisal of the module. However, from practitioner experience, and the occasional student review, we know that it is not always the case. Therefore it would be preferable if the project groups chosen for in depth study reflect both types of experience, negative and positive.

When choosing two project groups to study there was the potential for researcher bias. Over several presentations of the course my attention had been drawn to several groups where interpersonal issues were particularly problematic. Such knowledge could lead to bias towards extreme examples of problematic groups which is not the aim of this thesis. There are other potential sources of bias, preconceived and anecdotal views about the style and competence of individual teachers and about which type of project is

likely to cause conflict amongst group members. Furthermore, the module assessment is a key milestone for students so that a researcher observing the group during the presentation of the module could have unintended consequences.

However, there is a full record of the textual exchanges which means that the developmental nature of the group can be studied retrospectively,

the project groups can be observed without intrusion. For all these reasons it was decided to select project groups by making further use of the survey data, described in Chapter 3 which included the following open question

> *Please supply any additional comments that you would like to make.*

The responses that students offered to the open question were analysed as follows. Any emotional words used by students when they responded to the open question were classified into one of six categories denoting a primary emotion, fear, surprise, joy, sadness, anger, love, using a scheme for emotion classification (Parrott, 2001). This scheme is hierarchically organised and classifies emotion terms at three levels, with the secondary and tertiary level derived from the primary level; it forms a thesaurus of emotion words. Using this thesaurus each occurrence of an emotion word in the open responses of students was noted. By categorising each emotion word according to the primary emotion from which it was derived a profile was constructed for each of four cohorts as illustrated in Figure 4.1 (four distinct cohorts of students had

been identified in a research study previously reported (Robinson, 2010)).

That study used data from the same presentation of the VRS as this thesis.
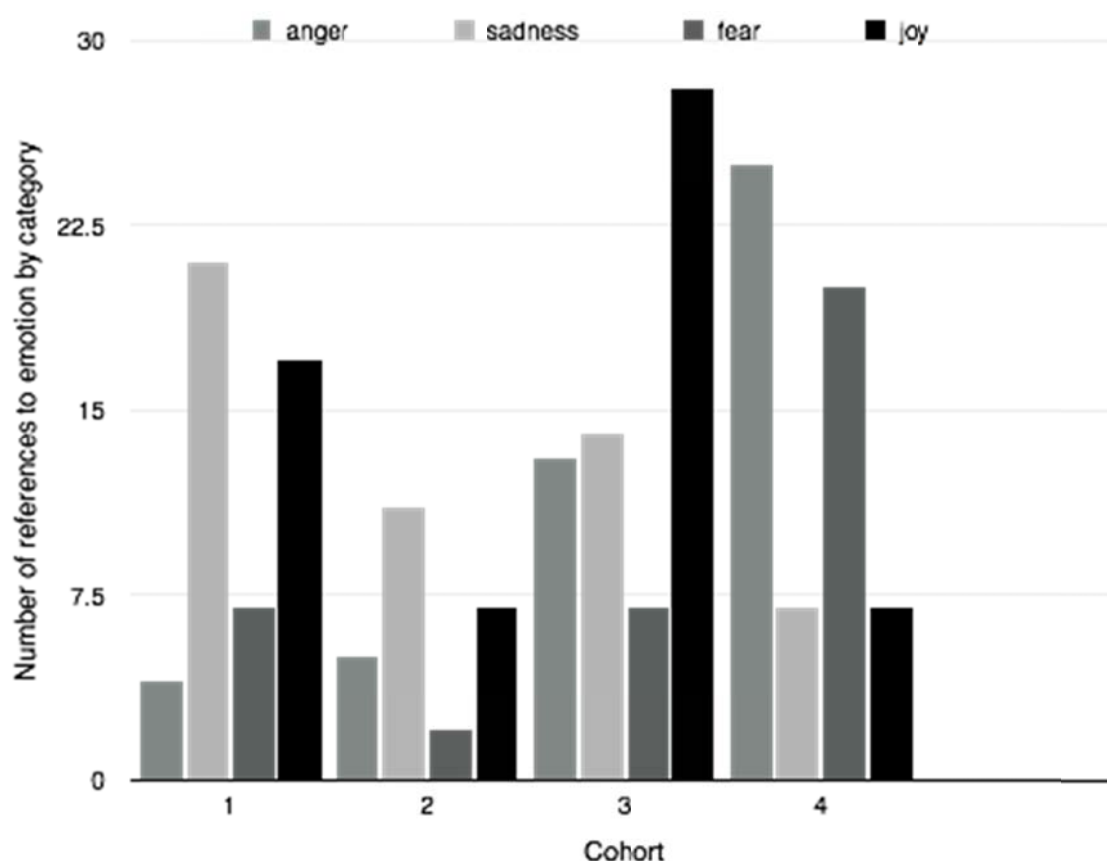
Figure 4-1 Student reports of emotion and group work experience when undertaking a VRS

These profiles were then used to select two contrasting project groups. The

cohort that described their experience by using the highest proportion of 'joy'

descriptors, Cohort 3 was targeted as one group. Based on the high incidence

of 'fear ' descriptors Cohort 4 was targeted as the second group. It is the

implication for education of the motivational consequence of these emotions

that determined the choice of cohorts. From a psychobiological perspective

joy is associated with a motivation to approach (engage) while fear is associated with a motivation to withdraw (disengage). Significantly, from the research published in 2010 we know that the students in Cohort 3 reported the highest mean rating for appraisal of the questions about the lack of 'visible' information about others (the absence of identity cues was positively appraised) and their experience of interacting with other forum members was positive, whereas Cohort 4 had the highest mean score for negative experience yet was matched to Cohort 3 for attitude to the lack of 'visible' information (Robinson, 2010). Taken together these two factors, namely, the open question account of emotional experience and membership of an appropriate cohort, presented the best opportunity of selecting two project groups that would be representative of contrasting student socio-emotional experience.

By identifying a target student from each cohort, the sample project groups for the thesis were chosen. The target student had to fulfil two criteria: they had agreed to their responses being quoted for research purposes, and they had responded to the survey using their institutional email account. The latter made it possible to identify which project group the student had belonged to. Thus two project groups emerged that reflected the relational space of the group as experienced by at least one member of each (since the aim for Studies 2 and 3 is to study the relational space of the 'group as a unit' it is not necessary for other members of the group to similarly appraise the experience). The two groups selected were named the Wenlock group

(student experience negative), which had seven members, all female and a male teacher and the Mandeville group (student experience positive), which had 5 members, all female and a female teacher (approximately 81% of the students enrolled on the course were female).

This method of sampling is purposive; the prime aim is not to sample for proportionality but to identify forums that would be appropriate for observing how social presence, teaching presence, style of communicating in a text based forum and the appropriation of the technology might be associated with contrasting retrospective accounts of experience. Although there is no guarantee that the emotional experience of the target student is representative of the group it is a similar method of sampling to that adopted by (Barron, 2003). The research aim of the Barron study, to characterise the social and cognitive factors that contribute productive interactions, is not dissimilar to the aim of this study. From a possible 12 groups Barron chose two groups that were successful and two that were not. Success was measured at a group level and therefore there was no guarantee that the collaborative learning was successfully/unsuccessfully experienced by each individual member. Nevertheless the microanalysis of group interactions undertaken by Barron led to some useful portraits that characterise the differences between successful and unsuccessful groups (Barron, 2003) as reviewed in Exemplar 2, Chapter 2, Section 2.2.2 ; a finding that supports the use of purposive sampling for this thesis.

4.3 Study 2

Content analysis is a popular method for researchers who study social learning online. It involves devising and applying a system for categorising message content, or parts of a message; a measuring instrument for the quantitative analysis of the content of forum messages. In order to maximize validity, the method used for collecting the data and for constructing the content analysis instrument should be strongly aligned with a theoretical framework and with the aims of the learning event under study (Wever, Schellens, Valcke, & Keer, 2006). The content analysis approach for Study 2 meets these two criteria as follows:

- The development of a set of content analysis instruments for the COI framework was strongly influenced by previous research and has been confirmed more recently using large-scale surveys with students drawn from a range of educational settings.

- A stated aim of the thesis is to provide support for teachers. The validity of the COI method for measuring social presence has been investigated by (Rourke et al., 1999) who reported a study where two independent observers coded the transcripts from two forums; the findings were consistent with intuitive impression of the researchers; the method has face validity. Therefore it could be useful to have a social presence profile available to teachers while the group work is taking place.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

There is another reason for choosing this instrument: it contains a category 'Group cohesiveness' that was identified as important group process when reviewing the four Exemplars of group work in Chapter 2.

4.4 Measuring presence (social and teaching) using the COI methodology.

Content analysis for social learning online involves the development of a coding system for extracting information about the processes of interaction. The application of a coding system in order to 'observe' learning and teaching in online forums depends on specifying a meaningful classification scheme for the message content and determining a suitable unit of analysis. The COI template is an outcome of this process and is described in the following subsections. In order to address the research question for Study 2 the templates developed for measuring presence, social and teacher, as conceptualized by the COI, will be applied to the forum transcripts of two project groups; the Mandevilles and the Wenlocks.

4.4.1 Unit of analysis

In a recent review of coding for content analysis (Garrison et al., 2010) it was concluded that the most appropriate unit of analysis is one that is meaningful. This is the approach adopted for Study 2; a thematic unit of analysis (the occurrence of a piece of content that fits the classification scheme) will be used irrespective of whether it is an entire contribution (posting) to the forum, or part of one.

There are other reasons for deciding that a section of content that links to a coding indicator is the most appropriate unit of analysis. The conversations in text-based forums do not always take place sequentially. Sometimes participants respond to a number of forum postings within one message. This means that the analysis of a single posting can involve more than one conversational thread and by consequence, more than one coding indicator and/or multiple instances of a single indicator. Furthermore, there is no information as to how students have ordered the postings (i.e. used the view menu shown in Table 3.1). Therefore, when using the COI templates for a content analysis of the text corpus for each of two project groups in Study 2, a thematic unit of text was the unit of analysis for indicating a particular social or teaching activity. The number of such indicators is what each template calls a 'score'[10].

4.4.2 Social Presence

In order to measure social presence each thematic unit is classified into one of the following three categories (type of communication) based on a system devised by (Rourke et al., 1999):

Affective: message content that provides a sense of belonging and communicates affect in the absence of non-verbal communication cues.

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[10] The same criteria apply to the analysis of teaching presence.

Open communication: message content that supports the purposeful intent of an online group and represents the way in which the conferencing technology is used and the way in which the learning conversations are conducted.

Cohesive: message content that exhibits collaborative intent.

Five indicators are specified for the A*ffective* category, eight for *Open Communication*, and five for *Cohesive*.

The total number of messages posted by the five Mandeville students was 180 with 1451 occurrences of the COI social presence indicators (excluding 'threading' and 'salutation'), whilst the total number of messages posted by the seven Wenlock students was196, with 670 occurrences of the COI social presence indicators (excluding 'threading' and 'salutation'). To compare the groups the score for each indicator is presented as a percentage of the group total for all indicators as shown in Table 4.2.

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Table 4-1 Indicator level analysis of social presence using the COI template (Rourke et al., 1999)

Category	Indicator	Mandevilles %	Wenlocks %
Affective	Expressing emotions	6	1
	Use of humour	0	0
	Self disclosure	4	3
	Use of unconventional expressions to express emotion	0	0.5
	Expressing value	0	0
Open Communication	Continuing a thread	4	14
	Quoting from others' messages	3	1
	Referring explicitly to others' messages	8	9
	Asking questions	4	11
	Complimenting, expressing appreciation	4	2
	Expressing agreement	4	3
	Expressing disagreement	1	0.5
	Personal advice	0	0
Group Cohesion	Vocatives	20	10
	Addresses or refers to the group using inclusive pronouns	42	45
	Social sharing	0	0
	Course reflection	0	0

A social presence profile for both groups was constructed by calculating the proportion of COI indicator scores that are attributed to each category (affective, open communication, group cohesion) and these profiles are shown in Figure 4.2. Salutation and threading can only be counted once per post and are therefore not included in the construction of the profile.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
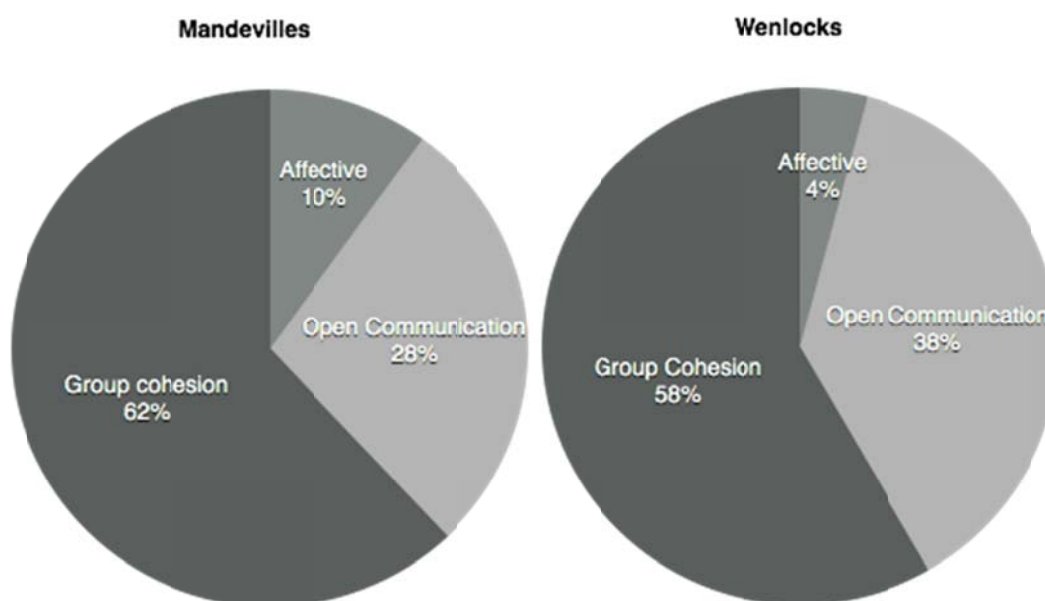
Figure 4-2 Social Presence Profiles

Both project groups communicated an understanding of the collaborative nature of the learning task by using a high proportion of group cohesion indicators. A more detailed inspection shows that it is the item 'use of inclusive pronouns' that contributes the most to this category. The proportion of affective content was higher for the Mandevilles and the proportion of open communication was higher between the Wenlocks. Any further interpretation would require a wider sample of project group profiles and a robust representation of how the social presence profile changes during group work.

Two items, 'continuing a thread' from the Open Communication category and 'salutation' from the Group cohesion category were assessed for every posting in the forum of each group. The results for continuing a thread are reported in Table 4.2. The Wenlocks made more efficient use of the threading

facility provide by the conferencing software achieving a depth of 6 or 7 on several occasions whereas the Mandevilles rarely achieved a depth of 3.

Table 4-2 Threading

	No. of Student postings	Continuing a thread 'threading'
Mandevilles	180	60 33%
Wenlocks	196	106 54%

4.1.1.1.1.1

There is a striking contrast between the two groups in salutation practice, proportionately more in the Mandeville group, and also in the way that a posting ended, 'close'. Furthermore, 'salutation' and 'close' by the Mandeville group was of a different quality. For example, it was not uncommon for members of the Mandeville group to share emotion during the opening stages and/or closing stages of a message. In contrast the Wenlock group members mostly started and ended messages in a very task focused way. Members of the Mandeville group often added an additional symbol at the end of the message, using 'x' either singly or in multiples, up to 15; 53% of all the messages posted by Mandeville students ended with this symbol. It was also common for the students in the Mandeville forum to include a preclose

sentence, i.e. a remark that was not directly relevant to the task in hand.

Therefore, a more detailed quantitative analysis was carried out on the

salutation behavior, the results being shown in Table 4.3.

Table 4-3 Salutation and close

	No. of Student postings	Salutation	Close	Sign off	Pre close remark
Mandevilles	180	167 93%	110 61%	180 100%	98 54%
Wenlocks	196	104 53%	35 18%	84 43%	1 0%

 'Threading' and "salutation/close" are the two items of the COI that

differentiate the two project groups. It could be argued that the appropriate

use of threading is an indication of a 'task focused' group while a relative lack

of 'salutation and close' is an indicator of a less developed relational space.

4.4.3 Teaching presence

When students are required to undertake a collaborative task, or encouraged

to learn by discussion, the role of the teacher is both complex and demanding;

it involves being a subject matter expert who scaffolds the learning,

administering the schedule and instruction as appropriate, and as a

facilitator and co-creator of the social environment conducive to active and successful learning (Anderson et al., 2001, p2).

This view led to the identification of three morphological elements of teaching presence for the COI: design, facilitation, and directive (Anderson et al., 2001), and was consistent with contemporary research at that time (Berge, 1995; Laurillard, 1993; Paulsen, 1995). Therefore, in the original formulation of teaching presence (Anderson et al., 2001) these three elements were adopted as the categories into which the teacher discourse was classified. Indicators were specified for each category (design, 4 indicators), (facilitation, 6 indicators), (directive, 7 indicators) as shown in Table 4.4.

This template was then was applied to the text corpus of each project group. The total number of messages posted by the Mandeville's teacher was 96, with 142 occurrences of a teaching presence indicator whilst the number of messages posted by the Wenlock teacher was 33, with 95 occurrences of a teaching presence indicator. The proportion that contributed to each indicator, for each teacher, is shown in Table 4.4. The ratio of teaching presence indicators to number of teacher messages was 1.5 (Mandeville) and 2.8 (Wenlock).

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Table 4-4 Indicator level analysis of teaching presence using the COI template (Anderson et al., 2001)

Category	Indicator	Mandeville %	Wenlock %
Organisation	Setting curriculum	13.4	13.6
	Designing methods	0.7	2.1
	Establishing time parameters	7.7	8.4
	Utilizing medium effectively	2.1	2.1
	Establishing netiquette	0	0
Facilitation	Identifying areas of agreement & disagreement	0.7	1.1
	Seek consensus/understanding	3.5	2.1
	Encouraging, acknowledging or reinforcing student contributions	26.1	20
	Setting climate for learning	4.2	1.1
	Drawing in participants, prompting discussion	1.4	0
	Assess the efficacy of the process	1.4	0
Instruction	Present content/questions	2.1	9.4
	Focus the discussion on specific issues	11.3	5.3
	Summarize the discussion	0.7	1.1
	Confirm understanding through assessment and explanatory feedback	16.9	14.7
	Diagnose misconceptions	3.5	14.7
	Inject knowledge from diverse sources	1.4	4.2
	Respond to technical concerns	2.8	0

Proportionally, the forum postings of the Mandeville teacher contained more content that could be classified as facilitation than the Wenlock teacher whereas the postings of the Wenlock teacher contained more content that was classified as direct instruction. Both teachers spent approximately the same proportion of time on reminding the group members about organisational issues. A teaching presence profile, represented at category level for each project group, is shown in Figure 4.4.

For the category, facilitating discourse, both teachers scored highly on the indicator 'encouraging, acknowledging or reinforcing student contributions'. For both teachers the largest proportion of postings in the directive category was about confirming understanding through explanatory feedback. The Wenlock teacher posed more questions and was explicit about highlighting student misconceptions whilst the Mandeville teacher spent proportionately more time on keeping the discussion focused.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

Mandevilles

Wenlocks
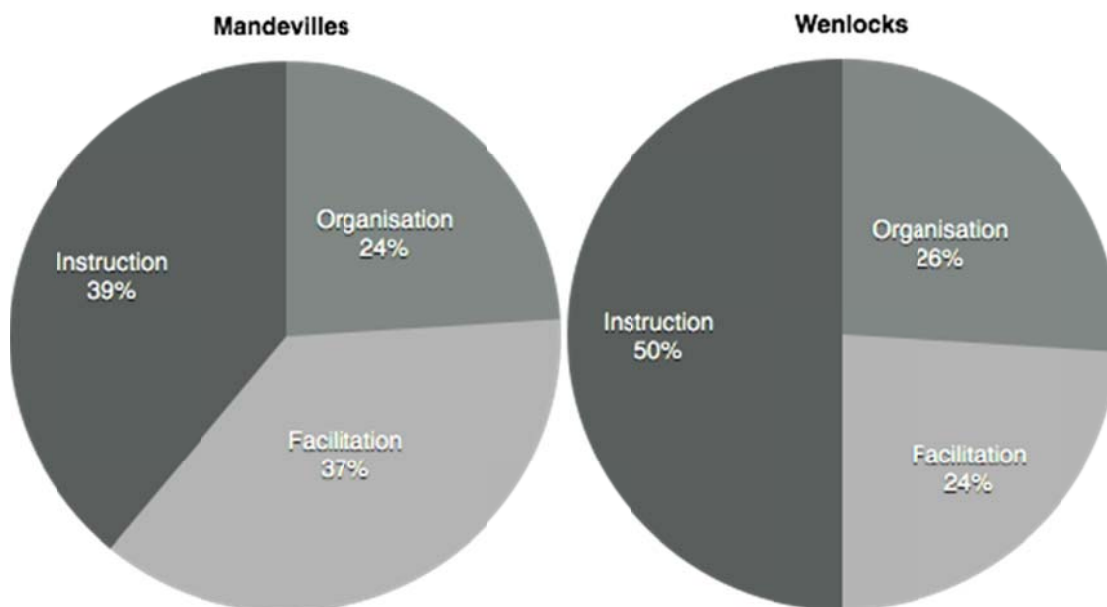
Figure 4-3 Teaching Presence Profiles

The COI conceptualises the role of the teacher online as consisting of three main activities, organization, instruction, and facilitation; an idea that is supported by these two profiles. The proportion of instruction/facilitation activity is different for each tutor.

4.5 Profiling the contribution of individual students

Figure 4.4 provides a profile, constructed from the First Class 'View 'option, as an analysis of the total number of postings by each individual student over the entire course.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
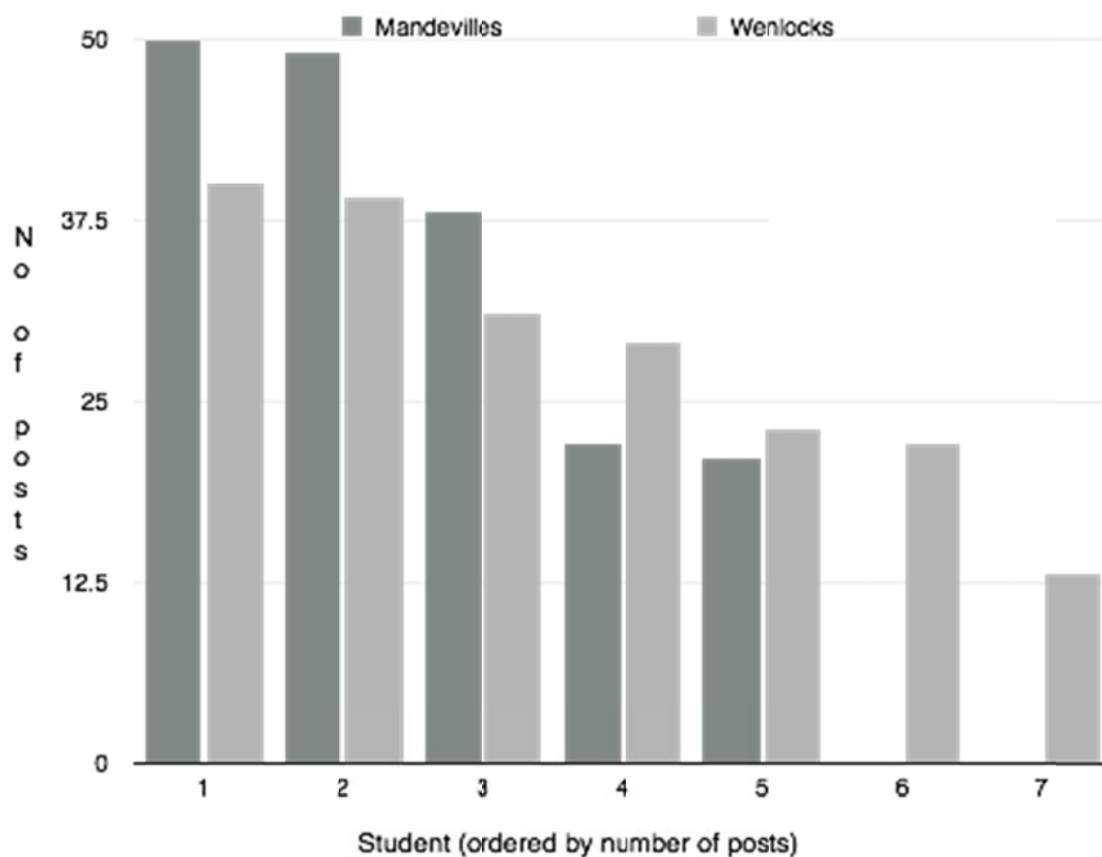
Figure 4-4 Contribution profiles for individual students

However, it is the patterning of the individual contribution that is likely to be of more value to the teacher who needs to manage the critical phases of both group development and project development. To elucidate the value of this information for teachers the patterning of contribution is provided in Figure 4.5 for days 3-23 of the module. During this period the groups need to develop a project proposal in a limited time frame. Distance students and teachers will vary as to when it most convenient for them to engage with the course; from my own practitioner experience this can become implicit knowledge and arguably this is information that conveys a sense of presence. Therefore, in

Figure 4.5 each day is split into three 6 hourly periods (6am-12noon, 12noon – 6pm, 6pm-midnight). The teacher contributions are also included. The colour code used for both teachers is blue. This map provides the teacher with a means of checking whether the contribution pattern of an individual has changed and also an indication of when the change occurred. For example, in the context of this particular course the teacher would find it useful to check whether the pattern of contribution from a particular student changed between the period when the draft submission was prepared and the final proposal. A significant change should prompt the teacher to review the student's contributions in the context of the outcome of the draft proposal.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
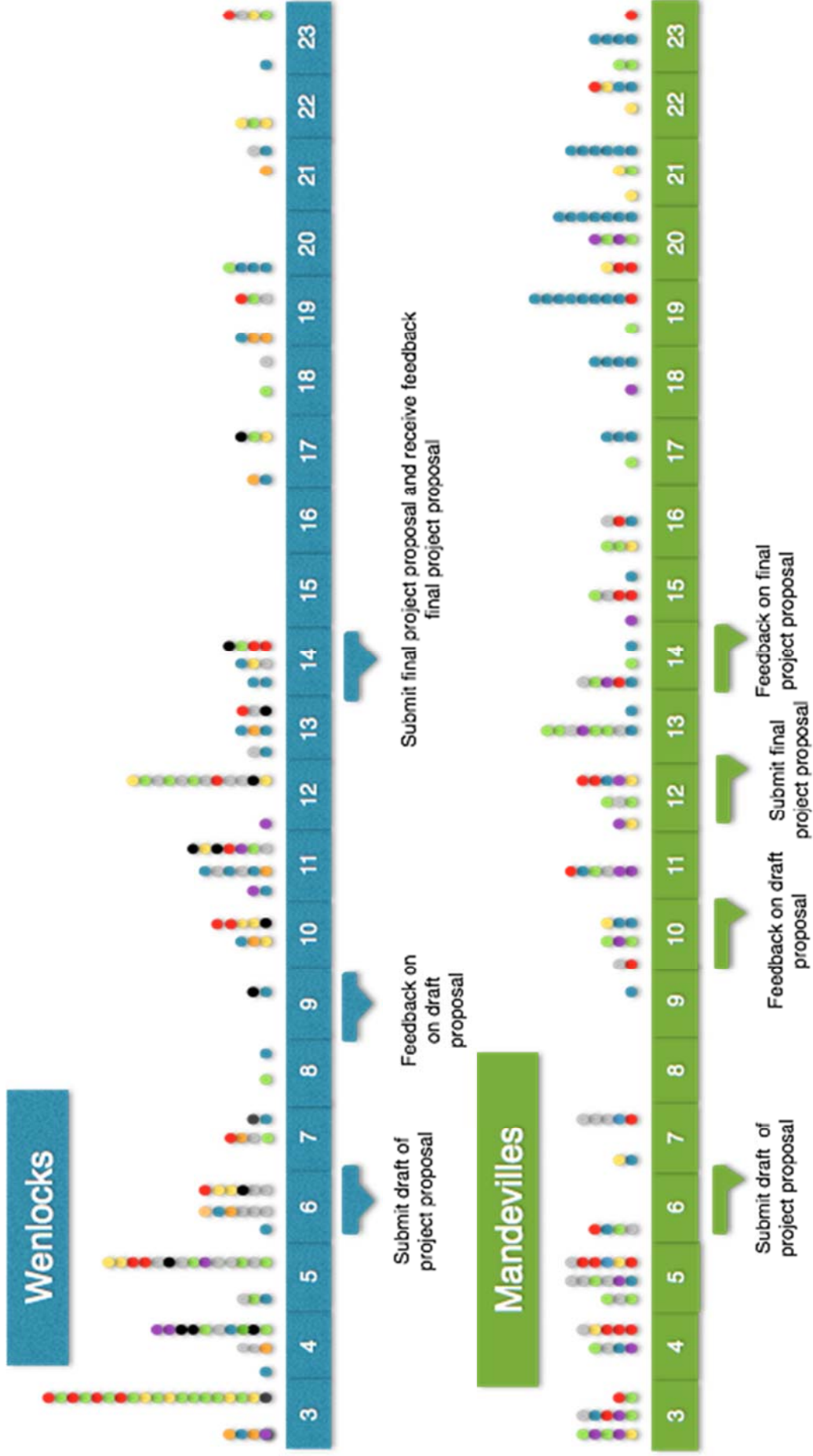
Figure 4-5 Mapping the contributions to the group

4.6 Study 2. Comment on the Methodology

A considerable amount of useful research about social learning online has cohered around using the measuring instruments developed for the COI and to ignore that methodology would be ill advised. However, several issues about the COI methodology have been identified while conducting Study 2.

Social presence density, the ratio of social presence indicators to word count, was proposed as the defining measure of social presence (Rourke et al., 1999) for example, that social presence density could be used as an independent variable (IV) for studies of student satisfaction. However the calculation of social presence density does not take into account how the CMC software is used for example, 'Reply with quote' functionality and the option to attach documents. While undertaking the analysis for Study 2 it was noted that both these functions were used extensively, as is likely to be the case for 'learning through collaboration' so that a precise measure of word count is difficult to achieve. Furthermore, it is unlikely to be meaningful given the different ways in which this functionality has been used.

Assessing whether social presence is a valid representation of the relational space of the group is also challenging.   Although a pie chart could be a useful way of visualising relational space for tutors, there are

questions about whether social presence as measured by the COI template is a meaningful representation for the following reasons. Firstly, the aim for Study 2 is to investigate the 'group as a unit'. However, the social presence instrument conflates levels of analysis; one of the categories, Affective, is focused on the individual, whilst the other two categories, Open Communication and Group Cohesiveness, have their focus at the level of the group. Secondly, two of the items can only occur once per posting while there can be multiple occurrences within a single posting for all other items. Thirdly, by assessing the findings of Study 2 from the perspective of the three fields of study, Learning, Emotion, and Communication, introduced and reviewed in Chapter 1, some additional concerns arise concerning the classification structure of the template, and how the indicators relate to each category. Arguably 'complimenting, expressing appreciation' is an indicator of Affect while 'asking questions' is an indicator of Learning behaviour yet these two indicators reside within the same category, Open Communication. Based on a Communications perspective the way that vocatives and salutations are used can enhance Group Cohesiveness while the use of inclusive pronouns, which is also an indicator for the Group Cohesiveness category, supports a sense of within group identity. While cohesiveness and within group identity are likely to be interrelated it is not clear to what extent; there may be value in investigating them as independent constructs. Finally two indicators 'continuing a thread' and 'referring explicitly to others' depend on the way

that students appropriate the technology and yet these indicators are also representative of the Open Communication category. Overall, it would seem that the COI methodology is not sufficient for investigating the relational space of the 'group as a unit' at the level of granularity proposed for this thesis.

4.6.1 Reliability

The indicators of three items from the social presence template, use of emoticons, vocatives, inclusive pronouns, was checked by using the 'Find' function in Word. The analysis of the other items was repeated three times over a two-year period. Most discrepancies were detected at the second reading and were of a clerical nature. Inter-session reliability measures (session 2 and 3) was 0.98 overall and demonstrated a similar pattern to the inter-rater reliability as reported by (Rourke et al., 1999) i.e. when indicators such as *addressing participants by name* had coefficients of 1.0 whereas the inter session reliability for other indicators for example, *expressing appreciation* was lower.

A similar approach was applied to the analysis of teaching presence. However, reproducibility across the different intervals was not so high as for social presence. The results reported in Table 4.4 and illustrated in Figure 4.3, are based on a fourth session, when the inter-session reliability between the third and fourth session was 0.78. Given these relatively low values ideally the reproducibility of the teaching presence analysis for this

thesis should be confirmed by obtaining a measure of inter-rater reliability. However, that would require a rater with an appropriate academic background and knowledge of the course and would involve a colleague of the teachers involved. Although their identity could be anonymised I do not have their permission for this process. However, it is relevant that as part of the development of the teaching presence template for the COI similarly low values (inter- rater reliability of k=77 and k=0.84 using Cohen's kappa) were obtained for each of two online courses (Anderson et al., 2001).

4.7 Study 2. Comment on the findings

The findings are evaluated from three perspectives in the context of the research question:

> *To what extent are the presence constructs (social and teaching) of value for the thesis?*

The first is whether the analysis validates the choice of project groups to study, i.e. the extent to which a presence profile (social and teaching) is consistent with the experience of the target students. The second relates to the role of the teacher and comprises two elements: the usefulness of presence (social and teaching) profiles and a description of teacher influence on group practice. These two elements are relevant for the second aim of the thesis,

> *to improve our support for teachers in understanding the role of*
>
> *the emotional climate when students are engaged in online*
>
> *collaborative learning.*

Finally the limitations of the COI as a methodology for investigating *immediacy* practice are discussed.

4.7.1 The Mandeville and the Wenlock project groups: a comparison of social and teaching presence

The designation of the Mandevilles as the more positively valenced and the Wenlocks as the more negatively valenced group cannot be validated using the COI measurement of social presence as a proxy for relational space. However two findings may be relevant:

1. The Mandevilles used and elaborated 'salutation' and 'close' consistently while the Wenlocks did not.
2. The Mandeville tutor engaged in more facilitatory activity.

4.7.2 Profiling the 'group as a unit': its value for the role of the teacher

Although some limitations of the COI method for measuring social presence have been identified (Section 4.6) nevertheless, a dynamic visualisation of the social presence profile of a group, and the teaching presence profile, on the teacher dashboard could provide useful information for checking the group, and teacher interaction with the group.

However, the development of such a tool would depend on automated processes that are capable of assessing the content at an equivalent level to a human coder, a requirement that would be particularly challenging for teaching presence as discussed in Section 4.6.1. Although the analysis of some indicators of social presence could be automated relatively easily there are others that depend on very specific knowledge of the course. Furthermore, the indicators for teaching presence are not specific to an online context. Most of the indicators for teaching presence apply equally to face-to-face context with the exception of: utilizing the medium effectively, establishing netiquette and responding to technical concerns. A more practicable and attainable use for the information on social and teaching presence collected in Study 2 is as a resource for teacher professional development. The profiles could be used as an illustration of the interactions that take place between student and teacher during collaborative learning, and could seed useful discussion amongst teachers about what these elements of their role might involve when teaching online.

By contrast, information about the pattern of contribution from individual members is easily attainable (collected by the learning platform) and would be useful for the following reasons. A basic form of participation is 'attendance' and involves an individual engaging with the learning task (reading the forum postings) but not necessarily contributing to the work or the relational space of the group. A contribution is a form of participation

that involves an interaction and will be either a contribution to the group task or an interaction with other members of the group. A contribution involves posting a message to the forum. Both students and the teacher can use the CMC software to construct a profile of the student's pattern of contribution, as illustrated in Figure 4.4. A perceived lack of commitment is a source of frustration during group work (Burdett, 2003; Capdeferro & Romero, 2012; Robinson, 2013). While some students with low contribution levels are seen as 'free riders' (Kollock and Smith, 1996) many are not; interpretations about involvement and commitment based solely on the number and pattern of contribution can be very misleading. In a face-to-face context teachers and peers can make use of non-verbal cues in order to infer the reason for a student's lack of action. These non-verbal cues are not available online. However, there is an alternative source of useful data for the online teacher. For example, in a study that used the log files of a CMC forum to research the practices of three students, student 1 opened the messages sequentially and revisited them repeatedly, student 2 opened only those posts at the top level of a thread and reviewed his own posts several times while student 3 only opened the teacher's messages (Wise et al., 2011). This small data set provides a snapshot of the variation in student practice. It is important information for teachers who need to be aware when, and how, students deviate from the pedagogical ideal. For example, for group work online it is important that students read all the contributions and use the threading facility

appropriately. Access to a meaningful visualisation of student practice at this level based on data collected using learning analytics technology (Clow, 2013; Elias, 2011) would be arguably more useful to teachers than a social presence profile. The argument is based on the view that the tutor should be monitoring the individual student alongside the 'group as a unit' and assumes that student practice depends on their current socio-emotional experience to some extent.

Monitoring the developmental nature of the group was an issue that was identified as an important element of the teacher role in as illustrated by Exemplar 9, Chapter 2 Section 2.4.1 while Exemplar 10, Section 2.4.2 provides a theoretical description for the developmental nature of group work. Each member of a group will have a unique pattern of engagement for example, the time of day when they are present online, and how often they make a contribution. Therefore a display similar to that constructed for Figure 4.5 should alert the teacher to anything untoward as regards the involvement of the individual student during each developmental stage of the group.

4.7.3 Interaction between the teacher and the group as a unit

One of the indicators of teaching presence in the COI template relevant for the thesis is 'setting a climate for learning'. Both teachers did model practice that is particularly appropriate for an online context however, there is little evidence that the group members modeled their teacher. The Wenlock teacher always included a salutation in his messages while the

Mandeville teacher sometimes omitted to do so, yet salutation was much less common in the Wenlock group and was embellished in the Mandeville group. The Wenlock teacher modeled one form of good task-related practice, 'selective quote', using this function to draw attention to the aspects of the work in progress that required attention. This practice was not taken up by the students most of whom used 'reply with quote' regularly but were not selective about which content they quoted; quoting an entire thread repeatedly was common.

The patterning of the contributions made by each teacher was also studied. The participation rate (as indicated by the number of days on which a message was posted) was lower for the Wenlock teacher (20 from 40 days) compared to the Mandeville teacher (37 from 40 days). This may represent a difference in approach, for example, the Wenlock teacher allowing the group members more time to develop consensus and collaborate. One of the institutional checks was to use the 'History' function of the CMC software with a sample of the teacher's workload to check whether a teacher had accessed the forum messages in a timely manner; both teachers received a satisfactory report so that we know that he was paying an equal amount of attention to his task as the Mandeville teacher.

The previous three sub-sections have considered the interaction between group members and the teacher and the group. It has highlighted that social presence, as a visualisation of student practices, does not have

sufficient granularity therefore, other methodology for investing the online 'group as a unit' is required. A review of research drawn from the field of Communication in Chapter 1, Section 1.7.3 and Chapter 2, Section 2.3, gave prominence to participant practices when using CMC for interpersonal interaction, that participants adapt their style of writing to convey immediacy (i.e. verbal immediacy). In the following sub-section the findings from Study 2 are considered from this perspective.

4.7.4 Interpersonal communication by writing

There are four indicators: use of humour (Affective), complimenting and expressing appreciation (Open communication), using inclusive pronouns (Group cohesion) that could be described as adaptations that students make when they need to collaborate with others on a joint task. However, it is likely that these practices would also be invoked during group work face-to-face. The only indicator with the potential to pick up an adaptation as a consequence of writing rather than speaking is the 'use of unconventional expressions to express emotion' for example, emoticons. The rate of occurrence for emoticons was extremely low in the body of the text for both project groups. However, the use of 'x', and multiples of 'x' during 'close' could be interpreted as an adaptation; that students substitute this symbol for the non-verbal and paralanguage of face-to-face communication.

Another indicator of verbal immediacy is salutation practice. The course presentation on which the thesis is based took place in 2007 at a time

when email and forums were the dominant modes of online communication and before the informality that is a characteristic of present day interpersonal interaction online had fully emerged for example, Twitter. This means that the salutation elaboration of the Mandeville group, and the contrast with a relative absence of any form of salutation for the Wenlock group can be cautiously interpreted as a relationally significant adaptation.

4.8 Conclusion

The objective for Study 2 was to investigate social presence as a proxy for relational space and to investigate the interrelationship with teaching presence. Study 2 has applied the COI template in the context of a course with a clearly defined group task, a high stakes outcome, and the CMC software functionality available in 2007. By response social presence, as conceptualized by the COI, is not a sufficient representation of relational space in the context of 'learning through collaboration'. However, some issues have been raised about the interaction between teacher, 'the group as a unit', and the individual student, that are relevant for the second aim of this thesis 'to improve our support for teachers in understanding the role of the emotional climate'. For example, the visualisation of social and teaching presence, as measured by the COI template (Figures 4.2 and 4.3), could function as a useful trigger for discussion during professional development. Also, the potential of two forms of learning analytics, pattern of individual student contribution (Figure 4.4) and pattern of individual

engagement with the forum posts (Figure 4.5) could function as useful representations at the level of the individual student.

Social presence, as originally conceptualised for technologically mediated interpersonal interactions incorporates two components, *intimacy* and *immediacy* (Short et al., 1976). *Verbal Immediacy* depends on the actions of those involved in an interaction, how they express involvement and emotional attitude. The methodological question to arise from Study 2 is how to optimise the investigation of *immediacy* for 'learning through collaboration'. Adaptations such as the use of ''x' after sign off and other elaborations during salutation and close have emerged. This is just one example of how going beyond the categories defined by the COI template could provide a better indication of student practices that communicate immediacy i.e*. verbal immediacy* when using CMC.

Two student practices, adaptation of style of writing, and appropriation of the functionality of the CMC software, will be investigated in more detail in Study 3. Study 3 will take into account what is required when 'learning through collaboration'; the necessary task and relational processes as identified during the literature review (Section 2.5).

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Chapter 5 Study 3 'The group as a unit': a qualitative approach.

5.1 Introduction

For Study 2, a content analysis approach was used to analyse the interpersonal interactions between students in two project groups. However, meaning depends on context and for group work context is constructed during the sequence of interpersonal interactions. Therefore, Study 3 will adopt an interpretive approach to the flow of interaction during group work for each of the two project groups, the Mandevilles and the Wenlocks. The aim for Study 3 is to determine what linguistic and technological practices are employed during group work using CMC, and their purpose; an investigation of how students construct a context for 'learning through collaboration' at distance using CMC.

The study is data-driven and the approach is interpretive, grounded by a procedure informed by the research literature of Chapters 1 and 2. To inform the method for Study 3 there was value in comparing the two approaches, content analysis (Study 2) and the interpretive approach proposed for this study (Study 3) at the outset, as addressed in Section 5.1.1. In Section 5.1.2 the issues that arose from the review of interpersonal interaction during group work and other social contexts (Chapter 2) will be reexamined to confirm the key elements that pertain to

task and relation space. Each individual in the group uniquely experiences relational space, and therefore ideas from Cognitive Neuroscience concerning social cognition processes, described in Chapter 1 Sections 1.3.1, 1.3.2, and Chapter 2 Section 2.6.1 are also summarised. The summary review in Section 5.2 identifies some elements for grounding an interpretive study of group work. However, these pertain irrespective of whether group work is undertaken face-to-face or online. Therefore, to develop a framework that is specific for group work at distance using CMC the features that are unique are revisited in Section 5.3. The procedure and analysis are described in Section 5.4 and 5.5 respectively, and the findings are evaluated in section 5.7 following an evaluation of the method in Section 5.6. In Section 5.8 the research question posed for Study 3 is revisited and some implications of the findings for the second aim of the thesis are identified.

5.1.1 Limitations of a content analysis approach

Studies 2 and 3 both use the forum transcripts of the Mandevilles and the Wenlocks as the data source and there is value in comparing the two approaches, content analysis (Study 2) and the interpretive approach proposed for this study (Study 3) before reacquainting with the processes of interaction that were identified as relevant for group work during the literature review. The content analysis tool in Study 2 uses a method developed for the Community of Inquiry framework (COI). The COI methodology is based on the expectation that students who use

asynchronous CMC to interact with other students will develop ways to communicate social presence (Rourke et al., 1999). Some limitations of the COI approach to the investigation of social presence were identified. Firstly, the COI does not make an explicit distinction between 'learning through collaboration' and 'learning through discussion'; negotiation as a key process for successful collaborative learning is largely ignored. Secondly, the COI content analysis tool drew predominantly on research studies conducted at a time when CMC research and practice were both at an early stage of development. By contrast, this thesis reviewed more recent examples of computer supported collaborative learning and investigated two additional fields of study: Emotion, Communication. Two practices that students might engage in emerged; achieving a style of writing that is more speech-like (adaptation), and utilising the functions of the computer mediated conferencing software (appropriation). Although some information about how students appropriate the functionality of the CMC software was obtained from Study 2 it was not possible to comprehensively survey these practices (appropriation, adaptation) by using the methodology developed for the COI. Thirdly, the dynamic nature of group work was not considered; that groups go through at least four developmental stages: forming, storming, norming and performing (Tuckman, 1965; Tuckman & Jensen, 1977). Fourthly, the COI does not address the requirement to investigate the socio-emotional experience of the individual as distinct from the investigation of the relational space of the

group. Finally, social presence is an abstract concept so the use of a pre-determined checklist of indicators may restrict its study.

5.1.2 Flow of interaction during group work: contribution from the research literature

Interactive moves that are essential for collaborative learning were identified from a review of four contemporary and contrasting studies of computer supported collaborative learning (CSCL), Exemplars 1-4, Chapter 2, Section 2.2. A useful morphology for describing the task-based purpose of an interaction emerged: joint attention, coherence and negotiation. Based on Exemplars 5-12, drawn from the fields of Communication (Chapter 2, Section 2.3) and Emotion (Chapter 2, Section 2.4), characteristics of interaction such as an informal style of writing and unconventional use of punctuation symbols were identified as important for supporting the 'group as a unit' through the development of norms, dialect and cohesiveness, processes that can scaffold the relational space of the group.

 In Chapter 2, Section 2.6 the value of adopting ideas from Cognitive Neuroscience for investigating social learning was discussed. There is psychological and neuroscience knowledge to support the claim that explicit social cognition (being able to make inferences about the thoughts and feelings of others) and reflective self-awareness (being able to interact with others on the basis of those cognitions) is a uniquely human

ability. During collaborative learning making inferences about the feelings and thoughts of others in the group is vital for a satisfactory outcome from periods of negotiation. Expressing empathy is one process that may be particularly valuable. By focusing on empathy, relational space is conceptualised as more than social presence, more than presenting information about self and acknowledging the group. It is the space where socio-cognition takes place. Socio-cognitive processes provide an explanation of how members of the group formulate a mental model (cognitive and affective) of the minds of other members of the group (Frith, 2007), and how subsequent interaction with others in the group, and their ideas, will be influenced by this inferred knowledge. When using CMC for interpersonal interaction the outcome from these metacognitive processes will need to be communicated through writing.

5.2 Study 3

 For face-to-face group work the elements (joint attention, coherence, negotiation, norms, dialect, cohesion and empathy) that are necessary for a successful outcome can be achieved through a combination of non-verbal actions (gesture, facial expression, bodily position and eye gaze) and paralanguage (the modulations of voice that nuance meaning). By comparison, when using CMC, these two features are unavailable, because students and the teacher are not co-present in time or physical space and all interpersonal interaction is through writing. It is these two features that determine the research question for Study 3.

What are the student practices, linguistic (adaptation) and technological (appropriation) that emerge when interactants are not co-present, when the sensory information about others is not available and all interpersonal interaction is through writing?

Although this question will be considered from the perspective of the socio-emotional experience of the individuals involved, and the relational space of the group, the analysis will be situated in the flow of interaction which means that the interrelationship between task space and relational space is also taken into consideration.

Study 3 will take an interpretative approach to the flow of interaction during group work. Therefore, a framework is required that will guide the interpretation of the transcript.

5.3 A framework for an interpretive approach to the flow of interaction

Two aspects of student practice will be considered:

1. Students adapt writing to be more speech-like.
2. Students appropriate the functionality of the CMC software for communicative purposes.

Adaptation and appropriation practices will be considered in the context of the interpersonal interactions that are required for group work.

To determine which elements of discourse to target the implications of the two features that are unique to interpersonal communication online, students are not co-present in time and space and all interpersonal communication is in a written form will be reexamined. The functionality provided by First Class, the CMC software that was used, will also be specified so that the ways in which students appropriate this technology can be systematically studied.

5.3.1 Students are not co-present in time or physical space

When students are not co-present in physical space, or time, and have not previously met, some degree of imagination is required to get a sense of other members of the group and the teacher. From a psycholinguistic perspective 'metaphor is closely allied to human imagination' (Gibbs & Matlock, 2008, p 189) and metaphor can be used as a form of embodied simulation. This view, that metaphor can be used as a form of embodied simulation, is supported by research that has investigated students communicating remotely using text based forums.

> Figurative language was a very important linguistic resource used to express participants' feelings (Manca & Delfino, 2007, p 15).

Inspection of the examples provided in the descriptive section of the Manca and Delfino report show that all instances reported involve metaphor for example,

> Maybe in the beginning we saw this course almost as
> an oasis where we could relax a while
> In a world full of anxiety, a reassuring posting is like
> dew in the desert (Delfino & Manca, 2007, p18)

Therefore, for Study 3, the use of metaphor is one element of the forum corpus that will be investigated. It will involve reading the text corpus for instances when the writer might be using discourse to evoke an image that would implicitly convey a object, action, feeling, or thought.

5.3.2 All interpersonal interaction is through writing.

To reiterate, an aim for Study 3 is to determine what linguistic and technological practices are employed during group work using CMC, and their purpose. In Chapter 1 Section 1.7.3.1 a question posed by Crystal when contemplating the use of language on the Internet is relevant; whether it is possible to 'write speech'. Crystal adopts a linguist's perspective for differentiating speaking from writing and concludes that written communication online (i.e. Netspeak)

> relies on characteristics belonging to both sides of the
> speech/writing divide (Crystal, 2006, p 31).

According to Crystal a style of writing that does not observe grammatical conventions, Netspeak (for example, the use of slang, contracted forms, abbreviation) is more common online and is more typical of speech, while adherence to grammatical rules, punctuation, and presentational conventions (for example, capitalisation, paragraphs) is what defines writing that is formal. Netspeak, as defined by Crystal, will inform the

investigation of the characteristics that define the style of each project group studied for this thesis.

Although a written form of interpersonal communication can be rendered speech-like it lacks one important element, sound. Therefore the paralinguistic forms of expression (prosody, pitch, volume, intonation, rhythm) that could be used for task related issues (for example, to nuance a negotiation, to draw attention), and are integral for interpreting the intensity and valence of an expressed emotion, and a sense of affect, are not available for interpersonal interactions using CMC. Crystal's suggestion that participants use devices such as exaggerated spelling and punctuation, repeating symbols, to make visible the communicative intention of the sender (Crystal, 2006) could be relevant and is developed further.

To better understand the nature of Netspeak, as both communicated and interpreted, researchers drew on speech act theory (Dresner & Herring, 2010). Speech act theory was formulated for theorising interpersonal communication through speaking and paralanguage. Three components were identified as relevant: a syntactically formed component that has literal meaning, an illocutionary component that signals the force of the words being spoken, a component that depends on the receiver's interpretation (Dresner & Herring, 2010). Paralanguage is the most common way to indicate illocutionary force during face-to-face interaction.

It was proposed that, when using CMC for interpersonal interaction at distance, an adaptation is made in the way that illocutionary meaning is communicated. An unconventional use of punctuation is a possible candidate. Exemplar 7, Chapter 2, Section 2.3.3 was included in the literature review as evidence that participants use punctuation symbol in unconventional ways when communicating online and that the communicative intent of this use pattern is perceived (Hancock et al., 2007). Exemplar 7 drew on evidence from participants who used Instant Messaging. There is also evidence for the use of punctuation in unconventional ways from research conducted on courses where students are using CMC (Bollinger, 2009). The research evidence showing that it is possible to comprehend communicative intention when unconventional forms of punctuation are used (Lea & Spears, 1992) is also relevant. Furthermore, there is evidence that a use pattern of punctuation symbol is one of the components that characterize the dialect of a group (Postmes & Spears, 2000) (Exemplar 8 of the literature review, Chapter 2, Section 2.3.4). Therefore the third element of the forum corpus to be investigated is the use of punctuation symbol in unconventional ways.

5.3.3 CMC and the technology available

In 2007 the conferencing software First Class offered a comprehensive range of function for editing, navigation, styling and collaboration, as summarised in Table 3.1, Chapter 3. This section describes those outcomes from using the First Class software that are visible to the

researcher. They comprise of three elements, 'styling and presentation', 'threading', and 'synchronous communication using a Live Chat facility'.

5.3.3.1 Styling and presentation

Students and teachers who interact by CMC can use the styling elements as a resource. The First Class software available at the time provided a comprehensive set of functions [11] that was compatible with that of commercial software available at the time. Students had the option of composing a posting online using First Class or preparing it offline using their own software before pasting it into the First Class message and posting to the forum.

5.3.3.2 'Threading'

On entering the forum an index of every posting is displayed and each entry contains the following elements

---

[11] Editing: Undo, Redo, Revert, Cut, Copy, Paste, Clear, Select All, Paste, Find, Find Next, Insert (signature, file, voice, page break, horizontal line, link, Marker, background Image)

Styling: Font, Size, Style, Colour, Align, Increase indent, Decrease indent,

Layout: paragraphs, bullets, margins, background, table, cells

1. An icon, the default is a stamped letter. A range of icons was available for students to use including some national flags.
2. The title: ideally it should contain information about the subject matter of the posting and the position of the posting in the conversational thread.
3. Sender name
4. The byte size of the message
5. A date and time stamp

To access a forum posting the student will click on an item from the index to 'open out' for reading. The format of a posting is very similar to that of an email. For example,

From:	David Wenlock 13 November 2007 09:41:33
Subject:	Project - Tutor Input
Hi	

Body of the message

I look forward to what you come up with.

David

Tutor

By selecting a reply option ('With quote', 'All', 'Sender') students can use the First Class conferencing software to organise their contributions to a topic into a 'thread'. 'Threading' means that the participants in a forum can engage in a discussion in a coherent way and have more than one discussion topic underway at any one time. When a discussion is taking place asynchronously, 'threading' can make a considerable contribution to coherence. As each member revisits the forum she/he can use the subject heading to pick up on any unread postings and by using the "Next in thread ' menu option access all those postings with the same subject heading. Choosing a subject line (title) thread that is clear, relevant, and concrete, benefits coherence. The coherence of a discussion topic also relies on the student opting for an appropriate 'reply' option. The COI template used for Study 2 contains two items about the use of 'threading' (continuing a thread, quoting from others' messages) and some observations were made about the use and misuse of 'threading' in Sections 4.4.2 and 4.7.2; findings that will be taken into account when gathering evidence for Study 3.

5.3.3.3 Synchronous communication using a Live Chat facility (Instant messaging).

Although flexibility for students as to when and where they study is paramount for the design of the course each group of students was also provided with a Live Chat facility embedded within the project group forum.

There is no institutional requirement for teachers to attend Live Chat and for practical reasons the majority do not (a teacher can be supervising up to twelve project groups and is employed on a fractional contract). However, it is possible for participants in Live Chat to record a transcript of their conversation and make it available in the project group forum for anyone who is unable to attend the Live Chat session, including the teacher. Despite the fact that students are provided with detailed instructions, and staff were available online to help, many of the groups that meet in Live Chat did not use, or failed to master, the option to produce a transcript of the session. The implications of the time frame (synchronous, asynchronous) for group work involving distance students were identified and discussed in Chapter 2, Section 2.2.6.4; while synchronous communication means that it is possible to effect 'repair work' instantly, flexibility is compromised and there is no time for reflection. An evaluation of the Live Chat facility is relevant to the second aim of the thesis; which technologies to use and how to integrate them. Therefore the use pattern of synchronous communication will also be investigated.

A framework for the interpretive analysis of the flow of interaction has emerged as illustrated in Figure 5.1. It involves assigning an intention (joint attention, coherence, negotiation, express or demonstrate empathy) to an interactional move, and/or an outcome (norming, dialect, cohesiveness, social presence); group processes that were identified as key during the literature review. Six elements of the transcript will be investigated. Styling

& presentation, 'threading' and the use of the Live Chat facility, pertain to the way in which the technology is used. The three other elements; use of metaphor, style of writing and using punctuation in an unconventional way are conceptualised as adaptations that students might make due to the lack of sensory information. The incidence of the six elements will be interpreted in context and each interactive move is assessed for intention and/or outcome using an inductive and iterative approach.

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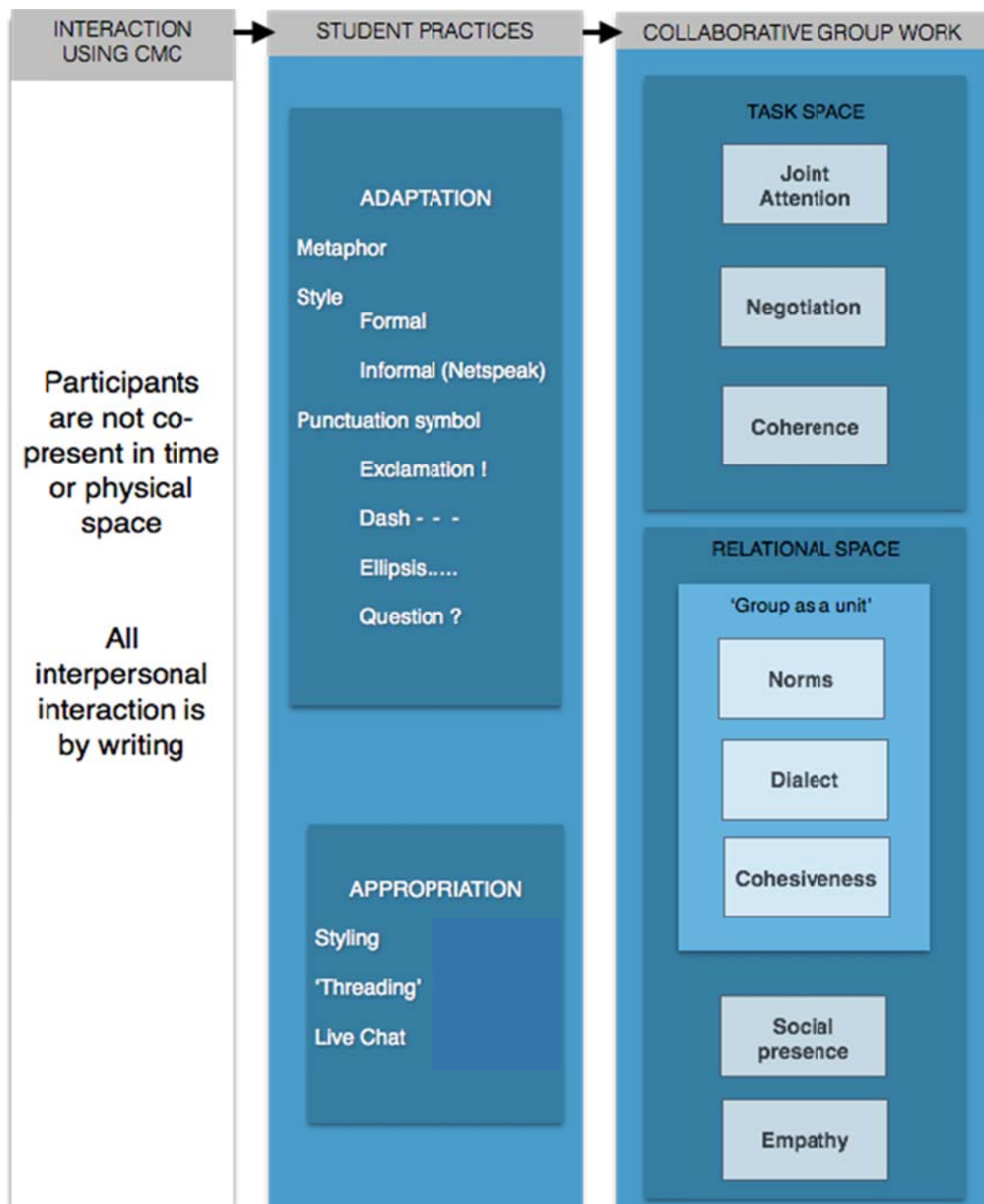
Figure 5-1 A framework for the micro-analysis of the flow of interaction during collaborative group work

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

5.4 A procedure for the micro-analysis of the flow of interaction

A procedure for guiding the analysis of the six student practices, as identified for the framework, was established through a two-stage process.

5.4.1 Stage 1

Two decisions were required at the outset. Firstly, what designates writing as formal or informal and secondly, when to classify punctuation use as unconventional. The text corpus of both groups were read three times so as to get an overall sense of the components that may be relevant. From this initial reading the following components for a formal style (*paragraphs* and *enclosing those parts of text of less emphasis in brackets)* and informal style (*slang, abbreviation, unconventional use of lower case, contractions, spelling that reflects pronunciation)* writing style emerged. Furthermore, the use of the symbols dash and ellipsis in unconventional ways, and the persistent use of exclamation and question mark, became apparent.

5.4.2 Stage 2

For the next stage of analysis a working definition of conventional use for the set of punctuation symbols [!, -, ?] was determined. Conventionally the punctuation symbols - (dash) and ? (question mark) are an integral part of formal writing and use conventions apply. A dash is used to

introduce an explanation, amplification, paraphrase, particularization or corrections of what immediately precedes it. Use it to gather up the subject of a long sentence. Use it to introduce a paradoxical or whimsical ending to s sentence' (Economist, 2012) a description compiled from Gowers, The Complete Plain Words.

Exclamation is not normally used for academic writing; ellipsis can be used to indicate an omission from a quotation.

By contrast, the use of punctuation in fiction writing is not so strictly prescribed. For writing to become more speech-like there are conventions for the use of the symbols! (exclamation), … (ellipsis) and also – (dash) (G. Davidson, 2005). Interpreting the use of punctuation symbol in context is important

When there is a clash between the form of a sentence and its meaning, it is the meaning that governs the choice of punctuation marks (G. Davidson, 2005, p 72).

It is also relevant that interpersonal communication using the internet has changed the way that punctuation is used (Crystal, 2006). Based on a survey of internet usage Crystal concluded that the use of punctuation does not follow a prescribed format but can depend on both context and the individual style of those involved.

Punctuation tends to be minimalist in most situations, and completely absent in some emails……..a lot depends on personality: some e-mailers are scrupulous about maintaining a traditional punctuation; others use it when they have to, to avoid ambiguity (Crystal, 2006, p 94-95).

Using the scholarship of punctuation usage in fiction writing and on the internet (Crystal, 2006; G. Davidson, 2005), as a basis for defining punctuation use that is not strictly grammatical, the following guidelines emerged.

(!) Exclamation used to add emphasis, to indicate surprise, scorn, with multiple use indicating the strength of emotion

(-) Dash used to indicate break in thought, or shifts in tone

(…) Ellipsis used to convey prosody, a pause in the flow of the sentence, a hesitation

(?) Question mark used to express surprise or sarcasm, used in combination with other punctuation to convey complex cognition; for example, wondering, supposing

When a symbol string such as !!!!! is detected it was considered to be a strong indicator of unconventional use.

5.5 A micro-analysis of the flow of interaction

Using the date and time stamp all postings, including those of the teacher, were numbered in sequential order. For each posting the occurrence of a punctuation symbol, brackets, paragraphs, word contractions, unconventional case use, the occurrence of metaphor, slang and abbreviation was recorded onto an Excel spreadsheet. The message

author was also recorded. The use pattern of all elements was interpreted in context, and attributed to a collaborative process: attention, coherence, negotiation, norms, dialect, cohesiveness, social presence, and empathy.

When assessing the reported findings it is relevant that the researcher had considerable practitioner experience with this module and had previously been a distance student on another course that required students to undertake group work using similar technology. The interpretation of each element of practice defined for the framework illustrated in Figure 5.1 was influenced by those experiences ' how would I, as a participant interpret this posting' rather than an informed or preconceived expectation from a researcher perspective. Furthermore, the interpretation of a discourse unit as conveying empathy was from an entirely subjective viewpoint, how the researcher would feel as a teacher, or as a student. In that way empathy was interpreted from the same perspective as the other processes that comprise collaborative group work. In Study 4 there was an opportunity to take a more objective view of empathy when definitions from both Education and Neuroscience were used to guide the analysis of the comments of both novice and experienced online teachers who acted as participants for Study 4, and also for a pilot study.

5.5.1 Figurative language

Examples of metaphor use were found throughout the text corpus of both groups, 106 for the Mandevilles, 19 for the Wenlocks. All five members of

the Mandeville group used metaphor and 4/7 members of the Wenlocks did so. Metaphor was used as a resource in a range of different contexts to achieve the outcomes illustrated in Figure 5.2.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
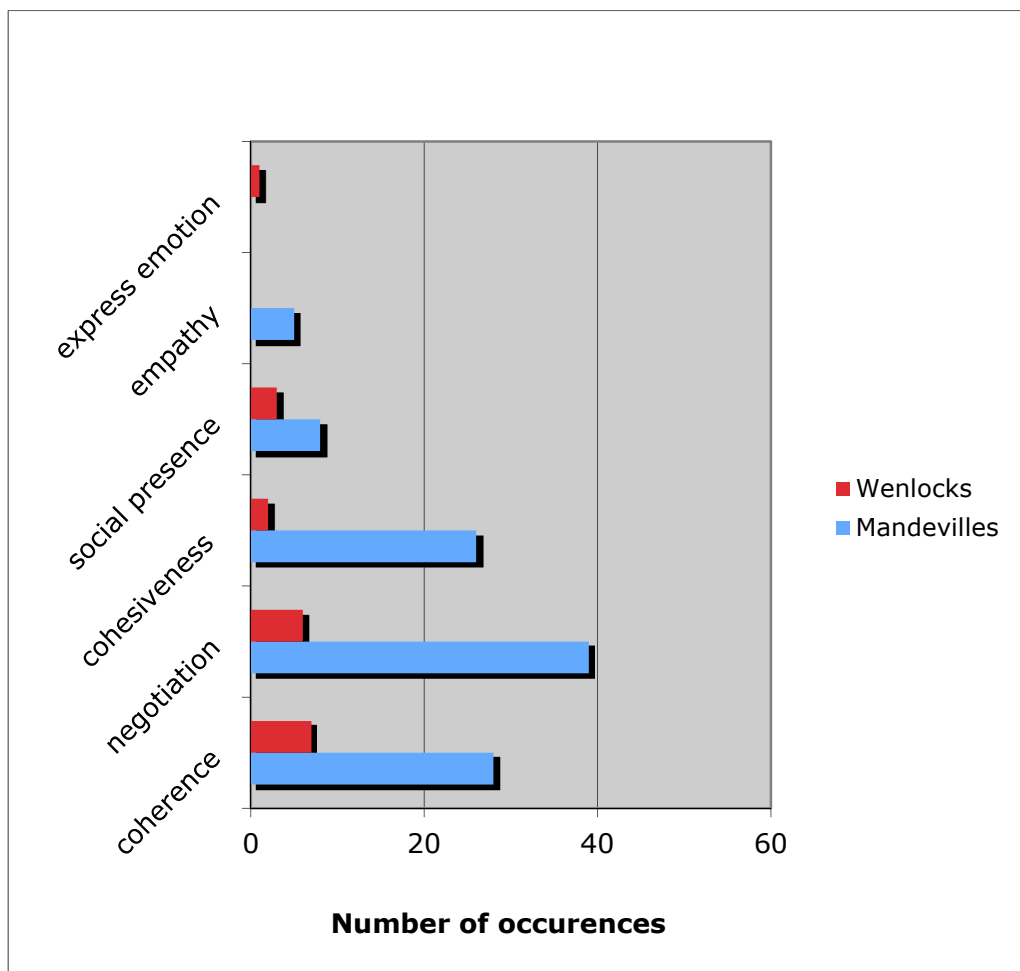
Figure 5-2 Figurative language use pattern

A striking finding for the Mandevilles group was the number of times that metaphor was used during periods of negotiation.

> I know that some of you are saying that we wouldn't have enough 'meat' if we didn't do all the theories, but you can already see that just hauling out the themes (and making sure they're relevant), is a bit of a task.

This extract was embedded in a posting that was 850 words long and used metaphor six times. Metaphor was also employed when signaling to the rest of the group that coherence was required, for example.

> … should keep us all on track. One thing I always find doing textual analysis is that it does become quite easy to just wander off

 Metaphorical references to 'tracks' and 'lines' were made several times. The third most common context for metaphor use was as a linguistic device for achieving cohesiveness

> we have some minor clashes, but should be able to iron these out quite quickly I reckon!

5.5.2 Style of writing

Overall the Mandevilles adopted a more formal style of writing than the Wenlocks; as a group the conventions for capitalization were followed and contractions were rare. By contrast 6/7 members of the Wenlock group predominately used lower case for I, and on some occasions began a sentence in lower case. Contractions were common for this group. Examples of slang and abbreviation were found in the text corpus of both groups and were a characteristic of the individual student, for example 'wee' and 'crack on' occurred often but were always produced by the same student.

5.5.3 Punctuation Symbol

5.5.3.1 The use pattern for dash and ellipsis

The use pattern of the punctuation symbols dash (-) and ellipsis (…) was assessed in the context of the flow of interaction; as either grammatical or unconventional using the criteria described in Section 5.4. The results are shown in Table 5.1. From a total of 404 occurrences (both symbols, both project groups) 319 (77%) were assessed as unconventional usage. The impression formed when reading the text was that these symbols were being used as a substitution for paralanguage, to render the text more speech-like. It was an impression that applied to the text corpus from each group. However, it was the dash symbol that was used in a speech-like way for the Mandeville group (82% of the us pattern of this symbol in this group),

> I have been thinking along similar lines as the others – although I guess the difficulty is that we are all calling our themes different things – will that need to be sorted for the final project?

whereas for the Wenlock group the ellipsis was the symbol that was predominately chosen to convey speech-like information (93% of the use pattern in this group).

> that's a possible suggestion .. fairly similar to the orginal .. anybody else got any ideas?

It appears that either a dash or an ellipsis is adapted so as to communicate a sense of those auditory cues that nuance speech in face-to-face contexts, for example hesitation, pause, intonation.

Furthermore, the symbol that is used in a speech-like way for a majority time may be an indicator of group dialect.

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Table 5-1 The use pattern for dash and ellipsis

	Grammatical	Unconventional	Total
Punctuation Symbol			
Mandevilles			
Dash (-)	58	264	322
Ellipsis (.)	12	6	18
Total	70	270	340
Wenlocks			
Dash (-)	12	10	22
Ellipsis (.)	3	39	42
Total	15	49	
Mandevilles & Wenlocks			
Total	85	319	404

5.5.3.2 The use pattern of the exclamation symbol

The exclamation symbol was used 45 times by the Wenlocks group and 265 times by the Mandevilles group. Every member of each group used this symbol, sometimes singly and other occasions as a multiple. When its functional significance was interpreted in context the use pattern illustrated in Fig 5.3 emerged.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
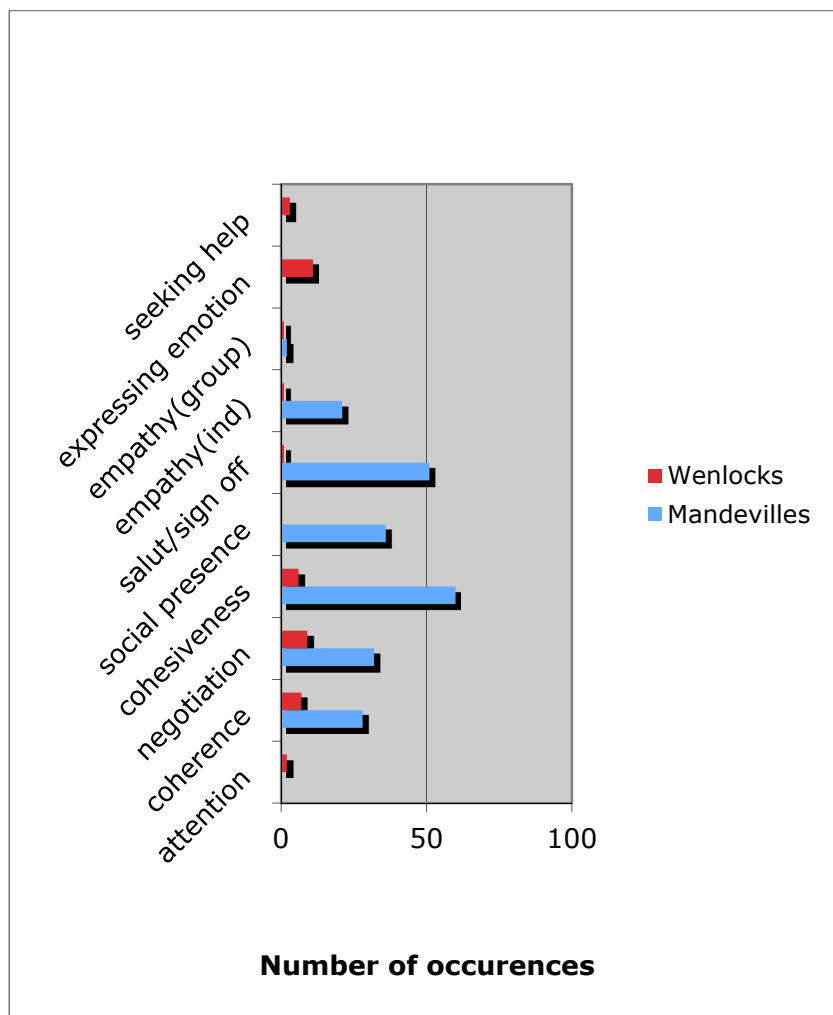
**Figure 5-3 Exclamation symbol use pattern**

Example quotes are provided for each category

Cohesiveness

Hope we hear back soon with feedback – will be good to get cracking with it all

Congrats All!

Social presence

my typing was at a snail's pace with one hand most of the way!

I must apologise for my ver bad spelling lol im working on it!

Coherence

as it is a group analysis and each of our work is marked by the same examiner, we will all have to have marked up articles that look exactly the same!

Think we will have to decide on this one quick!

Negotiation

Therefore, not sure about ///////// 'simply presenting facts' as intimated by X – but please correct if wrong!

I'm not really sure! A point system could work – we would then need to

Empathy

Y, I'd hate you to think that you'd messed up – you did a brill job!! (as did you all!)

 I'm sure tutor made constructive comments, but whatever they were you could take on board and throw in for the write up. But the main thing is, our overall objective has been achieved, and it was a success!

Emotion

I have posted loads now but am having trouble!

5.5.3.3 The use pattern for the question symbol

This is summarized here and in Figure 5.4.

- Only two students used the '?' symbol in an unconventional way by using multiples. These occurrences were interpreted as expressing a lack of certainty about an idea. Four distinct use patterns for the question symbol were discerned that were adopted by all the students.

- social how are we all today?

- inviting discussion without reference to a specific question what does everyone else think?

- questions of a rhetorical form, or by using a question tag, to invite a response to a specific question

but would this be a category in *///*, *///////* or just */////* ?? Let me know

- a direct question

Using this definition the use pattern for the question symbol is illustrated in Figure 5.4.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
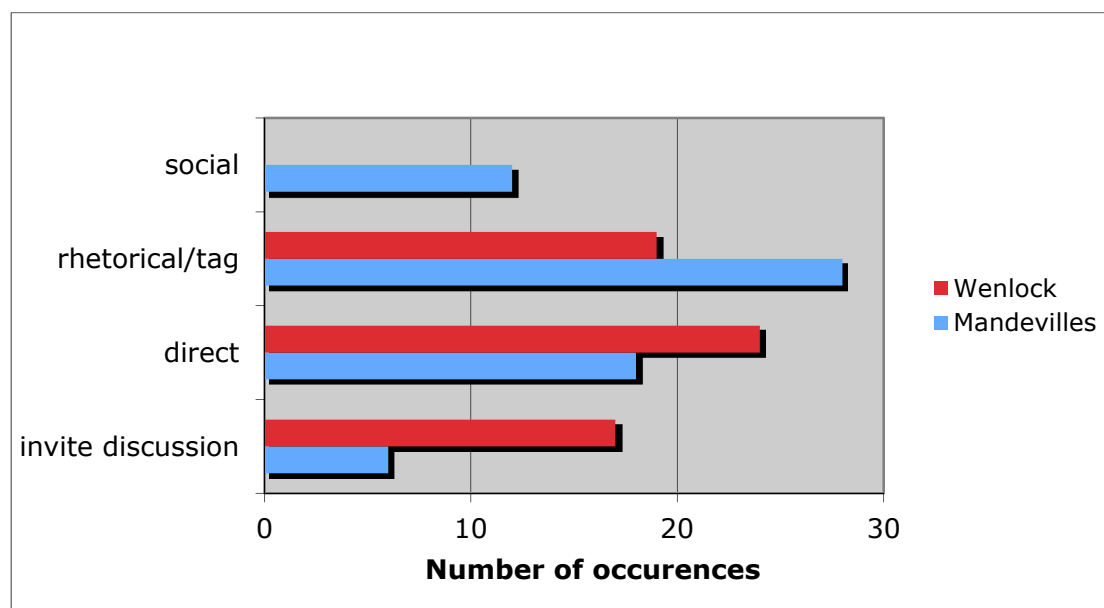
Figure 5-4 Question symbol use pattern

5.5.4 Styling and presentation

While reading and re-reading the text corpus of each project group it became apparent that the presentation of each was distinct. For the Mandeville group three presentation elements emerged.

- Paragraphs: paragraphs were used to organize the body of the message into discussion points.
- Quotation marks (single): those ideas identified as requiring further discussion and development were enclosed in single quotation marks.
- Parenthesis: During complex discussion parenthesis was employed to clarify meaning.

 'Paragraphs' were the device that was used most consistently by this group (95% of the time) and by all members. However all members also

used 'quotation' and 'brackets' on more than one occasion. Content of an affective or relational nature was similarly organized

By contrast, the Wenlock group made extensive use of the styling features. Coloured text was a distinctive feature of the postings for two students, purple for one, green for the other; the teacher used blue. Three other students used colour for emphasis and to make ideas explicit. On occasion a change of font size and/or underline was used apparently with similar purpose. An example of the styling and presentation of each group is provided in the following extracts (the identity of the students has been anonymised and the task related discourse is represented, proportionately, as a blank line).

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

MANDEVILLES	WENLOCKS
I can see how **X**'s explanations of _____ _____/ contributes to an understanding of issues surrounding_____. In terms of _____, I guess the main idea is _____ _____ _____. This would also be informed by the _____. While the _____ seeks to '_____', _____ '_____'_____, '_____' with _____ to support its contention etc,_____. In doing this, both however, still attempt to put forward their points of view. The main question would be I guess how _____ '_____/' _____ (_____) and what _____ are used to achieve this (i.e_____). So for this task, we may _____ '_____' tool to examine say, how _____ (ie. _____ _____), and what descriptions and explanations sustain and perpetuate _____ . I've only really _____ (as I'm trying to keep up with the postings and how we're getting on!), but I'm really optimistic that we can very nicely tie in all these theories and actually enjoy doing the analyses! So far, thanks to **Y** for putting the pp together'	*'I will not be able to chat tonight so I an leaving MY THOUGHTS..* *Last night we have a majority for:* _____/. *I have read current comments that, to get this one through we need to state it in our instructions: Do it then!!!!* _____*(see below)* *I am adding a few words to ensure that the sentences below are unambiguous. (Our analysis will _____* _____. *Here are a few notes for amending the :* *Proposal.* *Please also note: A change of colour means I have added extra words* 1. _____ _____ 7_____ 12_____ _____ _____

By contrast with the Mandeville group who used 'paragraph', 'quotation', and 'brackets' the members of the Wenlock group used, 'colour',

'capitalisation', 'font size', and 'underline'. On some occasions the Wenlock group members chose different elements to do similar work. In the example two distinct colours were used in item 12 to achieve the same effect.

5.5.5 'Threading'

There were striking differences in the way that threading, the facility to link together related messages by using a common heading, was used by each project group, the individuals within each group and each teacher.

42% of postings in the Wenlock forum introduced a new heading, 16% were instigated by the teacher and the remainder by a student. From an inspection of the threads instigated by students 15 distinct conversations could be discerned. Three were concerned with arranging a time to meet in Live Chat while the headings for the other 12 provided a credible summary of the conversations taking place as the project work progressed. The majority of the twelve threads contained postings labeled to a depth of four or more.

The headings of the teacher's postings provided a clear history of the teaching interventions made by him/her ('Project formulation', 'Project ideas', 'Project-tutor input, Project-needs moving on', 'Project proposal – tutor input', 'LQ Answers', 'Well done'). The 'group as a unit' retained two of the tutor headings for an ensuing discussion. Also, when a teacher

instigated heading was not carried forward, there is good evidence that the posting acted as a trigger and that the 'group as a unit' undertook an appropriate line of discussion by response. From time to time the Wenlock teacher would take part in a student-initiated thread. He always used the facility to selectively quote from a previous message so that the teaching intervention appeared in context.

Individual members of the Wenlock group varied in their competence in and/or commitment to 'threading'. There was one member of the group who made subtle changes to the heading of two threads so that information about the progress of the thread was conveyed. For example there is a thread labeled 'converted data'. On the sixth response the heading was changed so that it appeared as follows 'Re (6) updatedconverteddata' (the First Class software automatically adds the indicator 'Re' when the 'Reply' option is chosen). By contrast with this level of sophistication two members of the group consistently left out the title; 17 of the postings to the forum.

53% of postings in the Mandeville forum introduced a new heading, 13% were instigated by the teacher and the remainder by a student. From an inspection of the threads instigated by students 25 headings were discerned that are meaningful indicators of progress with the task. However, it was rare for these threads to continue and those that were taken up were only developed minimally; four was the maximum number of

responses for any thread. Closer inspection showed that the same conversational topic would be continued with a new heading despite the fact that there was no apparent reason why the heading should be changed or even nuanced. Furthermore, it was not uncommon to see a very minimal change in heading, for example, 'Discussion' to 'discussion'. When viewed collectively, in the context of progress with the task, the headings used by the Mandeville teacher do not provide any sense of how the teacher is directing the group. Also, she mostly included a reference to self, for example, '*Fredrica's input again'* in the heading although the name of the sender, Fredrica, is already clearly indicated in the index of forum postings. One of the students in the Mandeville group did not seem to understand that, to continue a thread, they would need to use the Reply option (embedded in the message body or available from the menu bar) although 'threading', what it is and how to use it, had been explained in the study guide. This student consistently replied to a message by using typing in 're', followed by the title which meant that each posting from this student became a new thread. One other student, the second most prolific contributor to the Mandeville forum, never continued a thread; that student consistently introduced a new title each time she made a posting.

By viewing the way that the "threading' facility has been used retrospectively, and in the context of the group task, a 'norm' for each project group can be discerned. The Wenlock group, and their teacher, did use 'threading' to achieve a coherent approach to progress with the task.

Furthermore, the headings used by both the Wenlock's teacher and the students were meaningful. Any student accessing the forum would be able to discern the flow of conversation/s from the forum index and follow the conversation in a coherent way. By contrast, the headings used by the Mandeville group and their teacher were much less meaningful and 'threading', as a way of achieving a coherent approach to the task, was not developed to the same extent.

Towards the end of the fourth week is the time when each member needs to contribute his/her data and analysis so that the 'group as a unit' can collate it into a final version before reporting their findings. By this point three of the members of the Mandeville group had adopted the practice of naming themselves and the teacher in the heading, for example a posting by Fiona is titled *'Fredrica - Fiona's analysis'*. These same members would also use the message heading to 'ask' the teacher for advice or comment. Although these contributions are posted to the forum the implication is that the dialogue is with the teacher rather than the 'group as a unit'. Furthermore, the Mandeville teacher always replied to the posting of each member of the group individually rather than responding in the context of the group's collective progress (see days 19-21 on Figure 4.5). The Wenlocks did achieve a coherent approach to the task by appropriating 'threading' whereas the Mandevilles did not demonstrate much evidence of doing so and they compromised cohesiveness to some extent.

5.5.6 Interacting in real time: Using Live Chat

Each project group is provided with a Live Chat facility, which means that students have a choice of time frame for interpersonal interaction, synchronous or asynchronous. Only the Wenlock group used this facility. During the first week of group work one member of the Mandeville group did suggest that they use it; after some discussion it became apparent that it would not be feasible for all students from the group to be co-present in time. An aim for the thesis is to

> *inform the integration of forums and other technological tools*
> *into the design of online learning*

and is why a detailed account of the Wenlock use pattern of this technology is provided in the following section. The date and time stamp for the forum messages that refer to Live Chat sessions are provided.

---

13 Nov 19.44

> I was just thinking we have a lot of agreeing to do. So if at all possible we can perhaps agree to log on at between 7-8pm in case we have some last minute finalising to do.

this student then suggested an agenda for the Live Chat meeting scheduled for the following evening and signed off with

> Hope this is moving us guys!!!

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---

14 Nov 19.11

Five students posted to the asynchronous forum all on the topic of moving to Live Chat before doing so.

At 22.06 (therefore following the Live Chat session) one of the students posted a draft proposal (using the preformatted form provided for each group) as an attachment to a posting in the asynchronous forum. From a teacher perspective, there is nothing in the postings to indicate how this draft version of the proposal was arrived at and who was involved in its development.

---

18 Nov 20.51

There had been calls for nightly Live Chat sessions. Although at least one did take place, not everyone attended which caused frustration for at least one student, apparently

I am online tonight. Visited chatroom, no one there, between 7-8 PM

If this time is not good, why don't someone say !!

Several of the students then posted to 'say' that they are not able to make the Live Chat on a nightly basis. However, at least three members of the group persisted with trying to arrange for a Live Chat meeting on a nightly basis; apparently with limited success.

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---

21 November 21.10

I know, X and I were in but no one there, we wernt there last night so we thought we had missed something. Were you in last night, did we miss plans.

---

22 November 22.32

One student posted a summary of the Live chat meeting held that evening

Just a quick message for all of you who were not in the chat tonight

---

23 November onwards

A number of messages were posted about missing each other in Live Chat a pattern that continued until the end of the project work.

Based on the information available in the asynchronous forum there is abundant evidence to indicate that seven people meeting synchronously, always between 7-8 p.m., and on a nightly basis, was not feasible. This is unsurprising; students had opted for a flexible time-line for doing project work as opposed to attending Residential School. The best attendance was at the first meeting, 5/7 students; thereon 3/7 students attending was the maximum. Although the outcome from the discussion was made

available on two occasions, those members of the group who were not present, and the teacher, did not contribute and did not have access to the discussion. Furthermore 10% of all the postings in the asynchronous forum were solely concerned with arranging times, absenting, or haranguing each other about non-attendance. It is likely that the availability of Live Chat compromised the cohesiveness for this group and it could be an issue that influenced, negatively, the socio-emotional experience of some group members. The potential for misuse of this technology, and its consequences will be discussed in more detail in Section 5.7.3.

5.6 Study 3. Comment on the method

There is a great deal of information that is not available in the text corpus, for example how much editing was undertaken before posting a contribution, how many times a student re-read a message thread, whether or not they access the History function (a function that shows when a posting has been read and by whom), how often they take advantage of the facility to rearrange the forum index. That information would provide a more granular account of the technological moves made by the individual student. For example if a student uses the History function on a regular basis the information obtained is likely to impact on their emotional experience, positively if their messages are regularly read by other members and negatively if they are not. There are other unknowns that may be relevant. The project groups may include members who have English as a second/third language and/or dyslexia, characteristics that

could limit both understanding and use of alternative linguistic devices, or a motor disability that affects their ability to manipulate the technology. Students in the cohort varied according to their previous experience with technology and communicating online. Another unknown is the metaphor use pattern when group work takes place face-to-face; it would be informative to compare the incidence of metaphor use in the two contexts, face-to-face and online.

The findings of Study 3 are the outcome of a highly subjective analysis undertaken by just one person, the researcher. The researcher has extensive practitioner experience with this course, a factor that undoubtedly influenced the interpretation and there is a possibility of 'bias'. However, one aim of the thesis is to 'improve support for teachers' so that a teacher perspective is relevant and was represented by inferring the communicative intention of the student contributor in the context of the flow of interaction. Intention was pre-defined by the processes identified for the framework for analysis (Figure 5.1). However, the boundary between processes is not always distinct and could be disputed by another researcher. For example, a section of dialogue that is emotionally expressive has been interpreted as ' conveying social presence', as communicating a sense of emotional state to other members of the group. Another teacher/researcher might interpret the same section of text as an emotion expressed without any communicative intent.

The verification of this conceptualision for collaborative space, and the student practices that support their construction and maintenance, would need to be established by extending this analysis to other project groups, and by involving other researchers.

5.7 Study 3. Comment on the findings

Although the focus of the thesis is relational space it is presumed that the interpersonal interactions that pertain to task space (cognition) and relational space (emotion) are inextricably connected. Therefore, to address the research question for Study 3 elements of both spaces (task and relational) are represented in the framework for analysis and findings about student practices that pertain to both are described in this section. In response to the research question the student practices can be mapped (using a colour code for each practice) onto a group process as illustrated in Figure 5.5. This mapping was achieved by using the framework illustrated in Figure 5.1 and the procedure for analysis described in Section 5.4.

The findings will be discussed from three perspectives, digital literacy and digital fluency, the 'group as a unit' as a sub-component of relational space, and the contrasts and similarities between the two groups.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
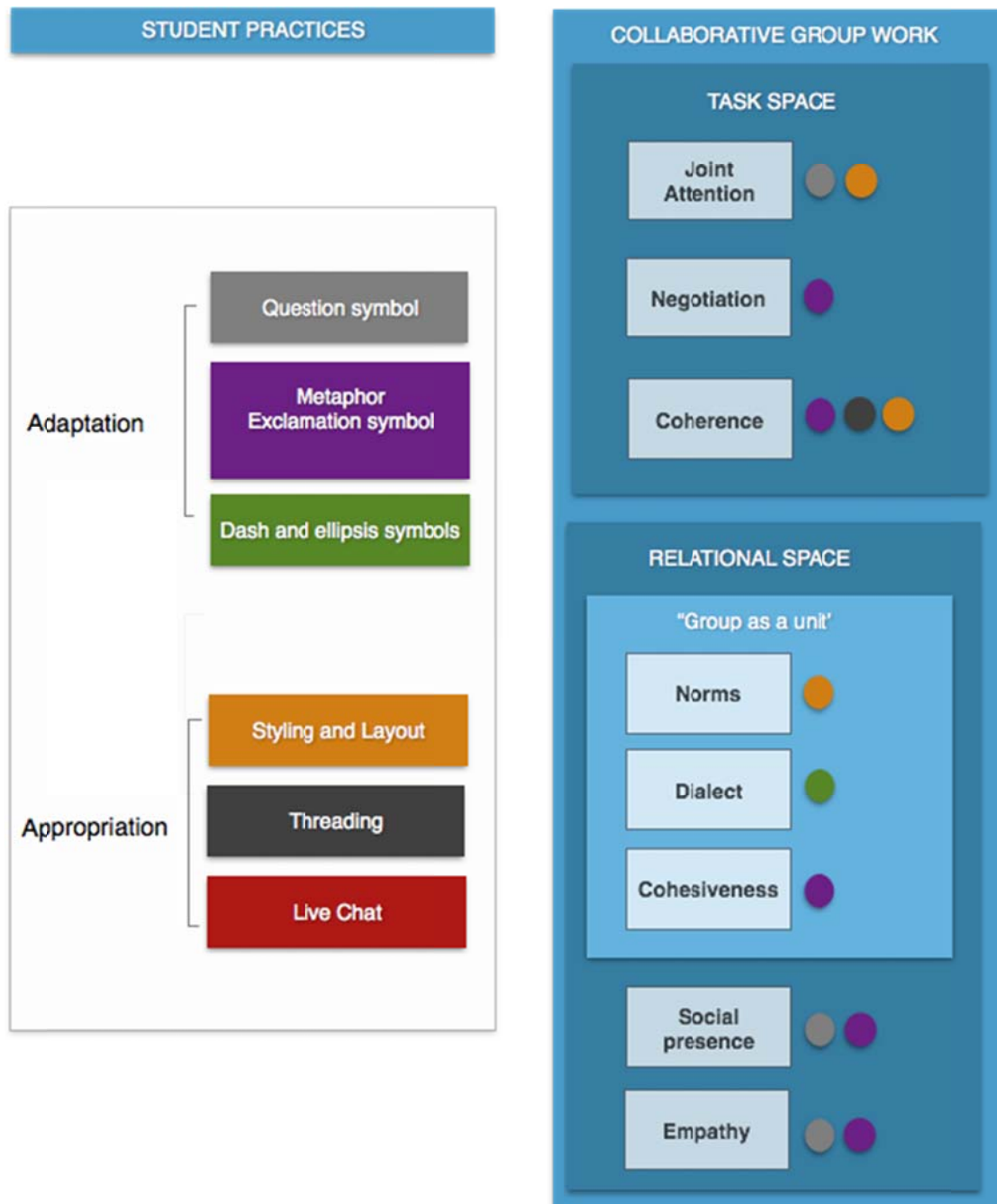
Figure 5-5 Mapping the student practices onto the group processes

5.7.1 Digital literacy and digital fluency

While there has been a sustained debate in Education about the need for digital literacy (Ala-Mutka, 2011) digital fluency, the ability to successfully communicate online for Education and work purposes (White, 2013), has received less attention. Therefore, an important outcome from this study is the demonstration of digital fluency (how students adapt to communicating remotely through writing) and digital literacy (their ability to appropriate the technology) in the context of group work online.

The members of both project groups demonstrated digital fluency in the way they used metaphor and exclamation symbol for the task related interactions of negotiation and coherence, and during sections of the dialogue that were interpreted as making a contribution to the cohesiveness of the 'group as a unit'. In face-to-face contexts embodied cues (for example, facial expression, paralanguage, physical movement) would be interwoven with the spoken message during negotiation and for cohesiveness. Therefore it is reasonable to propose that using metaphor and exclamation are adaptations of human communication that emerge as a substitute for sensory information and physical action and that a metaphor is a correlate of experience (Gibbs & Matlock, 2008). Both project groups also used metaphor and exclamation symbol when the focus of the dialogue was coherence, with the task and its progression. A plausible explanation is that this form of metaphor and exclamation symbol use pattern is a substitute for the tangible artifacts and synchrony of

comparable circumstances face-to-face. The Mandevilles group also used both practices to communicate social presence and express empathy.

Each group used the punctuation symbols, dash and ellipsis, more frequently than would be expected of written communication for academic purposes. The use pattern of these symbols was interpreted as a substitute for paralanguage, for the auditory information, prosody and hesitation, that accompanies spoken communication. Furthermore the members of Mandeville group were more likely to use the dash symbol in this way whereas the members of Wenlock group used the ellipsis symbol. The identification of a prototypical use pattern for the dash and ellipsis symbols for each group is consistent with claims that a distinctive within group dialect can develop (Postmes & Spears, 2000).

The Mandevilles relied on devices traditionally associated with formal writing, parenthesis to clarify structure, enclosing a key word or phrase by quotation marks, using paragraphs to communicate distinct ideas. By contrast, most members of the Wenlock group made use of the software styling functions, such as font size, underline, bullet points and colour for signaling emphasis and distinctiveness. Overall, when combined with the use of lower case for referring to self (i rather than **I**), and the frequent use of contracted word form (for example, wernt), the visual aspects of the text corpus for the Wenlock group did not give the impression that an academic discussion was taking place. Furthermore, as a group, the styling elements

were not used in a consistent way. It may be that the contractions and unconventional use of lower case were short cuts, a time saving practice that reduces the number of keyboard manipulations required. However, this argument is contradicted when considered alongside the use of styling embellishment, all of which require extra keystrokes.

The Wenlock group members did advantage coherence by using the 'threading' facility in an appropriate and efficient way whereas the Mandeville group did not always use this facility competently. One advantage of asynchronous CMC is that the dialogue can be reviewed retrospectively, an option that is more effective when the text corpus is organised by 'titling' and 'threading'. The Mandevilles did not use clear 'titling' or a meaningful form of 'threading' and thereby compromised that advantage. It is notable that the Wenlock teacher modeled appropriate use of threading whereas the Mandeville teacher did not.

Both groups used the question symbol extensively and four use patterns were discerned. The Mandevilles used it as a way of expressing interest in the wellbeing of other members and for the cohesion of the group. However, its main function was task related; the question symbol use pattern is an indicator of the level of engagement with the task ranging from its use as an invitation to put forward ideas to a request for others to consider and develop a specific idea. It would seem that in most instances the question symbol is being used as an attentional device; as a substitute

for the tangibles and embodied actions (for example, gesture, eye gaze) available in face-to-face contexts.

5.7.2 The 'group as a unit' as a sub-component of relational space

During the literature review of 'learning through collaboration' two elements, task space and relational space, were identified as relevant for the success of group work (Barron, 2003) while other researchers drew attention to the group operating as a unit (Stahl, 2011). Therefore the framework, as illustrated in Figure 5.1, represented the 'group as a unit' as a distinct aspect of relational space. The findings are consistent with the idea that the 'group as a unit' is a sub-component of relational space.

'Jointness' is the aspect that characterises the 'group as a unit' with 'jointness' conceptualised as involving three processes; cohesiveness, norming, and the development of a distinct communicative style i.e. dialect. Based on the findings it would seem that both groups target the three elements defined for the 'group as a unit', that the 'group as a unit' has a distinct role during collaborative learning. There is a use pattern for both metaphor and exclamation symbol that can be attributed as an intention to communicate 'groupness', cohesion with the 'group as a unit'. The use pattern of dash and ellipsis (dash for the Mandevilles, ellipsis for the Wenlocks) support the idea of a within group dialect with the adoption of one or other of these symbols acting as an indicator of dialect. Presentational style was strikingly and consistently different between the

two groups, and supports the idea that these are elements that define a group norm.

5.7.3 The Mandeville and the Wenlock project groups: a comparison

There are some inter-group contrasts between the use pattern of the exclamation symbol, metaphor, and question symbol that may be associated with differences in the quality of the relational space of each group (as reported by one student from each). Some of these have already been described in Sections 5.7.1 and 5.7.2. A summary of contrasts and similarities in digital literacy (appropriation) and digital fluency (adaptation) is provided in Table 5.2.

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Table 5-2 Digital literacy and digital fluency

	MANDEVILLES	WENLOCKS
CONTRASTS		
Styling and Layout	Layout appropriate and used in a coherent way to good effect. Norm for the group.	Range of styling features for example colour, font, size used for a range of purposes for example, to gain attention, to express an emotion, usually negative. Inconsistent relationship between styling feature and purpose limited the effectiveness of this practice. Norm for the group.
Threading	Inappropriate use of threading detracted from the coherence of a conversational thread	Good use of threading
Live Chat	Not used	Persistent attempts to use this function detracted from the cohesiveness of the group
Metaphor, exclamation symbol, and question symbol	The group used these to communicate social presence and express empathy	
Dash and ellipsis	Dash- - - - a component of the dialect for the group	Ellipsis…….. a component of the dialect for the group
SIMILARITIES		
Question symbol used for joint attention	Yes	Yes
Metaphor and exclamation symbol used for negotiation, coherence and cohesiveness	Yes	Yes

Interpersonal interactions of a relational nature are rare for the Wenlocks while the Mandevilles communicated information about self (social presence), and expressed empathy, using three linguistic resources,

metaphor, exclamation and question symbols, either singly, or in combination. By contrast the members of the Wenlock group did not use these three symbols for relational purposes. However, the Wenlocks did use an exclamation symbol on 11 occasions when expressing an emotion, about progress with the task or with the technology (for seven of these the valence of the expressed emotion was negative). The Mandeville group did not use the exclamation symbol in this way. So it seems that these are the practices that differentiate the construction of relational space from those that make a contribution to the 'group as a unit' and it is proposed that it is this aspect of relational space that influences the socio-emotional experience of the individual student. A proposal supported by the fact that a member of this group has independently rated the Mandevilles positively.

The Wenlock group opted to use the Live Chat facility and a minority persisted with using Live Chat despite the fact that a synchronous mode of communication was not convenient for the remainder of the group. The Mandeville group did not use Live Chat. For part time students, learning at a distance, flexibility as to when and where to learn is a major advantage. Therefore it is reasonable to assume that the students in the Wenlock group, who indicated that they could not attend the Live Chat sessions, were frustrated when meetings went ahead. Furthermore, a number of postings in the asynchronous forum were solely concerned with trying to arrange Live Chat meetings. First Class displays a red flag alongside any message that the user has not yet read and a syndrome, ' red flagitis', has

been coined by one teacher who investigated its effect on students as part of an Open University Personalised Integrated Learning Support (PILS) CETL project (Open-University(UK), 2005-2010). Being presented with a large number of unread postings when accessing the forum can be extremely stressful for the busy part-time distance student, a situation that is further aggravated if the contents are perceived as 'trivial'. When this occurs it is not conducive to good relationships. Some students, and the tutor, were not able to access the entire flow of interaction and some students were excluded from the discussion and decision-making. Inevitably the cohesiveness of the 'group as a unit' is compromised. Although a synchronous form of communication can advantage the speed at which decisions are made, course designers need to be aware of the potential for negative effects, and teachers need to be alert to those situation when synchronous use is inappropriate and intervene as necessary.

5.8 Conclusion

The findings of Study 3 show that communicating social presence and conveying empathy are the processes that characterise relational space as distinctive from the group functioning as a unit, and that empathy is the interactive element that enhances the quality of the relational experience. Digital fluency was observed for both task and relational purposes but needs to be interpreted in context for example; metaphor can be used for a range of purposes during negotiation, for coherence and cohesiveness and

was used by members of the Mandeville group for conveying empathy. Study 3 shows that digital fluency and digital literacy practices tend to become the norm for the group therefore, are likely to be important components of within group identity.

The findings of Study 3 have three implications for the second aim of the thesis.

- Practices that involve using typography in unconventional ways to render writing more speech-like are essential when interacting at distance using CMC.
- Two forms of digital literacy, appropriate use of styling and presentation, and of threading, advantage coherence when doing group work at distance using CMC.
- Automated methods for monitoring digital literacy and digital fluency could be developed to advantage learning and teaching when interacting at distance using CMC.

In face-to-face conversation (speaking) the verbal and non-verbal elements are interdependent. Participants in a face-to-face exchange rely on both for the expression and interpretation of meaning. The proportional contribution of verbal and non-verbal has been calculated; participants rated positive attitude (liking) as follows, 0.07 (verbal content) + 0.38 (tone of voice) + 0.55 (facial expression) (Mehrabian, 1972). Therefore, it is unsurprising that research has focused on the lack of visual sensory information in text

based forums; in particular the use of emoticons as a substitute for facial expression (Derks, Fischer, & Bos, 2008; Parkinson, 2008). However, there was just one occurrence of emoticon use in the combined text corpus of both project groups in this study. By contrast there is strong evidence to suggest that students may be using punctuation symbols in a way that renders their written text more speech-like; that the important adaptations that students make are those that substitute for the absence of the auditory sensory information.

It is imperative that the design for group work at distance using CMC allows for this and other forms of digital fluency. The discursive practices demonstrated by students using a discussion forum, as illustrated in Figure 5.5, enable them to co-construct and sustain an appropriate relational space for supporting the emotional needs of group members, and also for progressing the task. When designing for group work (Minocha & Thomas, 2007; Thomas, King, & Minocha, 2009) prioritised task space and chose a wiki as a replacement for a forum. This decision was based on the potential of wiki technology for collaborative authoring. This design decision assumed that students would use a formal and grammatically conventional writing style. However, the findings of Study 3 demonstrate the flaws of this assumption. A wiki it is not optimal for supporting the practices that student adopt for the discursive writing used to co-construct knowledge. Some of the pitfalls reported by Minocha and colleagues could have been avoided by recognising the consequences of limiting the

discursive (Minocha & Roberts, 2008; Thomas et al., 2009). When blogs, google docs, twitter, are similarly evaluated as spaces for group work, they too are demonstrably inferior when compared with the functionality of the forum. Furthermore, google docs, the cloud, twitter, do not provide the same level of privacy, sustainability, and ease of navigating socially, as is the case when the technologies are embedded in the VLE of an institution.

Digital literacy is also important. The Mandevilles group used layout and styling to enhance coherence and a norm for the group emerged which is likely to have enhanced the cohesiveness of the group. The Wenlock group members used 'threading' consistently and appropriately, whereas the members of the Mandeville group did not. Although the advantage of using threading was outlined in the study guide and the teachers should be alert to its appropriate use; these safeguards do not always impact on practice.

In Chapter 4 the potential of using data collected through a VLE for augmenting teacher practice (providing learning analytics data) was briefly outlined. When 'threading' is used appropriately it can function as a tacit indicator of conversation. It is another aspect of student practice where methods for automating intervention would be useful i.e. using learning analytics data to prompt the appropriate use of 'threading'. If the findings about the use of punctuation symbols (!, -, …, ?) can be replicated they would form a basis for the automated monitoring of relational space and

task space concurrently. Therefore it is significant that automated methods for detecting metaphor use are being developed (Krishnakumaran & Zhu). The information provided through automatic monitoring of these elements of the discourse would be of value for teachers and could be made available on a teacher dashboard as an aid to their role as facilitator of the 'group as a unit'. In Chapter 6 the teacher's role as facilitator of group work online, and resources to support this aspect of their role, are described and addressed in more detail.

Chapter 6 Supporting teachers' understanding of the student experience of 'learning through collaboration'

6.1 Introduction

The previous five chapters have considered learning and teaching during group work online from the perspective of the student. In Chapters 6 and 7 the focus will be on the teacher perspective specifically, their role as facilitators of the relational space of the group. An argument put forward in the thesis is that the role of the teacher as facilitator is an important element for 'learning by collaboration'. Successful facilitation of the group requires the teacher to be aware of the dynamics of the group, the pattern of engagement of the individual members (as discussed in Chapter 4, Section 4.5), and to have an understanding of the feelings of the individual student is important. The ambition is to build on the scholarship already developed (Garrison & Anderson, 2003; Garrison et al., 2010; Salmon, 2000) by providing teachers with resources in the form of a narrative account of relational space so that they can experience the minute by minute experience of the facilitative role, albeit with relational space simulated by a narrative.

Some resources have already been identified that could be implemented using data collected by a VLE:

- Measures of participation (defined as reading posts) for each individual student (Study 2).

- The patterns of engagement of individual students so that deviations can be detected, thus providing an opportunity for early intervention by the teacher if there is a problem. (Study 2).

- A social presence profile (group level) and a teaching presence profile provided in widget format (Study 2). Although there are some issues regarding the measurement of social presence, as currently developed, and challenges for automating the content analysis, this type of information would be very useful for teachers for monitoring the ongoing interrelationship of task and relational space. It would mean that they could quickly and easily check the 'group as a unit' and the teacher's interaction with the group.

- Checks on the appropriate use of 'threading' (Study 3). Study 3 drew attention to the fact that students did not always use the threading facility optimally. Although monitoring the appropriate use of 'threading' is a complex issue, and beyond the scope of this thesis, some simple automated procedures that could be implemented have been identified: detecting when an excessive number of threads are being used, detecting when the name of the sender, or recipient, is used in thread titles.

Such resources could be provided for teachers while they engage with online groups. By contrast, this chapter describes the rationale behind the

development of two narratives as resources that could be used for the professional development of teachers. Each narrative (one for the Mandevilles, the other for the Wenlocks) should represent relational space so that they can be used to seed discussion about best practice when facilitating group work online. Teachers are not immune to the emotional climate of group and so it is important that the narratives are capable of evoking social emotions. Therefore, it is significant that in some neuroscience research it has been demonstrated that a narrative is sufficient for evoking the social emotions of admiration and compassion at both a subjective and a neural level of description (Immordino-Yang, McColl, Damasio, & Damasio, 2009; Immordino-Yang, Yang, & Damasio, 2014).

The research and scholarship concerning the role of the teacher supervising group work online using CMC is summarised in Section 6.2.1. The teacher has a role as facilitator in face-to-face, as well as online contexts, as described (Section 6.2.2) which is followed by a discussion of the features that are unique when teaching in an online context, and when interpersonal interaction takes place asynchronously (Section 6.2.3). Professional development is most successful when offered in a constructionist environment (Cornelius & Macdonald, 2008; Laurillard, 2012; Laurillard et al., 2012; Macdonald & Campbell, 2012; Smith, 2013). For example, when trainee health practitioners were provided with access to a discussion forum, alongside preparing an e-portfolio about their

practice, an analysis of the outcome demonstrated that those practitioners who shared and discussed their reflections with others were more likely to move from a surface to a deep level of understanding (Smith, 2013). Therefore, a focus group where teachers can discuss the narratives, and any other resources, was proposed. At an early stage in the thesis a pilot study was conducted to ascertain whether a narrative, used in the context of a focus group, is a suitable format for the professional development of teachers. The pilot study, based on a pilot version of the narratives (Version 1) is described in Section 6.3. Version 2 of the narratives was developed after Studies 1-3 had been conducted and is based on nine criteria identified by a requirements analysis. The requirements analysis is described in Section 6.4 and the construction of Version 2 of the narratives is described in Section 6.5. The testing and evaluation of Version 2 of the narrative is addressed in a following chapter (Chapter 7).

6.2 The role of the online teacher

The dominant learning theory that underpins social learning is socio-cultural that the tools available, technological, symbolic and psychological mediate cognitive activity and that language is prime (Säljö, 1999). Through discussion and joint activity new forms of meaning emerge (Hopkins, Gibson, Ros I Solé, Savvides, & Starkey, 2008; Laurillard, 2009, 2012) as described in Chapter 1, Section 1.7.1, Chapter 2, Section 2.5, and as illustrated through four Exemplars in Chapter 2 Section 2.2. An emphasis on learning through discussion amongst peer students and

shared 'doing' places the students centre stage (King, 1993) and challenges the traditional role of the teacher as a transmitter of information. It is one reason why the facilitative aspects of the teacher role are the focus of this chapter. Facilitating the 'jointness' and dynamics of the group requires the teacher to be aware that the socio-emotional experience of an individual student may impact on their engagement and that it will depend on the relational space of the group to some extent.

The availability of communication technologies and the Internet meant that social learning opportunities could be offered to students studying at distance; two dominant frameworks for teacher practice online emerged in response, the Community of Inquiry (COI) (Anderson et al., 2001; Garrison & Anderson, 2003) and the 'five-stage model for e-learning' (Salmon, 2000). Both have a focus on the teachers' role as facilitator. The COI specifies the teacher role under three main headings organization and design, direct instruction, and facilitation of the inter-student discourse while the five-stage model conceptualises the teacher role as facilitating and supporting the students during a learning encounter as characterised by five stages (access and motivation, online socialisation, information exchange, knowledge construction, and development). While these models remain useful, they are not sufficient for conveying what it means to facilitate 'learning through collaboration' online not least because they were primarily developed for 'learning through discussion'. There is a danger that teacher facilitative practice solidifies around the ideas covered by

these two frameworks, the COI and the five-stage model. Neither has sufficient scope and granularity to convey the reality of facilitating groups online and thereby meet the pragmatic needs of the online teacher. For example, for the COI one of the descriptions of how a teacher might facilitate discourse is by

> setting the climate for learning (Anderson et al., 2001, p 8)

without providing any detail as to what is a climate for learning and how it might be achieved. Similarly, the five-stage model identifies

> sensitivity to online relationships and communication (Salmon, 2000, p 40)

as a key competence of the online teacher yet advice and resource for how this might be achieved is not provided for contexts where working together on a group task is mandatory. Furthermore, the guidance is based on the assumption that students will progress from relationship formation to knowledge construction yet other researchers have demonstrated that online relationships require time to develop (Walther et al., 2005), Exemplar 11 Section 2.4.3, and that trust and psychological safety are important (see Exemplar 12 Section 2.4.4).

Research shows that working with and relying on others to achieve an outcome can be a significant source of emotion (Burdett, 2003; Capdeferro & Romero, 2012). By contrast, while interpersonal interaction is encouraged for 'learning through discussion' it is either optional or difficult

to enforce, and progress with the learning task does not depend on others; 'the jointness' of the students involved is not as critical as when 'learning through collaboration' where the outcome is shared. The five-stage model does not make this pedagogical distinction between group work and optional discussion explicit, it does not take the dynamics of the group into account, or the stages of development that is a characteristic of a functioning group (deLaat & Lally, 2003; Tuckman & Jensen, 1977). These are the reasons why the development of resources for the professional development of teachers is an aim for this thesis.

The next section will focus specifically on the challenges that can arise for teachers when facilitating group work online i.e. being aware of the level of engagement of individual students and their socio-emotional experience alongside monitoring the 'jointness' and dynamic of the 'group as a unit'. A necessary first step involves untangling the issues that arise when facilitating group work per se from the additional challenges that are involved when group work takes place online.

6.2.1 Group work in practice: A vignette

The following vignette, based on a personal observation while supervising project group work online, illustrates the complex nature, and the reality of the teacher role when students undertake group work.

> *A group of four students have been engaged on a shared task for*
> *four weeks and the teacher has formed a subjective opinion of both*

the group and the individual members. Two members (j and k) are jostling for leadership, another (l) is critically time poor and stressed by the time involved in negotiating a shared view, and a member (m) is projecting an image that exaggerates her/his academic competence. There have been moments of conflict but nothing untoward. They are preparing to present their findings; k has offered up a draft presentation for the others to discuss and improve, m responds by referring the group to an inappropriate resource but does not comment on the contribution of k.

The vignette represents a point in time, a snapshot of just one of a host of different group scenarios that can occur, irrespective of whether group work takes place online or face-to-face. It is offered as a reminder that group members have needs (identity, emotional, cognitive) that are unique to the individual. An empathetic teacher will 'see the hidden' and can benefit both the individual student by helping them to develop greater esteem and self worth, and the group as a unit by supporting cohesion and security (Cooper, 2011). To comprehend fully the role of the teacher as facilitator of the relational space of groups interacting online it is necessary to identify what are the unique issues in these contexts. However, the first step is to consider group work per se in more detail.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

6.2.2 The role of the teacher in student group work in general

The group members working as a unit is fundamental for successful group work (Laurillard, 2009, 2012; Stahl, 2006, 2011) and therefore facilitating the 'group as a unit' is a priority for the teacher. At the same time the individuals within the group will have emotional needs. The relational space constructed by the group (Barron, 2003; Van den Bossche et al., 2006) and the empathy of the teacher (Cooper, 2011) are both important for supporting the emotional needs of the individual student. Therefore, the teacher needs to have insight into these factors so that they are better able to identify those moments when facilitative intervention would be appropriate, and when it would not. To extend an analogy from the Learning Design community (Larnaca, 2012), the teacher is the conductor who needs to be aware of the emotional climate of the group and its nuances over time, as well as assessing how the group is progressing with the task. When providing feedback to the group an empathetic teacher will take into account the self-image of each student (Cooper, 2011). In the example of the vignette above, the teacher should be aware of the self-image of m and l and the identity constructed by each, and at the same time assess the cognitive and relational space of the group.

6.2.3 The role of the teacher in student group work via online text based forums

From a teacher perspective there are some factors to take into account when group work takes place online. The interactions of the teacher are

with the 'group as a unit' and are transparent to all. Teacher contributions are added to the forum space and will remain there as part of the persistent record of the group discussions. This means that responding at a group level to the perceived needs of individual students is done publicly. However teachers who facilitate group work online have the opportunity to reflect and time to compose their responses although, the asynchronous nature of the interactions means that the timing of attempts to manage the dynamics of the group in a strategic way (for example, giving the group members the opportunity to resolve a situation for themselves) can be thwarted. The timing of a response has the potential to complicate decisions about the most appropriate way to manage a particular group.

Another factor to consider is that writing is the mode of communication. The scholarship of DE can contribute to our understanding of writing as a communication form in educational contexts. Distance Education (DE) has been negatively compared with conventional education on account of not being face-to-face (Blake, 2000).

> The notion that interaction by means of the written word diminishes the quality of communication (Blake, 2000, p 183)

was a widely held and persistent view before such comments were made in the context of CMC. The success and increasing uptake of Distance Education over time has challenged that negative view. In DE the teacher is remote from the students so that the student- teacher relationship has

depended on the DE teacher providing dialogically orientated learning material and feedback on assessment.

In order to explore the distinction between face-to-face and other forms of mediated communication (Blake, 2000) dissected face-to-face interaction on the basis of the speech acts involved during face-to-face interpersonal interactions, and formulated the following conclusions. All speech acts have a cognitive component, constatives, that convey information but there are also perfomatives, acts that are

> highly sensitive to social and material context (Blake, 2000, p 186).

Performatives can oil the conversation and the dynamics of the group. This view aligns with the findings of Studies 2 and 3 that demonstrate how the interpersonal exchanges between the group members are conveyed in writing, for example the project group rated highly (by one student member) tended to use a dialogically orientated style of writing by contrast with the other group. We could therefore conclude that the role of performatives is to keep the relational space comfortable.

This review of DE has confirmed the value of performatives as an aspect of dialogic tone. Therefore, a criterion for the narratives is that the dialogic tone of the interpersonal interactions within a project group is retained.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

6.3 The pilot study

The pilot study took place during the early stages of the thesis, before a full requirements analysis for a narrative had been completed. It was conducted to assess the value of using a narrative as a resource in the context of a group discussion. The construction of the narratives (Version 1) for the pilot study was limited to targeting relational issues that were identified during the early stages of the literature review: the research on groups in CMC (Postmes & Spears, 1998, 2000; Spears, Lea, & Lea, 1990), group dynamics (Tuckman, 1965; Tuckman & Jensen, 1977) and the importance of empathy for socio-emotional experience (Cooper, 2004, 2011; Immordino-Yang, 2010; Immordino-Yang et al., 2009).

The use of narrative as a resource for tutors was piloted with a group of four teachers who were taking up appointments on the course on which the thesis is based. In the following sub-sections Version 1 of the narratives is described, and their effectiveness as resources for a discussion between tutors participating in professional development is evaluated. The information for teachers who participated in this pilot is provided in Appendix F.

6.3.1 The narratives (Version 1)

A narrative for each project group was produced:

- the Mandeville group (the project group with a positive emotional climate)

- the Wenlock group (the project group with a negative emotional climate)

Each narrative was a summary, represented primarily through illustrative quotes from the student forums, of the development of these two groups over a 6 week period and represented the five main stages of the project group (group formation, working on the project proposal, preparing resources and collecting data, analysing and preparing presentations for a mini plenary, disbanding). The purpose of the pilot study was to assess whether using a narrative to seed discussion would be a useful approach to professional development therefore, the content was biased towards providing a distinct contrast between the two groups.

The Wenlock narrative was 1525 words and the Mandeville narrative 1641 words (the Mandevilles were more verbose than the Wenlocks).

6.3.2 The protocol

The participants were asked to read each narrative twice and as a teacher to reflect on what they had read before discussing the narratives with the other three teachers. The focus group discussion was seeded with just one question

How, as teachers, do you view the socio-emotional experience

of each project group?

To avoid any undue influence, the researcher was not present during the subsequent discussion, which was audio recorded.

6.3.3 The findings

The analysis of the pilot study involved two stages

1. Investigating joint attribution: assessing the group discussion for whether, and why, the emotional climate of the two project groups differed.

2. Investigating whether individual teachers demonstrated evidence of socio-emotional experience and empathy.

6.3.3.1 Joint attribution

An approach based on discourse psychology was used to interpret a transcript of the group discussion. The methodology of discourse psychology is based on a social constructionist approach, that attributions

> will be reworked and restated in the course of conversational interaction (Edwards & Potter, 1992, p84).

The idea of participants framing and reframing a conversation while formulating attribution jointly is central to the discourse psychology method (Edwards & Middleton, 1986). Accordingly, the analysis of the audio transcript of the discussion was focused on the way that the discussion

was framed and reframed by the focus group members. Four distinct phases in the discussion were discerned.

1. The participants in the discussion quickly agreed that 'one group' (The Mandevilles) was 'more friendly' and had ' a much better climate' thus validating that the emotional climate of the project groups selected for the pilot study were perceived in the way that had been predicted.

2. The topic of discussion was then reframed onto determining causal factors. During this phase of the discussion the perceived differences between the two project groups were attributed to a number of factors, the teacher role in facilitating the group, the dynamics and responsibilities of group members, and in a more limited sense to the design of the course.

3. After some time the discussion was once again reframed by one of the participants.

how do you encourage discussion to be more fulsome?

During this phase of the discussion the focus was on the group that was perceived as 'malfunctioning' with the discussion centred around issues such as lack of interpersonal respect and acknowledgement, the formation of cliques (those who met on Live Chat and those who did not) and the tone of some comments that were made

4. The discussion then moved on to *how, as teachers,* they should manage a group who engaged in interpersonal communications of this nature.

Through discussing the narrative four issues about managing group work online arose and collectively, the teachers considered how best to deal with such issues i.e. they co-constructed solutions to perceived problems as opposed to being presented with a list of teaching recommendations.

6.3.3.2 Socio-emotional experience and expression of empathy by individual teachers

Based on extensive interviews with classroom teachers and observations of their practice, a description of empathy from a teacher perspective has emerged, and the valuable role that empathy plays in teaching and learning relationships has been evidenced (Cooper, 2004, 2011). However, context and individual differences between teachers will determine whether empathy is experienced and the amount and quality of its expression. Although work in Neuroscience has demonstrated that a narrative is sufficient for evoking social emotions specifically, admiration and compassion (Immordino-Yang et al., 2009; Immordino-Yang et al., 2014) for the purposes of this thesis it is important to determine whether a narrative is also sufficient for inducing empathy. Using a grounded approach to the interpretation of the transcript and the following definition of empathy in Education.

> Empathy is a quality shown by individuals that enables them to accept others for who they are, to feel and perceive situations from their perspective and to take a constructive and long-term attitude toward the advancement of their situation by searching for solutions to meet their needs. (Cooper, 2004, p 14)

there was some evidence that reading and discussing narrative material were sufficient to evoke empathy and social emotions in teachers although this stage of the discussion predominately involved the Wenlock group.

I was just wondering some of the comments were a bit rude I don't know if I would as a teacher say mind your language or (slight laugh) something like that. (T1)

Was aggressive I will say rather than (T2)

But would you

I don't know if it is appropriate for us to say that's not appropriate

Personally I would want to mention something. (T1)

If it is offensive yes (T2)

Mhhh wondering (T3)

These comments suggest that a narrative does provide a realistic representation of how the student experience of relational space is interpreted by teachers. Depending on how they experienced the relational space of the group teachers faced individual dilemmas as to how best to facilitate each project group.

6.3.4 The pilot study. Comment on the findings

The pilot study was conducted to evaluate two aspects of the proposed use of narrative for teacher development.

- The value of using narrative as a seed for reflective discussion amongst practitioners.
- The quality of the narrative as a representation of remote interpersonal interaction while learning.

6.3.4.1 The value of using narrative as a trigger for reflective discussion

During the pilot study the narrative did act as a trigger that led to a meaningful and fruitful discussion. The way the members of the group framed and reframed the conversation is an indicator of how the focus group developed and refined their reflective practice collectively. As a group a number of challenges for the teacher were identified and they shared some ideas about management strategies. By engaging in joint discussion the participants collectively constructed an awareness and deeper understanding of the varied nature of group practices. However, it was illuminating for the researcher that the majority of the discussion was focused on the '*malfunctioning group'*. This may be the result of some inherent bias in the way that the content of each narrative had been selected and summarized, so that they formed a contrast that exaggerated

the differences between the two groups. An intention for Version 2 of the narratives is to avoid this type of bias.

6.3.4.2 The quality of the narrative as a representation of remote interaction while learning

The definition of empathy used for analysis of the discussion resulted from research with school aged participants and the expectation that teaching involves a pastoral role (Cooper, 2004, 2011). Nevertheless, by using that description the analysis of the pilot study discourse supports the view that narrative is sufficient for eliciting teacher empathy and supports the proposal that a narrative can simulate remote interpersonal interaction. Furthermore, narratives of the lived experience of fellow humans have been used successfully when investigating the processing of social-emotions in targeted brain areas (Immordino-Yang et al., 2009; Immordino-Yang et al., 2014). The findings of the pilot study are consistent with the claim that narratives have the potential to evoke social emotions and empathy at a subjective and neural level of description.

6.3.5 The pilot study. Conclusion

To take advantage of the opportunity to test out the use of narrative in an authentic setting (an induction session for a group of teachers new to facilitating group work online) the pilot study was conducted before the literature search was complete, Studies 1-3 had been conducted and therefore, before a requirements analysis had been completed. For a

research thesis this is not ideal protocol. However, it was unlikely that I would be able to pilot this form of staff development in such an authentic context in the future and therefore the opportunity was taken.

The pilot study did demonstrate that collective discussion in small groups is a useful format for staff development for online tutors. Furthermore a summary (narrative) of the forum interactions seeded some useful discussion when used in this context. That was the main purpose of the pilot study. However, a selection bias limits the quality of the narratives as true contrasts of relation space; an issue that was addressed during a requirements analysis for Version 2 of the narratives.

6.4 A narrative as a resource for teachers: requirements analysis

The teacher is expected to facilitate the emotional climate of the 'group as a unit' during collaborative learning. If there is something wrong with the way that a group is progressing the task the teacher can use academic knowledge, but facilitation depends on other skills. The ambition for Version 2 of the narratives is to provide sufficient granularity so that teachers are able to experience the relational space of a group as it unfolds so that the momentary nature of experience can be better simulated

> 'The present is the filling of a moment of time with
> reality ……… this filling with reality constantly exists

> while the content of experience constantly changes'
> (Dilthey, 1986, p 149).

6.4.1 The contribution from Studies 1-3

The finding from Study 1 (Chapter 3), that the student experience of group interactions was a distinct factor that influenced their overall evaluation of the course, attest to the value of taking into account group processes, social cognition and group dynamics. For Study 2 (Chapter 3) content analysis of the forum dialogue, as developed for the investigation of the COI model, was adopted. Based on this analysis a social presence profile, for each of two project groups was obtained. This analysis is useful in that it highlights how emotion and cohesive moves are expressed in writing by the group members; that the use of vocatives, phatics, salutation, inclusive pronouns and references to the messages of others, should be represented in the narrative. To ground an interpretive approach to the flow of interaction within a group Study 3 (Chapter 5) drew on contributions from the literature review about interpersonal interaction during group work and other social learning contexts. It also drew on psychological theory of inference, as the socio-cognitive process that enables us to formulate 'a mental model of other minds' (Frith, 2007). Empathy, alongside social presence, was identified as a key element for furthering our understanding of socio-emotional experience and relational space. In Study 3 three linguistic devices were identified as relevant for the expression of empathy and social presence, the use of metaphor, question tag and the exclamation symbol: findings that make a meaningful contribution to

decisions about what constitutes an appropriate level of granularity for a narrative. It is important that that these dialogic elements are represented in Version 2 of the narratives.

For the reader to experience the socio-emotional experience of those involved granularity is key, and the reader will need access to the on-going exchange as it develops and as contextually situated. The analysis undertaken in Studies 2 and 3 has evidenced how, over the time course of the group work, participants adapt communication style and appropriate technology in text based forums and that some of these practices become the property of the group. The quality of the narratives, as a representation of socio-emotional experience and relational space, should be improved by reflecting what students and teachers do in practice (Studies 2 and 3), and by representing the momentary nature of experience (Dilthey, 1986). Accordingly, the following nine requirements were applied when developing a second version (Version 2).

Chapter 9   Represent the time frame of the learning encounter.

Chapter 10   Represent the labile nature of relational space over time.

Chapter 11   Represent between project group differences in relational space.

Chapter 12   Represent the expression of empathy and induce reader empathy.

Chapter 13   Build on the scholarship available for informing the facilitative role of the online teacher.

Chapter 14   Demonstrate the role of relational space during group work online.

Chapter 15   Topic neutral.

Chapter 16   Authentic.

Chapter 17   Represent the dialogic tone.

6.5 Constructing Version 2 of the narrative

6.5.1 Criteria 1 and 2

While task-related discourse followed a linear and predictable pattern in both project groups this was not the case for relational discourse. Relational dialogue is labile and reactive and is co-constructed within the social context of the group. Therefore Version 2 includes a full and verbatim transcript of all the contributions of a relational nature and therefore meets criterion 1 and targets criterion 2.

6.5.2 Criteria 2,3,4,6,8,9

Study 2 provided an overall representation of how each project group constructed social presence. However, the profiles have limited granularity and do not represent the labile nature of interpersonal relationships over time. An important outcome from Study 3 was a clearer representation of the detail and the distinctive nature of the discourse practices of each project group across the timeline of the learning encounter as illustrated in

Figure 5.1. Another important finding from Study 3 was that each group appeared to develop a dialect that involved the use of a distinctive pattern of paralanguage and Netspeak. By incorporating these findings into Version 2 criteria, 2,3,4,6,8 and 9 are addressed.

6.5.3 Criterion 4

When group work takes place online it is the sense of *the other* that has been identified as problematic for students (Anderson et al., 2001; Bayne, 2010; Garrison & Anderson, 2003). There is some justification for this claim. In face-to-face interactions discerning the form and shape (the physical presence) of *the other* and interpreting physical movement of *the other* in terms of intentions are foundational elements of implicit social cognition. An argument put forward by this thesis is that when human participants interact with each other online they are capable of adapting language to a remote and asynchronous context for example, by the unconventional use of the symbols (! and ?) to communicate empathy, as illustrated in Figure 5.5. Therefore, it is important that unconventional use patterns are represented by the narratives.

The study of affective empathy in psychobiology has identified *a sense of self* as distinct from *a sense of the other* as essential, (Preston & de Vaal, 2002; Preston & Hofelich, 2011; Walter, 2011). The validity of each of these constructs, *self, other*, and *affective empathy*, is supported by evidence, there are studies that show that areas of the brain are

specifically recruited for each (Blakemore, 2012; Frith & Frith, 2006; Meltzoff & Decety, 2003; Saxe, 2006). Furthermore, from taking a comparative approach, as described in Section 1.7.3.2, it is claimed that reasoning about *others* and their relationship to *self* are social cognitions that are unique to humans and that the ability to reflect upon own mental states and to use language to make cognitions understandable are the processes that underpin explicit social cognition as a uniquely human capability (Frith & Frith, 2012; Saxe, 2006).

When testing the Version 2 narratives as a simulation of relational context, the participants will be specifically advised to make a distinction between *self* and *others* as follows,

> We would like you to imagine yourself as the teacher while you think about the interpersonal exchanges of the students so far.

so that the distinction between *self* and *other* is more likely to be assumed. This instruction provides a way of testing whether the human teacher relies solely on appraisal (adopting a detached and objective stance) or if empathy has a part to play i.e. the teacher with subjective views that arise out of being human. To develop the narratives as sufficient for demonstrating and inducing empathy the identity, anonymised of each contributor is provided so that the reader has access to the individual group members. Furthermore, teachers will be primed to make a distinction between *self* and the *other* when reading the narratives.

6.5.4 Criterion 7 & 5

Conversation relating to the organisation of the group for progressing the task is also included so that the time line of the learning encounter is represented. All other task-related discourse is excluded so as to focus attention on the relational discourse. Task related contributions to the forum dialogue are represented as blank inserts calibrated according to the word count of the contribution and retain their position within the forum discussions. The specification of the criteria that a narrative should meet has developed out of the research literature reviewed in Chapters 1,2, and Section 6.2 (that describes the facilitative role of the teacher in more detail) of this chapter. Therefore, Version 2 should address criterion 5 provided that all other criteria are addressed**.**

6.6 Conclusion

There are two distinct elements involved in group work, relational and task based (Barron, 2003; Van den Bossche et al., 2006). Facilitation of the relational space of a group of students is a key component of the teacher role. A conclusion drawn from an evaluation of the existing scholarship of teaching online (Anderson et al., 2001; Garrison & Anderson, 2003; Salmon, 2000) was that that resources that illustrate the development of relational space over time, and with much more granularity, would be useful. Therefore, a narrative account of relational space was proposed and a requirements analysis was conducted. The narratives should provide

an opportunity for teachers to concentrate on the relational aspects of group work as co-constructed by the group over time, experience it as fellow humans, and get a sense of the unique nature of the relational space of each group.

The validity of these narratives as a representation of the emotional climate of each of the sample project groups will be tested during a further study, Study 4, (Chapter 7). However, co-presence, as experienced in text-based forums, is the central theme of this thesis. Therefore the main aim for Study 4 is to target the spontaneous manifestation of co-presence when participants (acting as online teachers) engage in three distinct activities, reading the narrative, reflecting on the feelings of the individual group members, and writing comments from the perspective of a teacher. It will involve applying neurophysiological methods.

Chapter 7 Study 4 A methodology for obtaining a subjective, behavioural and neural line of evidence

7.1 Introduction

It is argued that socio-emotional experience depends in part on the extent to which a sense of others as real people is salient i.e. co-presence. Co-presence is a difficult construct to describe and define and by consequence, to evidence. It is why co-presence will be investigated at a neural level of description and also as a spontaneous manifestation in facial expression. Both would be objective evidence of co-presence; a manifestation of co-presence that is not under voluntary control and thereby strong evidence for co-presence as undiminished at this fundamental level of experience. The aim for Study 4 was to develop a methodology that could progress our knowledge about co-presence as both an embodied and a subjective experience. During Study 4 subjective, behavioural and neural data will be collected when participants, taking on the role of a teacher, engage with the narratives developed for professional development.

Although the participants are asked to read the narratives, and reflect and comment on them, 'as if' they are managing the project groups, it is assumed that their phenomenological and embodied experience will mirror the valence and motivational intensity of a real encounter, which is itself

experienced through an entirely text-based medium. To some extent the outcome will depend on whether the narratives are a sufficient representation of relational space. Therefore, the first research question is:

RQ1: Are the narratives a sufficient representation of the relational space of each group?

By response to RQ1 the narratives will be evaluated using the criteria developed during the requirements analysis described in Chapter 6 Section 6.6.

The second research question addresses the central topic of this thesis, co-presence and the argument about the quality of interpersonal interaction as reviewed in Chapter 1.7.2. Objective evidence for the spontaneous expression of emotion at a neural and behavioural level of description would support the conclusion that the quality of relational experience is not compromised by the mode of communication. Furthermore this thesis is based on a psycho-biological perspective of social cognition processes. Therefore, for Study 4 the processes involved in social cognition and affect will be investigated using neurophysiological methods. Specifically, neural activity will be continuously monitored by recording an electroencephalogram (EEG) while participants read the two narratives, and while they reflect and comment on what they have just read, so that the momentary nature of experience, as spontaneously reflected by neural activity, can be captured. Similarly, by using another

neurophysiological method, the electromyogram (EMG), spontaneous smiling will be investigated (alongside its voluntary expression) by monitoring the activation patterns of the two facial muscles involved.

> *RQ2: To what extent does collecting a line of evidence, subjective, behavioural and neural data (while participants engage with a simulation of project group interactions) progress our understanding of co-presence when interpersonal interaction takes place at distance?*

By using neurophysiological methods the momentary nature of experience can be monitored. Furthermore, the valence of the relational experience can be investigated as described in Section 7.5.2. Teachers are human and so it is reasonable to expect that the motivational influence of the interpersonal interactions will manifest at a neural level and so provide a proxy measure for the influence of relational space on the motivational experience of students.

The design and procedure for Study 4 are described in Section 7.2. Then Sections 7.3, 7.4,and 7.5 describe the methodology and findings for each of the three levels of investigation, subjective, behavioural and neural. The contribution of the combined findings to each of the research questions is then discussed in Sections 7.6 (RQ1) and Section 7.7 (RQ2) respectively.

7.2 Design and procedure

Narrative will be used as a simulation of the interpersonal interactions that take place during group work. There are two reasons for using narrative. The first is practical and was demonstrated during the pilot study; narrative can be used as a resource to illustrate the interactions amongst participants during group work and to seed discussion as to how to facilitate. The second reason is that narrative has been used successfully when investigating the neural correlates of social emotions (Immordino-Yang et al., 2009; Immordino-Yang et al., 2014). In a study of two social emotions, compassion and admiration, the neural correlates were compared for physical circumstance (compassion for pain, admiration for skill) and psycho-social context (compassion for social/psychological pain, admiration for virtue) by using narrative accounts from the lives of real people. It was hypothesized that since social emotions evoked by physical circumstance is an earlier developmental milestone less cognitive processing is required than for emotions that involve cultural influences. The authors proposed a neural correlate, timing of neural activation of the insula (the insula is an area of the brain involved in interoceptive representation and homeostatic regulation). That activity in the insula peaks later when psych-social and cultural processing of emotion is involved was confirmed by using narrative to evoke these emotions. Furthermore, there was a differential pattern of activation in posterior medial cortical areas (PMC). The relevance for this thesis is that PMC is implicated in self/other introspection while the differential timing of

activation in the insula implies that when studying social emotions that have a contextual and cultural influence a method is required that is capable of monitoring the higher levels of cognitive processing. Measures such as heart rate, galvanic skin resistance, would not suffice since they only reflect the homeostatic function of the insula.

7.2.1 The participants

Twelve participants took part, of whom three were male and two used their left hand for writing. There was a wide age range from mid twenties to mid sixties. They were selected because they share the main characteristics of online teachers in Higher Education (HE). Six of the participants held doctorates, two held professional qualifications at an equivalent level, another was a doctoral student, and the remaining three participants were undertaking a Master's degree part time whilst at the same time working professionally. Eleven of the participants are active teachers, nine in HE, while the twelfth, who is employed in a multi-national company, has responsibility for professional development in her area of expertise. Although all twelve participants have some experience of supervising group work, and online teaching, the amount varied. Three of the participants had extensive experience of teaching on the course on which the study is based and had contributed to the development of the course. Three of the participants are published researchers in the realm of online learning.

Participants were sent the 'Information for Participants' (Appendix G) and the 'Informed Consent form' (Appendix H) before formally asking them to take part. They were then asked to read the 'Preparatory material' (Appendix I) before attending the session. The researcher discussed this material with the participant while she/he was being prepared for the EEG and EMG recording. A trained physiologist applied the EEG and EMG electrodes

7.2.2 The task

The participant was asked to undertake the following steps.

	Activity
1	Start reading the first narrative
2	Pause for 2 minutes in order to reflect on the socio-emotional experience of the group members so far
3	Respond to an invitation to write comments (optional)
4	Resume reading the first narrative
5	Pause for 2 minutes in order to reflect on the socio-emotional experience of the group members at this stage (end of the group project work)
6	Respond to an invitation to write comments (optional)
7	Start reading the second narrative
8-14	Repeat stages 2-6 while the participant engages with the

	second narrative

The participants undertook this task seated in a comfortable chair. At the same time neurophysiological data (EMG and EEG) was continuously collected. The first two participants read the narratives using an iPad, the remaining 10 participants read from a print version of the same narratives (the change was made so that it was easier to ascertain which part of the narrative the participants were reading). For the print version the Mandeville narrative was divided into 7 sections (each section represented successive 5 day periods of the course). Due to the scarcity of relational messages at some points during the course the Wenlock narrative was divided into 6 sections (representing 5,7,8,6,5,5 days) respectively. These divisions were marked so that they were visible to the physiologist who annotated the EMG and EEG records according to these divisions.

Once the participant had started the first step (reading) the instructions for each subsequent step were embedded at an appropriate point in the narrative. While reading each narrative participants were asked to pause to reflect for 2 minutes and then write notes at two points. The first pause occurred when the project group had submitted a final version of the project proposal and were waiting for feedback and permission to start collecting data. The second pause point occurred when the project group had submitted a presentation to a mini plenary session and were waiting

for feedback from teachers and fellow students. The instructions to participants at these two pause points are in Appendix J. Participants were reassured that it was their individual approach to the task that was of value.

A session involved engaging with a simulation of two groups. From participant comments made post session it became apparent at an early stage that the order in which the narratives was presented might influence the data. When engaging with the second narrative it seemed that an additional cognitive activity comes into play, the participants start to make comparisons between the two project groups. Therefore order was quasi randomised so that 6 participants read the Wenlock narrative first and six the Mandeville narrative.

A session varied in length from 45 minutes – 1 hour 20 minutes with most of the participants taking about 1 hour to complete the task. At the end of the session, and while the physiologist was removing the electrodes, the participants were asked one further question

Now that you have had the opportunity to read both narratives

do you have any further comments to make?

In Study 4 three types of data are collected while participants engage with this task. The following sections will describe the methods used to collect and analyse each type of data the subjective (Section 7.3), the behavioural (Section 7.4), and the neural (Section 7.5).

7.3 A teacher perspective: The subjective account of the participants who took on a teacher role

The participants were teachers who were participating 'as if' they were managing the online project groups, i.e. the Mandevilles and The Wenlocks. This meant that the process of empathic participation could be studied under more controlled and accessible conditions than is possible during the actual remote teaching on a course. Version 2 of the narratives is based on the interpersonal interactions of real people taking part in an authentic collaborative learning context online. When the participants are reading these narratives it is simulating the situation where the teacher is working through the online comments and has to decide what their actions should be.

Participants were asked to read each narrative and engage with them as the teacher. That the narrative represented the relational space of the group was explained in the preparatory material (Appendix I)

> *For this study we would like you to concentrate just on judgments about discussion that contributes to the relational space as it is constructed in each of the project groups.*

The participants were also asked to undertake two further activities, firstly to pause and reflect and secondly to write comments. They were asked to do this at two points through prompts embedded within the narrative.

> *Before reading on please spend 2 minutes engaging emotionally with this group of students. Put yourself in their place as they go about the rest of their lives while they wait for feedback. Then if you would like to take an extra minute or two to write some comments to share with me that would be extremely valuable.*

Two sets of data were collected,

1. The written comments made while engaging with each narrative.

2. The spoken comments made immediately post session.

The analysis and findings from each of the data sets are described in the sections that follow.

7.3.1 A thematic analysis of the comments made while undertaking the task

With the exception of one participant (at the second pause point for the Mandevilles) all twelve participants provided comments during each writing activity. The comments from all 12 participants, and for each narrative, were collated to one transcript. To identify whether there were any recurring themes (patterns) a thematic analysis was carried out on this data set using the guidelines provided by Braun and Clarke (Braun & Clarke, 2006). Thematic analysis is a flexible method; it can involve taking either an inductive (data driven) or a theoretical approach. For Study 4 the analysis is guided by theory:

- The idea of a successful collaboration as dependent on a satisfactory interrelationship between task space and relational space (Barron, 2003)

- The teacher's role in facilitating the collaboration (Anderson et al., 2001).

- From a neuroscience perspective the teacher as human with a sense of self and the capacity for empathy (Saxe, 2006; Walter, 2011).

The transcript was read many times. Initially the following codes were identified; the group, the group dynamics, the individual, the teacher, guidance, language style, technologies, the course stakes, emotions, mode of learning, progress with the task, social cues and workload balance. After an extensive and recursive process of review in the context of the theoretical framework outlined above, two main themes and a number of sub themes were identified, as represented in Fig 7.1. The two main themes were identified as representing the overall experience of a teacher (participant) in this context; being emotionally involved, or in their role as a teacher with responsibility for guiding the task and encouraging a positive emotional climate. Each theme identified different kinds of description of their experience: (i) emotional involvement being given through expressions of affective or cognitive empathy, and (ii) as the teacher, a detached observer appraising the task and relational space as constructed by the group members.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
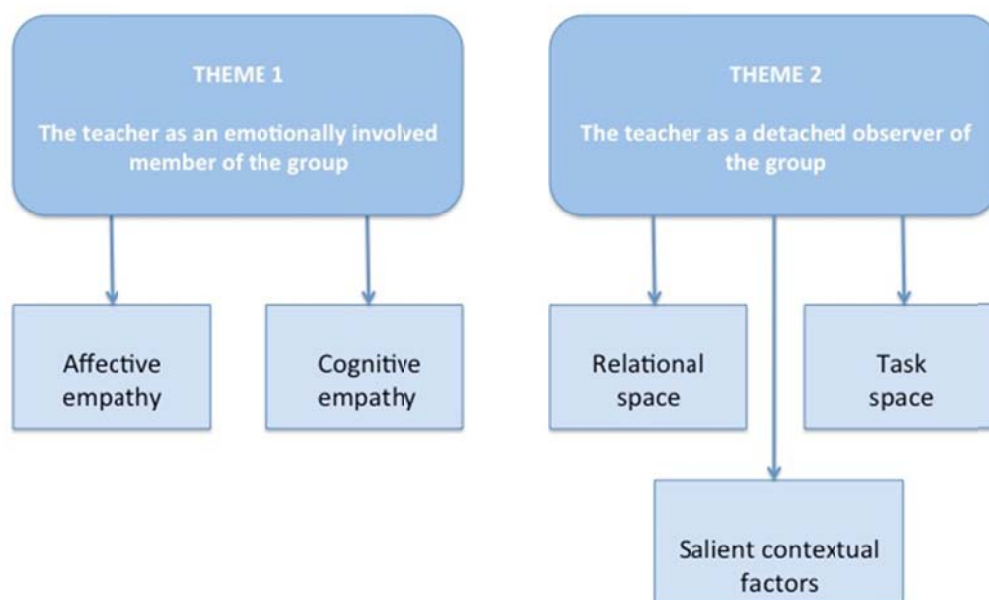
Figure 7-1 Teachers' subjective experience - a conceptual map

Illustrative comments are provided for the main themes and the subthemes. However, the comments were handwritten while participants were undergoing the EEG and EMG recording procedure and there may be some occasional transcription errors when reporting these.

7.3.1.1 Theme 1: The teacher (participant) as an emotionally involved with the group

Statements about 'feeling state' were common and could refer to the group as a whole

Students probably feeling a little tense around this point. Those that have put in more effort may feel a bit peeved that other haven't pulled their weight (P11)

an individual student,

Delia feeling unsupported at the end when the presentation was due (P8)

 or the participant 's (teacher) phenomenological experience

You can feel the tension (P12)

To analyse this theme in more depth, in particular the distinction between reference to 'self feelings' and 'inferences about the feelings of others', a definitional distinction, as formulated in neuroscience, was applied. Neuroscientists are interested in determining the anatomical and functional properties of affect (self feelings) and empathy (inferences about the feelings of others) and they have developed definitions for each to study these processes at a psycho-biological level.

For neuroscience research affective empathy is defined as follows.

> [A]n affective state that is elicited by the perceived, imagined, or inferred state of the affective state of another.

While cognitive empathy is defined as follows.

> [T]he ability to understand the feelings of others without necessarily implying that the empathiser is in an affective state himself (Walter, 2011, p 10).

By applying these definitions to the data set two sub themes were identified.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

Affective empathy

Some participants expressed self-feelings

> I feel a sense of disapproval about Fran going out rather than staying in and getting this sorted out (p7)
>
> Blond moments were off putting (even though I am a brunette) (P4)
>
> The blond stuff was weird (P7)
>
> I feel a bit more connected now with the new PC (Jody), the working nights (Helen), the going out (Fran) (P7)

There were some reflections that did not lead to a sense of emotional

connection. For example, when commenting on the Wenlocks one

participant wrote

> Very hard to engage 'emotionally' with the group as a teacher, although I am aware of them as individuals, know something of them as individuals (P4)

This contrasts with the comments made by the same participant (P5) while

engaging with the Mandeville narrative

> Sharing the sense of phew (P5)

Cognitive empathy

When the comments referred to the feelings of either an individual or a

group the use of modifiers, 'perhaps', 'probably', 'may', 'assume', 'imagine',

'seems', 'think' was common suggesting that the teachers (participants)

were inferring the emotions of others and that they did not share their

emotional state.

It can be frustrating to miss Live Chats then you fell out of the loop (P12)

There seems to be some tension in the group about broken agreements to spend time in Live Chat (P3)

Think they may be feeling much happier and keen to move on (P11)

I assume some feeling of anxiety, possibly guilt, maybe smugness for some….as a group, probably well enough pleased with each other (P5)

I can imagine this group carrying on thinking about their proposal while they wait (P2)

Perhaps she (Delia) was demotivated when her alternative suggestion in the early stages wasn't discussed (P4)

7.3.1.2 Theme 2: The teacher (participant) as a detached observer of the group

The comments that contribute to this theme are characterised by their categorical nature with most of the participants going beyond the remit of the study to appraise task space alongside relational space. Furthermore, the appraisals were supported by analysis and comment by the participants on the factors involved so that three sub themes were identified: relational space, task space, and salient contextual factors, as illustrated in Figure 7.1.

Relational space

It would seem that the order in which the participants read the narratives influenced the comments that contribute to this sub-theme. The following

comments all apply to the second narrative that they read i.e. they are in a position to make a comparison with the first narrative.

Supportive group (Mandeviilles) (P4)

Less encouragement (pats on the back). Less energetic, collegial group(Wenlocks) (P9)

Much more emotional investment by this group (Mandevilles) than the previous group (Wenlocks) (P11)

Lots of affirmation, lots of relational interaction (Mandevilles) (P11)

This group (Mandevilles) is much happier, more energised, more voluble, more complimentary expressive to each other (P2)

Task space

Although the narratives are task neutral the participants also formulated an impression about task space. These comments cohere around two topics:

Topic 1: the group process of collaborating on a joint task.

Too many different ideas at once (Mandevilles) (P2)

Too much administration, not enough thought/action on the actual topic (Wenlocks) (P2)

Should be more engaged with the subject (Wenlocks) (P2)

Very limited discussion about feedback/context (Wenlocks) (P2)

Minimalist approach to the task (Wenlocks) (P2)

Seemed like lots of independent actions (Mandevilles) (P8)

Balance of work seems much more equitable (Mandevilles) (P11)

They all seem to contribute lots of ideas (Mandevilles) (P9)

Lots of looking backing and forth seem to have led to confusion (Mandevilles) (P9)

Some in the group are doing more than others (Wenlocks) (P9)

I think that the workload was unfairly distributed (Mandevilles) (P7)

I would encourage the group to stick to the agreed time line (Mandevilles) (P1)

Topic 2: The participation of individual members

Don't know how it happened but Laura posted up a presentation – not even co-operative working here (Wenlocks) (P8)

A few of the students seem to be taking on the bulk of the work with some just dipping in and out with minimally helpful contributions (Wenlocks) (p11)

As a teacher I would have been worried about their participation (Wenlocks) (P5)

Some members not contributing (Wenlocks) (P1)

Taken together these comments indicate that participants gained a sense of the interrelated nature of task and relational space.

Salient contextual factors

In their comments the participants drew attention to some contextual factors, an indication that these factors would be appraised as salient if they were in fact the teachers facilitating the group. These comments position the teacher as an emotionally detached observer using their practitioner experience and knowledge to identify and manage the factors that mediate relational space and the students' progress with the task. Some teachers made observations about communicative style.

> Very 'chatty' style – lots of informal language (Mandevilles) (P9)
>
> One or two members use impatient/aggressive language style (Wenlocks) (P10)
>
> Introductions are all similar in style, informal, brief (Wenlocks) (P2)
>
> The only noticeable 'personality' is from the things like 'hugs' and 'luv' and '!!!!!!!, (Wenlocks). There is a contrast between the stark online scenario and the over exaggerated punctuation (Wenlocks) (P7)
>
> All of them calling each other "pinks" '(Mandevilles- pink was the colour code for the Mandeville forum) (P7)

The participants also made observations about group differences in the sharing of personal and social information.

> Then they (the Mandevilles towards the end of the course) share a lot of personal information about birthdays and Christmas (P12)
>
> Very little personal data revealed (Wenlocks) (P10)
>
> More sharing of personal information, family, birthdays, etc (Mandevilles) (P10)
>
> Fewer personal comments (Wenlocks) (P4)
>
> We all know exactly who Bethan (Mandeville group) is and what is going on in her life (P7)
>
> The only social data was about the pianist (from an individual in the Wenlock group) (P7)
>
> I know nothing about them (Wenlocks) except that several work late (P2)

Some comments concerned the use of technologies. Some were merely observational while others were focused on the impact on task and/or relational space when some students within a group crave real time communication i.e. to interact synchronously using Live Chat.

> They seem to over organise Live Chat but then don't all show up. They need to think about working together using the forum (P12)
>
> The group are preoccupied with simultaneous actioning rather than sharing ideas in other ways (P10)
>
> Continued obsession with co-presence at expense of leaving thoughts for team review (P10)
>
> Many attempts to talk to one another synchronously but forum discussion is none existent, apart from posting up attachments (P8)
>
> Adding difficulties to an already tricky task by agreeing to meet in Live Chat then apologising for not making the chat (P6)

7.3.1.3 The post session data set

Although six of the participants (1,2,4,5,8,11) did comment about differences between the narratives (project groups) at the writing stages of the procedure, these were not available to the researcher at that time. Therefore, at the end of the session, while the physiologist was removing the electrodes, the participants were asked the following question

> *Now that you have had the opportunity to read both narratives*
>
> *do you have any further comments to make?*

The purpose of this question was to ascertain whether a perceived difference between the two groups in terms of emotional climate had emerged. To avoid biasing the evaluation of the narratives the participants were not explicitly instructed to make a comparison. Nevertheless eight of the participants (1,2,3,4,5,6,10, &11) identified the Mandevilles as the more positive group while the comments from two other participants (7,8) are indicative but less direct.

Overall the Mandevilles were the more friendly group (P1)

Thought Wenlocks were OK but having read them both realised that Mandevilles were more friendly and supportive and that members were more likely to look forward to the group work (P2)

The Mandevilles were supportive of each other, took the trouble to explain absences or lateness, the others got a glimpse of their life circumstances. The Wenlocks were frosty, business like, unfriendly (P3)

The Mandevilles were collegiate and supportive the Wenlocks were quick and sharp in their comments (P4)

The emotional climate of the Mandevilles wins hands down (P5)

The Mandevilles gelled better than the Wenlocks. Can pick up on an underlying sense of annoyance within the Wenlock group (P6)

Mandevilles definitely more supportive and showing empathy (P10

The Mandevilles showed much more social and emotional investment in the group. The Wenlocks –shallow engagement with each other (P11)

The Mandevilles were working hard at being a group, some tricky moments but got through together. The Wenlocks were really frustrating I couldn't get to know them (P7)

Mandevilles got it together. Wenlocks didn't know how to work together (P8)

7.3.2 Subjective data. Comment on the method

The data collection procedure was unconventional in that the participants were asked to provide written comments in order to share their reflections. Since both the EEG and the electrical activity of the facial muscles are best recorded when the participant is comfortable and relaxed it was decided, at the design stage, to ask the participants to communicate by writing in order to minimise artifact in the EEG and EMG recordings. The mode of

communication used by participants was one reason why thematic analysis (TA) was chosen as the method for interpreting the transcript. Methods that rely on spoken discourse, for example, Conversation Analysis (CA), or socially constructed discourse, for example Discourse Analysis (DA), are not appropriate in the context of Study 4. CA is a method for analysis social interaction face-to-face, spoken and non-verbal, and DA presupposes a discussion whereas the participants in Study 4 were asked to report on their reflections. The theoretical flexibility of TA confers other advantage; an epistemological and ontological position from both Neuroscience and Education can be accommodated, and integrated to some extent. Knowledge from both Neuroscience and Education has been applied to the study of empathy in a way that is both systematic and coherent: systematic, because the thematic map was developed recursively by applying a pre-determined definition of empathy, and coherent, because the analysis was theoretically grounded and involved identifying meaningful links between Education and/or Neuroscience.

7.3.3 Subjective data: Comment on the findings

By response to RQ2 it is significant that criterion 4 has been met.

- The narratives do induce reader empathy (Criterion 4).

Empathy depends on achieving a sense of the thoughts and feelings of others and by implication confirms co-presence.

By response to RQ1 the subjective findings reported in this section demonstrate that in addition three further criteria have been met (3,5,6).

- The findings demonstrate that the narratives can be used to build on the scholarship available for informing the facilitatory role of the online teacher (Criterion 5).
- The narratives can demonstrate to teachers the role of relational space in collaborative learning (Criterion 6).
- The narratives do represent differences in relational space of each of two project groups (Criterion 3).

Four criteria for the narratives (1,7,8,9) were predetermined so 8/9 criteria in total are addressed. Evidence to show that the narratives represent the labile nature of relational space, criterion 2, cannot be assessed from this phenomenological data. The following provides a more detailed description as to how each of the criteria were met.

7.3.3.1 Criterion 5

By engaging so wholeheartedly in the task the participants, who are experienced teachers, have made some valuable observations that can contribute to the scholarship of teaching and learning in online social contexts. Firstly, there is a view in the research literature of a linear progression, from socialisation to knowledge construction, during social learning online (Murphy, 2004; Salmon, 2000). The comments made by

some participants in Study 4 challenge this view. They noted that exchanges of a social nature occur throughout the learning encounter and that some meaningful personal information was not shared until the latter stages.

Secondly, the comments that participants made were sometimes directed at the group as a whole and on other occasions at individual students. For the Mandeville group there were 20 separate comments about individual students (4/5 students were named) for the Wenlock group there were 8 separate comments about individual students (4/8 students were named). From the perspective of the pedagogy of collaborative learning a focus on the 'group as a unit' (Stahl, 2006, 2011; Stahl, Koschmann, & Suther, 2006) is paramount. However, when relational space is fore grounded it becomes apparent that in practice, teachers are likely to attend to individual as well as group needs.

The third contribution relates to the use of technology for communication. Collectively (in both the pilot study and Study 4) teachers drew attention to the way that students use these technologies. For this course students were able to communicate both synchronously, by using Live Chat, and asynchronously with a dedicated forum functioning as a repository for the interpersonal interactions. Although a Live Chat facility can be useful (for example, when making organisational decisions) for group work the task and outcome should be jointly owned so that using Live Chat is not always

appropriate. Arranging to meet at a set time can compromise flexibility for some students while others are left out. Furthermore, one of the key advantages of asynchronous CMC is the opportunity to reflect before responding, some participants in Study 4 noted that the Wenlock group sacrificed this advantage.

Finally, the comments about communicative style are significant. Study 3 drew attention to the way that students adapt communicative style and is why communicative style was fully represented in the narrative. For example the adaptations can involve frequent use of metaphor, Netspeak, informal language. Some participants in Study 4 commented on these adaptations specifically that they could be challenging for some students, for example, those with English as a second language.

7.3.3.2 Criterion 6

The comments from some participants raise an important question about the role of relational space during group work namely, whether some groups prioritise relational space over task space to the detriment of the outcome, i.e. the group assignment. For example a comment made about the Mandevilles by one of the participants.

> All very careful not to make negative comments about any individual's work/contribution. Risk that they may be scared to give a genuine criticism which could impact on the quality of the final work (p10)

This could be an example of 'groupthink' the 'group as a unit' valuing group cohesiveness above the quality of the outcome from the group task (Janis, 1997). For online contexts there are technological and AIED solutions for group think. AIED methods can be used to monitor the collaborations on the task and, when appropriate, offer tagging tools (hints and suggestions) about how a group might progress to the next level of knowledge building. The question for researchers is how to evaluate the interrelationship between task and relational space so that such solutions are applied effectively.

7.3.3.3 Criterion 4

Theme 1 is important because it brings into focus the human teacher as emotionally involved and empathetic. The quality of the experience of co-presence (a sense of others as fellow humans) during asynchronous social interaction in online contexts is the question that pervades this thesis. Theme 1 provides strong evidence that a sense of others and their feelings (co-presence) is appropriately developed in this context. The findings from the pilot study also demonstrate that reading and discussing narrative material was sufficient for inducing empathy and social emotion. However, the narratives (Version 1) for the pilot study were deliberately constructed as contrastive and focused on examples of social interaction that were extreme. By contrast, the narratives (Version 2) for Study 4 are an authentic representation across the time frame of the project group

encounter. Therefore, the subjective evidence that these narratives (Version 2) can induce empathy in the reader, and that the participants were able to discern differences between the emotional climate of the two groups, is strong evidence that others are experienced as real in these contexts i.e. that co-presence is not compromised.

7.3.3.4 Criterion 3

The comments made post session echoed some of the comments collected while the participants engaged with the narrative. 10/12 of these comments described the emotional climate of the Mandeville group as more positive, which was consistent with the view of the student participant whose survey comments determined the choice of groups to study.

Criterion 2 could not be assessed using the subjective data since

> affect is always 'turned on' and 'simmering' moving along, since social action is continually embodied (Wetherell, 2012, p. 12).

However, the patterning of affect can be monitored using neurophysiological methods as described in the following two sections.

7.4 Behavioural patterning

In face-to-face contexts the human face is considered a potent channel for interpersonal communication and emotional expression (Argyle, 1988; Boker et al., 2009; Oberman, Winkielman, & Ramachandran, 2009; Parkinson, Fischer, & Manstead, 2005; Rutter & Stephenson, 1977) and is

why facial expression was chosen as the target behaviour for Study 4. The expression of emotion, a facial expression for example, is both an input to the process of social interaction, and an output. Emotion is expressed, either voluntarily or involuntarily and provides information about the expresser that is socially relevant. In face-to-face contexts impressions and expectations about the expresser are the result and these impressions will in turn 'affect the nature of the on-going interaction' (Riggio & Friedman, 1986, p 425).

Expressions of emotion for example, smiling, tone of voice, are not available during group work online using CMC. It is why the findings from Study 2 and Study 3 that demonstrate how students adapt their communicative style and appropriate the technology are so interesting. These elements have been incorporated into the narratives and the question is whether they elicit an expression of emotion by the reader (interactant).

At a biological level facial expression is a reflection of the many different patterns of skin movement that are effected through the activation of the underlying musculature. There are 19 muscles on each side of the face involved in facial expression with the pattern of muscle contraction being an important indicator of emotion (Pelachaud, 2009). The activation patterns of the two facial muscles (orbicularis oculi and zygomotor) that are involved in smiling behaviours are particularly relevant for the investigation

of affect. Both are activated when a smile is produced spontaneously while smiles under voluntary control are confined to activation of zygomotor (Duchenne de Boulogne, 1862, 1990; P. Ekman et al., 1990)

The Facial action Coding system (FACS) (P. Ekman, Friesen, & Hager, 2002) and facial electromyography (EMG) (Fridlund & Cacioppo, 1986) are two methods used to investigate facial expression of all kinds. Both techniques have benefited from rigorous assessment and application over a significant period of time and in a range of contexts, and detailed procedural guidance is available for both (P. Ekman & Friesen, 1978; Fridlund & Cacioppo, 1986). The EMG has been chosen as the method for investigating smiling behaviours whilst reading the narratives for two reasons. Firstly, and most importantly, it is a method that can represent the labile nature of relational space (Criterion 2 for the narratives) and by consequence, the patterning of affective practice. Secondly, some facial expressions last for less than 2 seconds (R. J. Davidson, 1992) and are likely to be missed when using the FACs, even by a highly trained observer.

For Study 4 the expression of positive emotional experience was investigated by monitoring smiling behaviours using the electromyogram (EMG). However, smiling is not confined to expressions of positive affect for example, it can be an expression of irony, and it can used to conceal feeling and/or intention (Duchenne de Boulogne, 1862, 1990; P. Ekman et

al., 1990). By stimulating a facial muscle (zygomotor) electrically Duchenne was able to evoke a facial activation (upward curving of the corners of the mouth) from a volunteer as illustrated in Figure 7.2 (left) that could be interpreted as a smile (Duchenne de Boulogne, 1862, 1990). In contrast, when the volunteer smiled spontaneously the facial muscle, orbicularis oculi was also activated as illustrated in Figure 7.2 (right).

Figure 7-2 Spontaneous smiling (right) and when zygomotor is electrically stimulated (left) (Wellcome Trust images)

Based on this experiment Duchenne concluded that crinkling below the eyes is an involuntary indicator of positive affect as experienced by the expresser; for a smile to be a true expression of positive affect there should be activation of both orbicularis oculi and zygomotor.

Therefore, for Study 4 the positioning of the electrodes for the EMG has been chosen so that a distinction can be made between a smile that is spontaneously expressed (activation of both orbicularis oculi and

zygomotor) and a smile that is under voluntary control (zygomotor only activated).

7.4.1 Smiling behaviours as reflected by the EMG

The activation patterns of three facial muscles, frontalis, orbicularis oculi, and zygomotor were monitored using electromyographty (EMG) from pairs of electrodes (contact area diameter < 4mm) that were placed 3 cms apart over three facial muscles bilaterally. A bipolar recording for each facial muscle was reconstructed from the digitised data and digitally filtered to remove frequencies below 10 Hz.

To identify an activation as an indicator of smiling (voluntary or involuntary) two criteria were applied. Firstly, any activation pattern lasting longer than five seconds was excluded. The narrative represents the interpersonal interactions as they unfold and it was predicted that changes in facial expression that relate to emotional experience while reading the narratives will be fleeting. Secondly, activations patterns in the two target facial muscles that co-occurred with myogenic activity in any one of six control channels were excluded from further analysis. Specifically, the EMG for orbicularis oculi and zygomotor was inspected visually alongside the EMG from frontalis muscle, the Fz EEG channel (as a control for blink potentials), the F7 & F8 EEG channels (as a control for saccade potentials) and the T3 & T4 EEG channels (as a control for activation of temporalis muscle). This procedure was a control for myogenic activity resulting from

embodied behaviours (other than smiling) that involve the face. These include biting fingers, stroking the face with a pen, facial movement (non-expressive) and actions that reflect the concentration that participants applied to the task. Furthermore, orbicularis oculi is also activated for voluntary blinks (Iwasaki et al., 2005). The activations that met the two criteria were then classified as either an involuntary (activation patterns for both orbicularis and zygomotor) or voluntary (activation pattern for zygomotor alone).

7.4.2 Analysis of the behavioural data

Complete data was available for only 11/12 of the participants. EMG recordings of facial muscle using surface electrodes are not usually undertaken in the department that hosted this study. Therefore the EMG record from P1 was a pilot and was subsequently discarded.

The frequency of each type of smile (*smiling behaviour*) for each narrative (*projectgroup*) was calculated for each of 11 participants (P2-P12). These data were analysed using a repeated measures linear model with two factors (*projectgroup, smiling behaviour*). The order in which the narratives were presented (*order*) was also included in this model, specified as a between subject factor.

Table 7-1 Smiling behaviours, spontaneous and voluntary

Factors		p value
Main effects		
	projectgroup	**0.000**
	smiling behaviour	0.066
Two factor interaction		
	projectgroup/order	0.701
	projectgroup/smiling behaviour	**0.008**
	smiling behaviour/order	**0.005**
Three factor interaction		
	projectgroup/smiling behaviour/order	**0.001**

Smiling (spontaneous and voluntary), as detected by visual inspection of the EMG of two facial muscles (orbiularis oculi and zygomotor) was significantly more frequent while reading the Mandeville narrative (a mean difference of 12.5 smiles), and there was a significant interaction between the type of smiling behaviour detected and project group. The mean ratio of spontaneous to voluntary smiles was significantly higher when participants were reading the Mandeville narrative. The interaction between smiling behaviour and order was also significant, when the Wenlock narrative was read first the average number of spontaneous smiles (as expressed while reading both narratives) was 25 while for

voluntary smiles it was 8. In comparison, when the Mandeville narrative was read first the average number of spontaneous smiles was significantly lower (14 smiles). These results are consistent with the significant *projectgroup/smiling behaviour/order* interaction. The findings indicate that the order in which the narratives were read and the content of the narratives influence behaviour as evidenced by the occurrence of a smile, and the type of smile.

7.4.2.1 Laughter

There were 11 occasions when both the researcher and the physiologist noted that a participant had 'laughed out loud'. Six participants did so, for two of these participants there were multiple episodes (3 and 4 respectively). The activation patterns of the two target facial muscles during these episodes met the criteria for a spontaneous smile and were classified as such. Laughter was a vocal indication of activation of the facial muscles involved in smiling. An illustrative example of the patterning of smiling and laughter while reading is provided in Figure 7.3.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
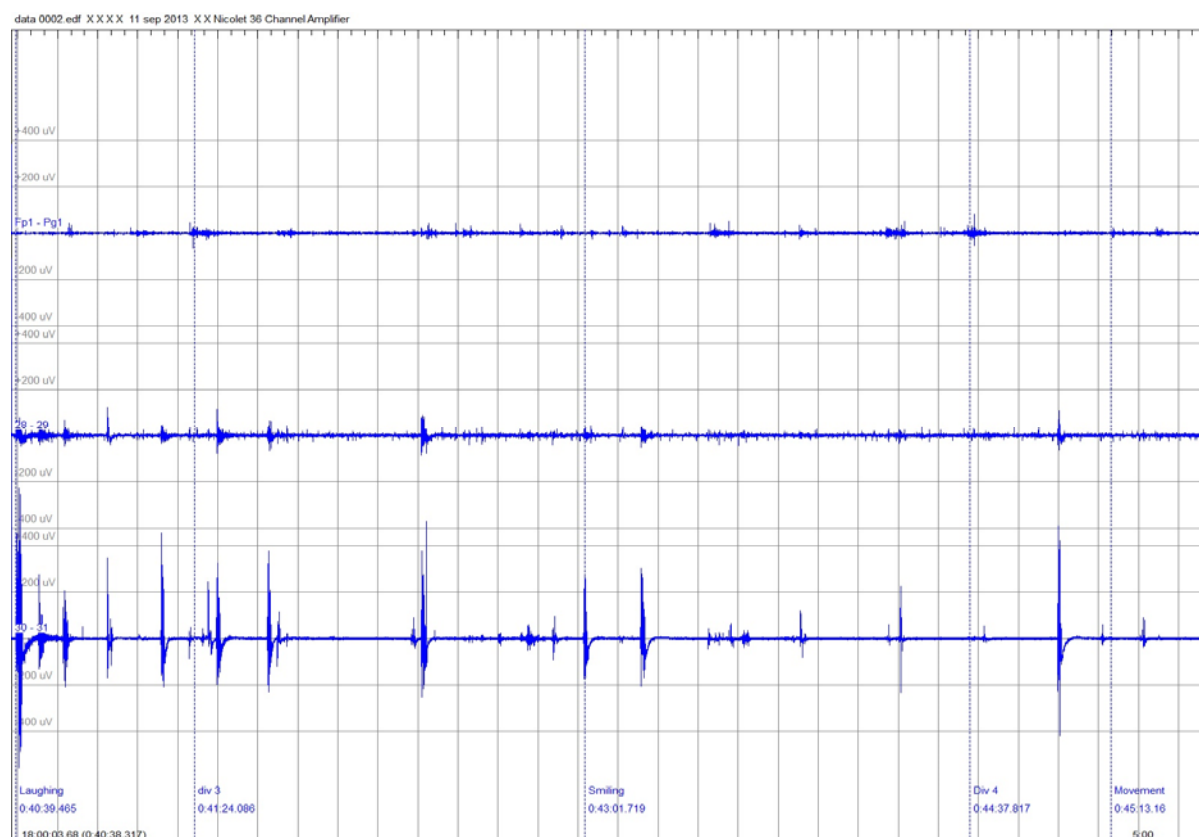
Figure 7-3 The patterning of smiling and laughter. 20 minute EMG. The top channel is frontalis, the middle orbicularis oculi, the bottom is zygomotor

7.4.3 Behavioral data. Comment on the method

Smiles can be described in a number of ways, for example: duration, frequency, type, and quality. To 'measure' smiling for Study 4 the frequency and type of smile (voluntary or spontaneous), as evidenced by the EMG, were chosen. The identification and classification of smiles depended on visual inspection of the EMG. Although this was carried out systematically following predefined criteria there are limitations. The main limitation involves the reliable distinction of myogenic activity as produced by smiling from the on-going background of electrical activity at the

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recording sites. Further research would benefit from using digital methods (for example, integrating the EMG) and further refinement of the recording procedures.

7.4.4   Behavioural data. Comment on the findings

The findings show that a simulation, reading a narrative account of interpersonal interactions of a relational nature, can result in smiling behaviours and on occasion laughter. Furthermore, the content of the narrative (the representation of relational space) and the order in which the narratives are read have been identified as factors that can influence the frequency of smiling and the type of smile (voluntary, spontaneous).

By response to RQ1 the behavioural findings can be interpreted as evidence that the narratives meet three criteria (3,2,1) as specified in Chapter 6. Firstly, the frequency of smiling behaviour was significantly higher when reading the Mandeville narrative indicating that the narratives do represent project group differences in relational space (criterion 3). Secondly, the labile nature of relational space over time is reflected in the patterning of smiling behaviours (criterion 2). Thirdly, the findings make a contribution to research and scholarship (criterion 5). The strategic use of text to convey emotion and its implications for social interaction online are not well understood (Marcoccia, Atifi, & Gauducheau, 2008). By focusing on how participants *respond* to the expression of emotion by others (as represented in the content of the narrative) the finding that both

spontaneous and voluntary smiling occur is important in that it adds to the body of evidence about social interaction when using written communication in CMC contexts. In previous research the *production* of relational content while students use CMC for interpersonal communication had been studied using video (Marcoccia et al., 2008). The facial expression of four pairs of participants was monitored while they engaged in an Instant Messaging (IM) exchange. By monitoring facial expression, alongside the use of text to indicate emotion, three different ways in which the *production* of text and the expresser's facial expression of emotion co-occurred were identified. Textual descriptions of emotion such as expressive punctuation, disclosure, and emoticons, were sometimes used alongside a smile and sometimes they were not. The third example involved an emotion being expressed in the text that was contradictory with facial expression, a deception; thereby demonstrating that the textual use of emotional markers during online communication did not always match the behaviour of the individual in physical space; that affect expressed through writing does not always match the state of the sender. It is why the patterning of each type of smile (voluntary, spontaneous) while reading the narratives is so interesting; it raises questions about what aspects of the discourse, and their context, determine each type.

7.5 Neural patterning

Although non-verbal spontaneous expressions of affect can occur during social interaction using CMC, and is evidence that the quality of co-

presence need not be compromised, neural data would be further objective evidence for co-presence and therefore make a significant contribution to RQ2.

The following subsection, Section 7.5.1, will describe why the electroencephalogram (EEG) was the technique chosen to monitor the patterning of neural activation when participants engaged with each of the two narratives. Then the following two subsections will review some Neuroscience research that is relevant for the study of affect using the EEG (Section 7.5.2) and co-presence, as indexed by social cognition processes (Section 7.5.3).

7.5.1 The EEG as an index of neural activity

Using EEG techniques neural activity can be recorded as an electrical potential between a pair of electrodes placed on the surface of the scalp. The EEG as a representation of neural activity in the time domain is excellent. When the electrical signal recorded at a pair of electrodes is represented as a graph of voltage against time a representation of neural activity can be plotted every 0.04 seconds (when using an analogue to digital sampling rate of 256 Hz). By contrast, it is important to emphasise at the outset that the EEG, as a method for locating the source of neural activity, is limited. There are other limitations. At any point in time the EEG signal represents the summation of an extremely large number of postsynaptic potentials from the dendrites that are orientated perpendicular

and relatively close to the scalp surface; these are modified by volume conduction and it is impossible to know whether the EEG is due to inhibitory or excitatory potentials.

However, in the context of Study 4 there are several reasons for preferring the EEG rather than using neuro-imaging techniques to investigate neural correlates. Firstly, compared with fMRI (the neuroscience method used in previous studies that used narrative to evoke social emotions) the EEG is less constraining and participants should be able to engage with the narratives as they would in context i.e. when teaching online. The EEG (or MEG) is the neuroscience method most suited to monitoring the patterning of affective practice and the labile nature of emotion. Secondly the EEG is a direct measure of neural activity (unlike the fMRI which is an indirect measure). Thirdly, the EEG has been the preferred technique for an increasing number of other studies in emotion research (reviewed in 7.5.2) some of which has contributed to the circumplex (dimensional) model of emotion and its interrelation with motivation, as described in Chapter 1, Section 1.7.2. The relevance of a dimensional model for engagement with learning is that the valence (quality) of the experience will influence the intrinsic motivation to engage. A fourth reason for using the EEG as a method for monitoring neural activity is that visual inspection procedures for interpreting the EEG as a representation of neural activity are firmly established; the first EEG study of a human was reported in 1929 and it has been developed and used as a routine clinical tool since the 1950s.

More recently it has been possible to collect the EEG as digital data and techniques have been developed for its quantitative analysis (QEEG). The analysis of the EEG for Study 4 will use both approaches, visual inspection and QEEG.

7.5.2 The EEG as an indicator of emotional experience

From a psych-biological perspective the study of affect when an individual is learning is important because intrinsic motivation to engage, or avoid a situation, depends on emotional experience. The motivational intensity of an event, the state dimensions, can be indexed by neural activity. In Chapter 1 Section 1.7.2 individual differences (trait) was also identified as a factor influencing the interrelationship between emotion and motivation. Hemisphere asymmetry during 'resting' neural activity, as indexed by the EEG, is correlated with psychometric measures of the dominance/submission dimension (i.e. the trait dimension of emotion is also reflected neurally) (Allen, Coan, & Nazarian, 2004; R. J. Davidson, 1992, 2004; Harmon-Jones et al., 2010). These authors propose that the contribution of state and trait aspects of the interrelationship between emotion and motivation is as follows. The motivational intensity (approach, avoidance) of an emotional event is modulated by a trait dimension (dominance/submission) which in turn has an effect on affect as modulated by its quality during a social encounter. When motivational intensity is high and/or valence is positive, then neural activation is greater in the left frontal hemisphere (i.e. the interaction between state and trait dimensions of

emotion is represented neurally). When the motivational intensity is low and/or the valence of an emotional experience is negative, neural activation as indexed by the EEG is greater in the frontal regions of the right hemisphere of the brain i.e. there is a degree of hemisphere specialisation for emotional experience.

There is supporting evidence for a hemisphere specialisation for the processing of an emotional experience. Two recent reviews are relevant and both are notable for the wide range of methodological techniques that have been used in the cited research with some of these techniques either predating, or not depending on, the use of modern neuro-imaging techniques (Demaree, Everhart, Youngstrom, & Harrison, 2005; Harmon-Jones et al., 2010). The methods include surveys of patients who have undergone carotid angiography, a pre-surgical screening procedure used to assess which hemisphere is dominant for language (sodium amytal is injected into a carotid artery so that the functioning of one of the brain hemispheres is blocked), the neuropsychological investigation of patients who have discrete anatomical lesions of the brain that compromise their ability to express emotion, or recognize and process an expression of emotion in others, and experimental studies using repetitive transcranial magnetic stimulation (rTMS) to block function in discrete brain areas. Participants with a healthy brain have also taken part in psychological studies that involve comparing the outcome when emotional material is presented selectively to either the right or the left hemisphere. By

combining neuroscience and psychological methods and extending the theoretical implications to include the motivational properties of emotional events, and individual differences in the self-regulation of emotion, these studies developed a nuanced account of hemisphere asymmetry in neural activation during emotional processing. This body of evidence, that one hemisphere is less accomplished than the other for a particular emotional task, has been operationalised into hemisphere asymmetries in activation that can be indexed using EEG techniques.

The implications of this knowledge for the research questions are as follows: differences in the patterns of neural activation from each hemisphere of the brain (right and left) while participants read each narrative account (one positive, one negative) of social interaction could be a neural indicator of the valence (as experienced by participants in their role as teachers) of the interpersonal interactions of the group.

7.5.3 The EEG as a neural index of empathy and social cognition

Based on the findings of Study 3, as summarised in Figure 5.5, expressions of empathy contribute to a positively experienced relational space for the individual members of a group. For Study 3 (a micro-analysis of the flow of interaction) the identification of expressions of empathy was based on the researcher's subjective viewpoint, how they would feel as a teacher or student within the group i.e. the researcher was continuously updating a *mental model* (Frith, 2007) for each individual member of the

group. Therefore, neural evidence for empathy while participants are reading the narratives would be an additional and objective source of evidence that a sense of others (co-presence) is experienced during remote interpersonal interaction using CMC. From fMRI studies anatomical maps of the neural processes involved in empathy and mentalizing are gradually emerging (Kennedy & Adolphs, 2013) similarly for emotion research (Immordino-Yang et al., 2009; Immordino-Yang et al., 2014). Much of the anatomical mapping is based on data collected using neuro-imaging techniques to ascertain the brain based location of these social cognition processes and sub-processes. Therefore it is important to reiterate that the spatial resolution of the EEG is poor. On the other hand Kennedy and Adolphs have demonstrated that the neural networks involved in inference and empathy, are widely distributed throughout the brain (Kennedy & Adolphs, 2013) so that the poor spatial resolution of the EEG may not be an issue.

7.5.4 The procedure for recording the EEG

The procedure took place at the same time each day and was hosted by the Department of Clinical Neurophysiology at the National Hospital for Neurology and Neurosurgery, Queen Square, London. The EEG and EMG were recorded with a Nicolet 36 Channel Amplifier, using a sample rate (analogue to digital conversion) of 256 Hz. A fully trained NHS physiologist carried out the electrode placement and impedance checks as well as the instrument checks. The physiologist, who is a trained observer, was

present throughout and annotated the recording, including for smiling. At the same time the researcher took notes, focusing on the participant's engagement with the task.

Electrodes for recording the EEG were attached to the scalp using paste and placed according to the 10-20 system, as illustrated in Figure 7.4. Electrode pairs were formed by using a common reference located 3 cms posterior to Cz.

7.5.5 Data analysis: quantitative EEG (qEEG)

During the last 20 years techniques that digitise the analogue EEG record have become available and Study 4 will take advantage of this development. Methods are available that transfer the EEG from the time to the frequency domain (the signals are described in terms of amplitude or phase vs. frequency). Visualisation in the frequency domain has the format of a power spectrum. By referring to the power spectrum the frequency of a signal, for example average frequency during a particular activity, can be examined quantitatively.

In the emotion research reviewed in sub section 7.5.2 the most commonly used measure for demonstrating the neural correlate of emotional valence and/or motivational intensity is alpha power i.e. the maximum amplitude in the alpha power spectrum. A relative measure of alpha power at right and left frontally placed electrodes has been used as an indicator of asymmetry in hemisphere activation (R. J. Davidson, 1992, 2004; Harmon-Jones &

Amodio, 2012). The alpha spectrum was chosen by those researchers for the following reasons:

- Alpha power appears to be inversely related to cortical activity using both positron emission tomography (PET) and functional magnetic resonance imaging (fMRI).
- Behavioural tasks that are presumed to activate a particular brain region have been shown to cause alpha power suppression in that region.
- Research suggests that EEG frequency bands below 20 Hz are highly and positively correlated with each other. Therefore sampling just one frequency band, the alpha band, is considered sufficient.

A review of research using this methodology concluded that frontal EEG asymmetry, as an indicator of emotional experience, has sizable construct validity (Allen & Kline, 2004). Although this approach will be taken into account, the analysis of the EEG for Study 4 will not be restricted to this methodology for the following reasons.

Firstly, it seems to be unconnected with the work on the critical role of the cortico-subcortical basis of emotional processing. This component of the neural network is relevant when the issue under investigation is how absence of multisensory information impacts on co-presence and by implication, socio-emotional experience. While EEG patterns are almost certainly a reflection of the activity in cortical neurons the highly rhythmic nature (the frequency bands that are characteristic of the healthy adult) of the EEG needs to be explained. Extensive investigation of the frequency

patterns over several decades has led to the prevailing view of complex interactions between cortical neuronal activity and the activity of neurons in the thalamus; that the thalamus is the pacemaker of the cortical neuronal activity (Fisch, 1999) as recorded by electrodes placed on the surface of the scalp, i.e. the EEG. This is a plausible explanation and the link between this view and the cortico-subcortico account of emotional regulation described in Chapter 1, Section 1.5.2 could be significant. The thalamus is a structure that sits between the cortex and subcortical areas both anatomically and functionally, and is therefore ideally positioned for modulating sensory input to the cortex. Secondly, it is reasonable to question whether a focus on the relative absence of a frequency band (alpha) as an indicator of neural activity is sufficient or even appropriate. Thirdly, neural representation rather than source location is an aim for Study 4 and therefore it is important to avoid being influenced by studies where brain-based source location is the focus. There is a fourth reason to modify the approach that has been used for emotion research. Artifacts such as muscle movement have been rejected or filtered out in emotion research that is based on EEG studies. However, muscle activations represent the embodied nature of emotion therefore, it could be argued that artifacts that are of myogenic origin should be an integral part of emotion research. For all these reasons the approach to the quantification of the EEG has been modified for Study 4 when compared with other research.

7.5.6 Artifact

Although reading the narratives is an approximation for engaging with the relational space of a group it is likely that embodied behaviours, for example clicking a pen, scratching the brow, will be similar to those that can accompany the task in real contexts. Embodied behaviours almost always involve movement and therefore the activation of the muscles that control the movement. The electrical activity that accompanies muscle activation will usually manifest as myogenic activity in the EEG. At the same time embodied behaviour will always involve a neural source, for example, clicking a pen will involve activity in the motor cortex, and will be linked with processes for example, thinking, that are occurring in other parts of the brain. Most of the emotion research using EEG has filtered out or rejected those parts of the record that contain myogenic activity. However, the majority of that body of research uses cognitively passive tasks, for example watching video, observing images of facial expression. There is usually no requirement for the participant to actively respond to the stimulus material. By contrast, participants are required to be cognitively active for Study 4 i.e. they are required to take on the role of the teacher as facilitator of the group and to be able to provide an account of doing so. As described in the previous section the electrical activity recorded by the EEG is a summation of neural activity; the EEG at any point in time will reflect the embodied, the cognitive, and the emotional, aspects of the task. Therefore, the practice of excludng a section of EEG

because there is also a myogenic contribution from embodied action is problematic. The exclusion of sections of the EEG from further analysis could compromise the methodology. Therefore, only those parts of a record that contain an instrumental artifact, or a myogenic artifact that is unrelated to the task, for example, coughing, will be excluded.

7.5.7 Data reduction: Identifying the target data using Principal Components Analysis (PCA).

21 channels of EEG (based on the 21 electrodes of the 10-20 system each of which was referred to a common reference (positioned 3 cm posterior to Cz) were recorded for Study 4. The electrode placements for the 21 channels are illustrated in Figure 7.4.

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Pg1   Pg2
Fp1   Fp2
Fz
F3   F4
F7   F8
T3   C3   Cz   C4   T4
T5   T6
P3   Pz   P4
O1   O2
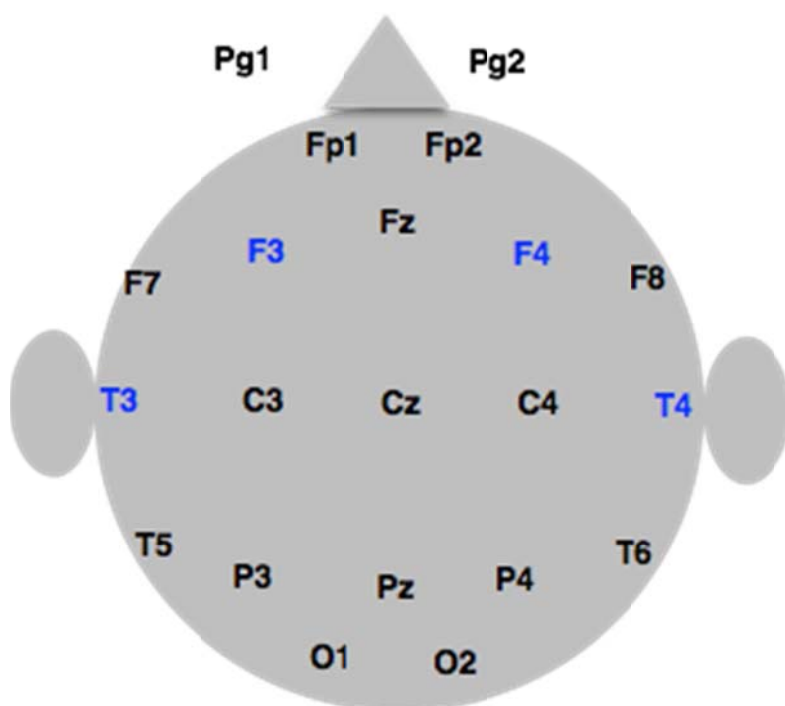
Figure 7-4 A schematic to show the positioning of surface EEG electrodes

The first step for the analysis of the digital EEG data involved reducing it in a meaningful way while retaining procedural rigor.

7.5.7.1 Data reduction step 1

The data from all 21 channels of EEG were subject to a principal component analysis (PCA) using a varimax rotation. A separate analysis was done for each activity (reading, reflecting, commenting) and for each narrative i.e. project group. For 10/12 participants the EEG record had been annotated according to sections of the narrative. For these 10 participants a PCA was undertaken for each section (7 for the

Mandevilles, 6 for the Wenlocks). Neural activity at adjacent electrode placements is likely to be highly correlated therefore all coefficients below 0.5 were suppressed. For each analysis at least 3 principal components were identified (4 or 5 components being more usual and up to 6 identified for some participants). Those analyses producing 5 or 6 components were inspected in more detail taking only those coefficients above 0.8 into account. The following four clusters of electrodes were consistently identified using this approach

- Fp1, Fp2, Fz
- F7, T3
- F8, T4
- Pz, O1, O2

7.5.7.2 Data reduction Step 2

These four clusters were then assessed in two ways:

- By cross-referring to the literature reviewed in Section 7.5.2 and Section 7.5.3. .
- A visual inspection of the EEG in the time domain

The visual inspection of the EEG drew attention to the patterning of eye blinks and also saccades (eye movement potentials) when reading and writing. Relative to neural activity eye blinks and saccades produce an

extremely large potential and in most studies they are classified as an artifact and excluded from further analysis. For study 4 they are a useful way of evaluating the PCA analysis. The patterning of eye blinks and eye movements when reading and writing is likely to be the explanation for the cluster Fp1, Fp2, Fz. The emotion research (reviewed in Section 7.5.2) has consistently identified F4 and F3 as the electrode placements most likely to show hemisphere differences that relate to the valence and motivational intensity of the experience. F4 and F3 do not feature in the clusters identified using a coefficient of 0.08 as the cut off. However visual inspection shows that the blink potentials are also present at F4 and F3, albeit with decreased amplitude (the electrodes with T4, T3, C4, C3 and Cz are also involved for some participants). Inspection of the PCA analysis, using 0.05 as the cut off, showed that F4 and F3 were commonly involved in more than one principal component the frontal cluster, Fp1, Fp2, and F3, as well as a cluster involving F7/8 and C3/C4, but rarely with a coefficient that exceeded 0.8.

Visual inspection of the EEG provided evidence about the contribution of both blinks and eye movement potentials (saccades) to the EEG data recorded at frontal electrodes. This is a good example of when it is important to have in mind that the EEG is the summation of electrical activity and the value of referring back to the time based EEG record. It was assumed that the involvement of F3 and F4 in more than one principal component is reflecting the contribution of blinks and eye movement

potentials thereby masking the co-occurring neural activity that is also likely to be reflected at these electrode placements. Based on this assessment the selection of F4 and F3 for the investigation of emotional experience, as reflected by the EEG, was considered appropriate for Study 4.

The principal component that involved F7/T3 and F8/T4 was commonly found for all activities and participants. The location of the F7 and F8 electrodes mean that they are optimally positioned for 'contamination by' the electrical potentials generated during horizontal eye movements (saccades whilst reading and writing). T4 and T3 can be 'contaminated' by saccade potentials in some participants but significantly less so. The T4 and T3 electrodes are also located over those areas of the cortex that are involved in social cognition, as evidenced by neuro-imaging studies reviewed in Section 7.5.3. Therefore, the EEG obtained at the T4 and T3 electrode placements is a candidate for further analysis. Although, it is important to be aware that there will be a contribution from eye movements (saccades) while reading.

The fourth cluster Pz, O1, and O2, involves electrodes placed directly over primary visual cortex. This area of the brain, and the neural processes that underpin vision, are undoubtedly implicated in reading and writing. This cluster is a further indication that it is not possible to study emotion, or any

process, in isolation. On the other hand it does support the value of the PCA analysis as a form of validation.

Based on the findings from the PCA analysis in the context of the literature review of Section 7.3.3 and 7.3.4 and a visual inspection of the EEG it seemed reasonable to concentrate subsequent analysis of the EEG recorded at F4, F3, T4, and T3.

7.5.8 The target data: EEG at F4 & F3 and EEG at T4 &T3.

The analysis involved sampling frequencies between 1-48 Hz. The average frequency at F4, F3, T4, & T3, was collected for every 30-second period (median number of samples per participant = 120) sequentially over the entire session. Blink rate per 30 second interval, was collected when the participant was reading. Using the European Data Format (EDF) open source software developed by Teunis van Beelen and others, http://www.teuniz.net/edfbrowser/, an average frequency was determined for each electrode placement, F4, F3, T4, and T3. These measures were coded according to which of the three categories of activity the participant was engaged in at the time of the sample, reading, R, Thinking, T, and Writing, W.

There is always some lag time between the onset of an activity (R, T, W), or embodied action, and the mark up on the record. A transition from one activity to another could occur within a 30 second sample period. When a change of activity occurred during the 30-second period that sample was

allocated to the activity that represented the largest amount of time. Only six samples were excluded, these contained either an extreme form of myogenic activity (for example during a bout of coughing) or an instrumental artifact.

To address the research questions the EEG data will be used to investigate whether the patterning of affective practice within a project group, as represented by two contrasting narrative accounts (one positive, one negative), was reflected neurally. Any neural activity that is recorded using the EEG is the sum of activity generated by the processes that are taking place in the brain at that point in time. Therefore, to construct a suitable statistical model three additional factors (sources of neural activations) need to be taken into account.

- Order of presentation: From participant comments made post session it became apparent at an early stage that the order in which the narratives was presented might influence the data; that the cortical activity involved will make some contribution to the overall neural activity.
- Activity: The activities, reading, writing, and thinking will each make an unique contribution to the overall neural pattern independently of which narrative is involved.
- Hemisphere: The activities reading, writing, and reflecting involve language and metacognition and there may be hemisphere

differences in neural activation at T4 and F4 compared to T3 and F3 that are dependent on each

To summarise, four factors (*project group, order, activity*, and *hemisphere*) can each have an independent effect and all need to be identified as main effects for the analysis.

Two sets of data, average frequency at F4 and F3, and the average frequency at T4 and T3, were subject to an analysis of variance using a three factor (*project group, hemisphere, activity*) repeated measures linear model, with a fourth factor, *order*, tested between subjects. The results of that analysis are presented in Table 7.2.

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Table 7-2 Neural activity

Factors		F4 F3	T4 T3
Main effects		p value	p value
	projectgroup	0.133	0.140
	hemisphere	0.146	0.928
	activity	0.245 0.378	0.319 **0.037**
Two factor interaction			
	projectgroup/order	**0.04**	0.808
	projectgroup/hemisphere	0.856	0.272
	projectgroup/activity	0.398 0.986	0.318 0.509
	hemisphere/order	0.206	0.198
	hemisphere/activity	0.661 0.588	0.521 **0.008**
	activity/order	0.677 0.111	0.014 0.458
Three factor interaction			
	projectgroup/hemisphere/activity	0.622	0.443
	projectgroup/activity/order	0.913 0.881	0.255 0.929
	projectgroup/hemisphere/activity	0.924 0.783	0.106 0.127
	hemisphere/activity/order	0.936 **0.052**	0.390 0.598
Four factor interaction			
	projectgroup/hemisphere/ activity/order	0.822 0.655	0.213 0.129

7.5.9 The results: EEG at F4 & F3 and EEG at T4 &T3.

The research on the neural basis of emotion consistently demonstrated a hemisphere asymmetry in activation, as indexed by the EEG at frontally placed electrode sites (R. J. Davidson, 1992, 2004; Harmon-Jones & Amodio, 2012). For this study, factors other than emotion may be salient and their influence on the dependent variable i.e. activity at T3, T4, F3, F4 may not be additive. Therefore an interpretation of the interactions between factors is required alongside the main effects.

7.5.9.1 The average frequency at electrode placements F4 and F3.

There are two results that are statistically significant.

- An interaction between *projectgroup* and the *order* in which the narratives were read.
- A three-way interaction between *hemisphere, activity*, and the *order* in which the narratives were read.

Inspection of the plot of the interaction, *project group / order* shows that when the participants engage with the Wenlock narrative first, there is no difference in the average frequency recorded at the frontal electrodes (F3 and F4 combined) between project groups (narratives). However, when participants engage with the Wenlock second the average frontal activity increased (a mean increase of 4 Hz).

The p value for the *hemisphere / activity / order interaction* was statistically significant indicating that the *activity* and/or *order* may be masking hemisphere differences when hemisphere is tested as a main effect. This is a plausible explanation since all the activities (reading, writing, thinking) require language, and there is hemisphere specialisation for language. A systematic inspection of the main effects and the two-way interactions between the factors involved should provide some clarification. The mean frequency while engaging with the Wenlocks was 1.5 Hz higher than when engaging with the Mandevilles, and the average frequency as measured at F4 (right hemisphere) was 2.5 Hz higher than at F3 (left hemisphere) irrespective of which narrative the participants were engaging with. When the interaction between the factors *hemisphere and order* is examined it shows that when the participants engage with the Wenlock narrative first the mean frequency at F4 is greater than at F3 (a mean difference of 4.5 Hz) this difference disappeared when participants engage with the Mandeville narrative first. However, an inspection of the interaction *hemisphere / activity* also shows that the average activity is higher on the right for all the activities. Although the mean difference in frequency between F4 and F3 (the *hemisphere main effect*) and the *hemisphere / project group* interaction did not reach statistical significance this result may be due the effects of both *order* and *activity*.

The interpretation of this pattern of interaction is as follows. Firstly, there are differences in the EEG at frontal electrodes that depend on the

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narrative (*projectgroup*). This finding is consistent with the findings of emotion research, that the valence and motivational intensity of an emotional event will be reflected in the neural activity recorded at frontal electrodes. However, by comparison with the paradigms used for the emotion research reviewed in Section 7.5.2 the participants were actively engaged in a range of activities (reading, writing, thinking) and there is evidence that the between hemisphere differences in EEG vary according to the activity and the order in which the narratives were presented. This means that hemisphere differences between narratives that are due to emotional response will be confounded by the fact that the asymmetry will in part be determined by lateralisation of function for language; the factors contributing to the neural measure cannot be interpreted in isolation.

7.5.9.2 The average frequency at the electrodes T4 and T3.

There are three results that are statistically significant.

- A main effect (quadratic) of *activity* (reading, reflecting, writing)
- An interaction between *activity* (quadratic) and *hemisphere*
- An interaction between *activity* (linear*)* and *order*

The electrode placements T4 and T3 have been chosen as the most likely to reflect neural activation patterns resulting from social cognition and empathy. However, the three activities, reading, reflecting, and writing that the participants are asked to engage with, are each likely to have a unique

effect on neural activity at brain areas located directly under these electrodes and will combine with the neural activity resulting from any social cognition processes. However, the pattern of interaction between each activity and the other three factors (*order, projectgroup, hemisphere*) can provide some indication of the contribution of each of the individual activities (reading, reflecting, writing) as follows. The average frequency when reading was 5 Hz lower than when reflecting or writing. Inspection of the *activity /order* interaction shows a similar pattern while reading and writing. However, when the Wenlock narrative was read first the mean activity was 10 Hz lower while reflecting than when the Mandeville narrative was read first. The visualisation of the activity/hemisphere activations show that the mean activation for each hemisphere was the same when reflecting, however when reading and writing the hemispheres were differentially activated, activation on the left was higher for reading (3 Hz) and lower for writing (3 Hz).

The effect on average activation, as measured at T3 and T4, and demonstrated during the periods of reflection, that depends on the order in which the narratives were read is consistent with the proposal that social cognition processes will be reflected by the electrical activity recorded at these sites. This finding can be cautiously interpreted as meaning that there is neural evidence that the narratives are sufficient for activating socio-cognitive processes.

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7.5.10 Eye Blinks

As a consequence of actively referring back to the time based EEG record to check the procedure for collecting and analysing the qEEG data, blink rate emerged as a potentially meaningful measure. The patterning of eye blinks was not preregistered in the design of Study 4. However, the visual inspection of the record suggested that psychological as well as physiological (eye lubrication) processes could be involved. Therefore, this observation was explored further. A method for reliably identifying the eye blink, for example, as distinct from a saccade, had to be identified (Iwasaki et al., 2005) and implemented. Therefore, the identification of an EEG potential as a valid eye blink at Fz has been confirmed by inspection of the video record that is taken while recording the EEG, and visual inspection of the EEG, by the researcher and an independent observer. Blink rate while the participant was reading, was subject to a single factor (*project group*) repeated measures linear model with a second factor, *order*, tested between subjects.

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Table 7-3 Blink rate

Factors		Blinks
Main effects		
	projectgroup	0.033
Two factor interaction		
	projectgroup/order	0.043

There were two statistically significant outcomes:

- A significant difference in blink rate whilst engaging with each of the two project groups

- An interaction between *projectgroup* and *order*.

The blink rate while reading the Wenlock narrative was on average 12 % higher that when the participants were reading the Mandevilles narrative. This suggests that blink rate is a factor that is moderated by the content of the narrative.

Inspection of the *projectgroup / order* interaction shows that the blink rate when the Wenlock narrative was read first was on average 25% higher while reading the Wenlock narrative than while reading the Mandeville narrative. When the Mandeville narrative was read first the blink rate was considerably lower (4 blinks per 30 second period) irrespective of whether reading the Wenlock or the Mandeville narrative.

7.5.11 Neural data. Comment on the method

For neuroscience research to be meaningful in educational contexts ecological validity is a key criterion. In other neuroscience research that uses narrative to evoke social emotions the approach to design is predominately experimental and is constrained by the method used, fMRI and thereby compromise the validity of the findings (Immordino-Yang et al., 2009; Immordino-Yang et al., 2014):

- Participants engage with the narratives and a discussion with the researcher about the emotions that they elicit before the neural data is collected.
- The narrative material about each person (50 real life examples) is of much shorter duration (60-90 seconds).
- Social emotions are re-elicited during a subsequent fMRI study by showing participants the most compelling segment of each narrative and participants are asked to engender the same emotion as they had reported in the pre scanning session.

By contrast, the design of the protocol for Study 4 means that the ecological validity of the findings is significantly improved. The momentary nature of social experience was monitored at a neural level as the narratives unfold, as the participants engage with them for the first time and for an uncontrolled range of emotion and feeling.

Another challenge that Study 4 has addressed is that in real contexts the brain is involved in the concurrent processing of a number of psychological activities. However, previous research on the neural basis of emotion had restricted the study of brain oscillations to the alpha band (9 – 13 Hz) (R. J. Davidson, 1992, 2004; R. J. Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Harmon-Jones et al., 2010) which limits its power for investigating cognitive complexity. For Study 4 oscillations across the frequency band 1-48 Hz were included in the analysis. The decision to sample a wider range of frequency was influenced by the recent research on the association of the higher frequency bands beta (14-31) and gamma (32-48) with attention and other forms of cognitive processing (Müller, 2000; Staufenbiel, Brouwer, Keizer, & van Wouwe, 2014). It meant that the analysis of the EEG could take into account that participants take on the role of teachers (the procedure for Study 4 requires them to engage in reading, thinking and writing as they would in an educational context) therefore complex cognitive work was required. It is hypothesised that each of the teacher activities is subserved by dedicated neural pathways and that the contribution of each to the EEG can be analysed by looking at their differential contribution to the average frequency at each of the target electrode sites. The contribution of each of the three activities has been investigated through a systematic assessment of the interaction effects, as provided by the linear model described in Sections 7.5.7 and 7.5.8.

The design for Study 4 demonstrates how it is possible to access the neural indicators of cognitive and emotional processing in contexts that require complex engagement. This is an important methodological development. Furthermore the embodied behaviours for example, scratching head, furrowing the brow, that were a feature of the participants immersion in their role as teachers have also been accommodated into the analysis. This approach is a significant departure from the usual controlled approach of Neuroscience and Cognitive Psychology and was achieved by combining visual inspection of the EEG with a quantitative analysis of the digital record.

This evaluation of the overall methodology for Study 4 should be considered alongside the limitations of the EEG as a method for investigating neural correlates. EEG activity at a particular electrode placement does not necessarily reflect activity in those cortical areas that lie directly underneath. Also, although the same anatomical regions of the brain (the temporo-parietal junction and superior temporal) have come up repeatedly in studies that use FMRI to map the neural correlates of social emotions it is important to acknowledge that the current status of anatomical mapping is a 'rough approximation' (Happé & Frith, 2013).

7.5.12 Neural data. Comment on the findings

By response to RQ2, the statistically significant difference in activation at F4 and F3 (that depends on which project group the participant is engaging

with, and the order in which the narratives are read and a three way interaction *hemisphere/activity/order*) is consistent with the findings of other EEG studies that show an asymmetry at this electrodes as a reflection of the valence of the stimulus (R. J. Davidson, 1992, 2004; R. J. Davidson et al., 1990) and is credible evidence of the signification of co-presence and that the narratives meet criteria 3; that the neural patterning at these electrode placements is a reflection of emotional valence/motivational intensity. This is objective evidence of co-presence when interacting with a simulation of group work at distance using CMC and supports the view that the digital fluency practices of students are a sufficient substitute for the multisensory information as expressed by others during social interaction.

T4 and T3 were selected as the electrode placements most likely to reflect the patterning of neural activations relating to social cognition processes. Although the p values obtained for the main effect of projectgroup at T4 and T3 are not statistically significant when the neural activity of the other cognitive processes that the participant is engaged in for example, reflecting, writing, is taken into account the combined results of the statistical analysis can be cautiously interpreted as evidence for empathy i.e. additional objective evidence of co-presence. The statistical analysis did show that the type of activity (reading reflecting, and writing) has a main effect on the average frequency recorded at the T4 and T3 electrodes. This finding is unsurprising, all three activities involve language

processes and the functional involvement in language of the cortical areas that underlie T4 and T3 are extensively documented (Parkin, 1996; Trans-Cranial-Technologies, 2012). Furthermore, the *hemisphere /activity* interaction is consistent with a hemisphere asymmetry for these activities, an effect that is likely to mask any asymmetry in hemisphere activation that is due to social cognition processes and could explain why the analysis of the *projectgroup* main effect did not reach statistical significance.

It is proposed that further refinement of this approach to the investigation of co-presence is warranted for example: by a design that allows for the average EEG of all participants to be computed. Also, a study involving a larger sample is required as the findings reported for this thesis are based on a linear model of three sets of data, a four-factor design, yet involves just twelve participants.

By response to RQ1 the neural data can be used as an indicator that three of the criteria (2,3,5) for the narratives have been met and that criterion 4 may have been met. Of particular significance is the evidence to support criterion 2, that the neural data reflects the labile nature of relational space. Figure 7.5 shows that when a participant (P5) engages with the Wenlock narrative the electrodes involved in the three main principal components change configuration as she reads each of the six sections of the Wenlock narrative. These changes in neural activity at electrodes involved in the main PCA components whilst reading the narratives were also shown by

other participants, and occurred when reading the other narrative (the Mandeville narrative). Blink rate also emerged as a potential indicator of the labile nature of relational space over time. Therefore, the combined findings can be interpreted as reflecting the labile nature of relational space, as experienced by the reader.

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Figure 7-5 Mapping the patterning of neural activity
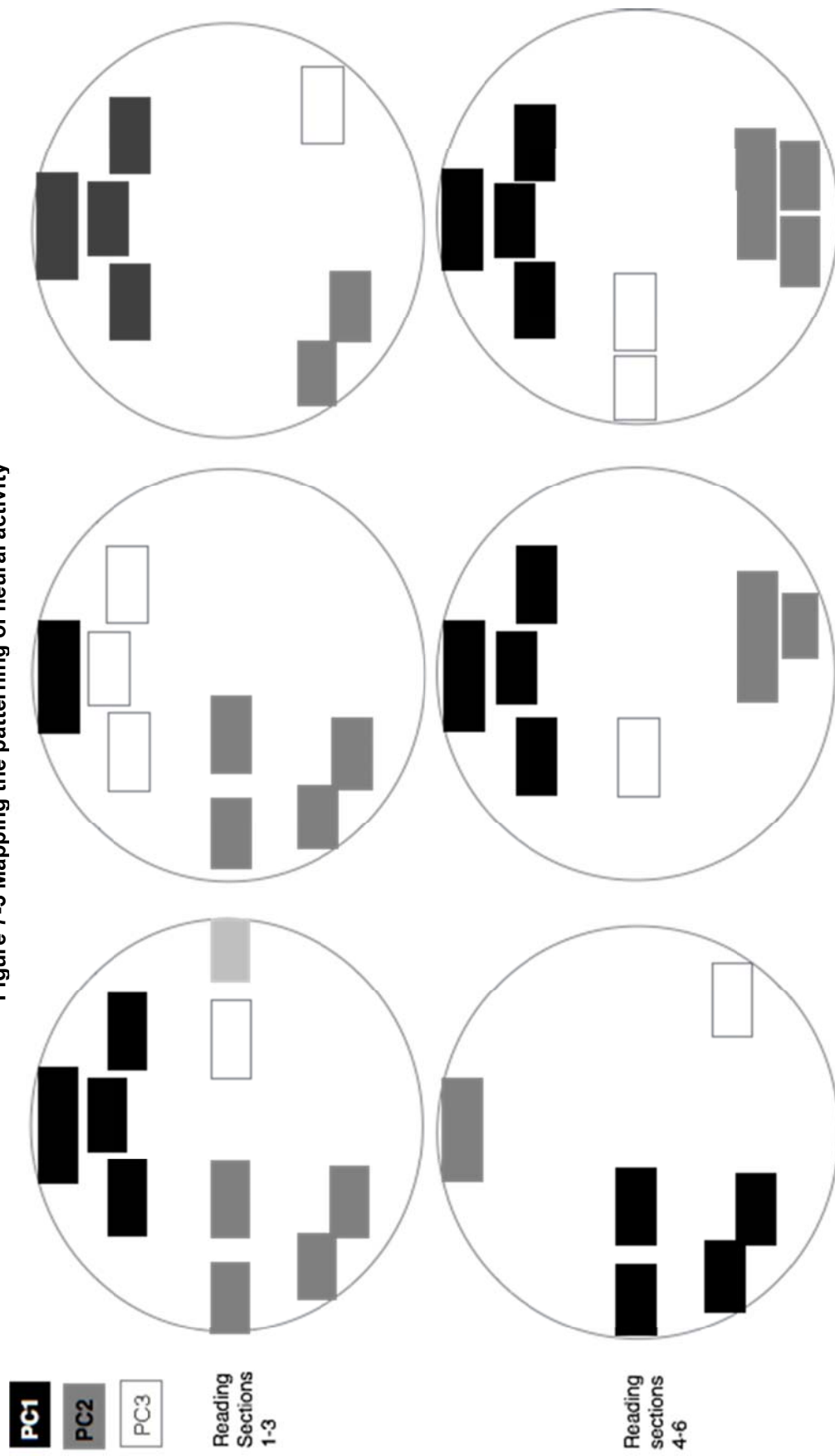
7.6 The narratives as a resource for the professional development of online teachers; an evaluation

The narratives were developed so that they could be used as a resource to support the professional development of online teachers in considering the social and emotional experiences of students, and its impact on group work. The development of the narratives was described in Chapter 6; after a requirements analysis 9 criteria were identified. In Study 4 three types of data were collected, subjective, behavioural, and neural, while participants acting as teachers, engaged with the narratives and the findings can be used to evaluate to what extent the narratives have met five of these criteria (the other four criteria were predetermined during the design of the narratives). The contribution of each type of data to this evaluation is shown in Table 7.4.

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Table 7-4 The narrative: mapping the findings against the criteria

	Criterion	Subjective	Behavioral	Neural
1	Represent the time frame of the learning encounter			
2	Represent the labile nature of relational space		YES	YES
3	Represent between project group differences in relational space	YES	YES	YES
4	Induce reader empathy	YES		YES (by implication)
5	Build on the scholarship for informing the facilitatory role of the online teacher	YES (practice)	YES (theory)	YES (theory)
6	Demonstrate the role of relational space during group work online	YES		
7	Topic neutral			
8	Authentic			
9	Represent dialogic tone			

Both the neural and behavioural data showed fluctuations over the time course of the reading activity and confirm the specification for criterion 2, that the narratives should **represent the labile nature of relational space**

.

The intention is to offer the narratives as a resource for teachers in the context of a focus group setting, as described for the pilot study. The purpose of this procedure for professional development is to provide some illustrative examples for novices, and to provoke discussion about practice at all levels of expertise. Therefore criterion 6 is that the narratives **demonstrate the role of relational space during group work online**. The subjective data provides strong evidence that the narratives did simulate relational space and that participants were able to discern its effect i.e. the narratives meet criterion 6.

Based on the subjective findings the claim that the narratives meet criteria 4, **induce reader empathy** is credible, as evidenced by Theme 1. Furthermore, the neural findings can be cautiously interpreted as implying neural evidence for the process of empathy. These findings are discussed in more detail in Section 7.7 i.e. by response to RQ2.

There was support for criterion 3, that the narratives should **represent between project group differences in relational space.** This claim is based on the findings from all three sources of evidence, subjective, behavioural, and neural. The narratives are accounts of the interactions of a relational nature for each of two project groups (the Wenlocks and the Mandevilles).

Based on a report from one student in each group the emotional climate of the Mandevilles was perceived as more positive than for the Wenlocks. The subjective data from Study 4 provides strong evidence that the emotional valence of the narratives (as a representation of relational space) was similarly perceived by most of the participants who took on the role of a teacher. The behavioural data (spontaneous smiles and laughter) also suggest that the emotional experience of the participants while reading the narrative was more positive for the Mandevilles i.e. similar to that of the students who took part. The statistical analysis of the neural data, as recorded by the EEG electrodes placed at frontal and temporal sites, also showed consistent differences between the narratives although, only when the order in which the narratives were read was taken into account. This neural evidence is discussed in more detail in Section 7.7 i.e. by response to RQ2.

The knowledge emerging from the combined findings (subjective, behavioural, neural) in Study 4 has the potential **build on the scholarship available for informing the facilitatory role of the online teacher** (criterion 5). As resources for professional development the narratives illustrate discourse within the group at an authentic level of granularity and they draw attention to relational space and its interrelationship with task space during group work online. Furthermore, their use in practice, as simulated in Study 4, has contributed to our understanding of the teacher's facilitatory role. The findings that are an outcome from using these narratives as a simulation of practice add to theory namely, that a teacher engages in a range of social cognition processes when facilitating a group; appraisal, inference, and mentalizing

also, the teacher can experience empathy in these contexts. This is unsurprising; teachers are human. Nevertheless there is benefit in establishing this finding. Based on the combined findings of Study 4, it is proposed that that two cognitive processes, inference and appraisal, are involved when teachers (as represented by participants in Study 4) are monitoring the group narrative as it unfolds. Inference involves the teacher in experiencing the relational space as a human agent within the group while at the same time making inferences regarding the emotional experience of the individual members of the group (Theme 1) of the subjective findings. The subjective findings also demonstrate how a teacher adopts a detached stance to assess the impact of the emotional experience of each member of the group on the group's progress with the task (Theme 2), and to make decisions about intervention. This characterisation of emotion and cognition will not be confined to the teacher. Similar processes can be attributed to each individual student as they play a part in the construction and maintenance of relational space alongside grappling with the cognitive demands of the task.

Assessing the findings from each level of data (Sections, 7.3.3, 7.4.4, 7.5.12) and in combination (this section) has achieved an informative evaluation of the narratives as resources for teachers. The combination of neural, behavioural, and subjective evidence provides sound evidence that the narratives meet five criteria (2,3,4,5, & 6).

7.6.1 Limitations of the narratives

The participants voiced some criticisms about the format of the Version 2 narratives, for example,

[T]he redacted text makes for jarring reading (P4)

[I]ts a bit boring to read (P2)

Addressing such criticisms while at the same time preserving the authenticity and granularity of the narratives is the challenge. The redacted text could be replaced by task related material that is discipline neutral without compromising a focus on the facilitatory role of the teacher. Alternatively an academically relevant summary of progress with the task could be inserted in the redacted sections i.e. repurposing the narratives rather than reusing them.

7.7 Co-presence and socio-emotional experience.

The theoretical question driving this thesis is whether the quality of co-presence is compromised when interpersonal interaction takes place asynchronously, through written communication, and without access to multisensory information as expressed by the others involved. Previous work that investigated expressive behaviours while using CMC (by using video and by monitoring the use of emoticons) (Marcoccia et al., 2008; Rourke et al., 1999) had not taken into account the difference between voluntary and spontaneous expression. By choosing the EEG to monitor neural activity and the EMG to discern between spontaneous and voluntary smiling behaviours the spontaneous expression of emotion can be assessed as the narrative account of group work unfolds. The coherence of the findings, subjective,

behavioral, and neural when participants take on the role of teachers and engage with authentic narratives of the relational conversations of the project groups are a powerful combination of subjective and objective evidence that co-presence and by implication, the quality of socio-emotional experience, need not be compromised when group work takes place at distance using CMC.

An ambition for Study 4 was to develop a methodology that combined the investigation of the neural correlates of the valence of interpersonal interaction and its impact on social cognition, and to link the neural correlates with the participants' subjective accounts. Social cognition processes were investigated by analysing the EEG at the T4, T3 electrodes and by assessing the subjective accounts of the participants while electrodes F4 and F3 were chosen as the best sites for using the EEG to monitor the valence of emotional experience. When comparisons are made between the EEG oscillations at T4, T3 and those at F4, F3 the findings are consistent with the findings of the literature reviewed in Section 7.5.3. Specifically, by using the EEG at F4 and F3 as the neural indicator of affect and an asymmetry at these electrode placements as an indicator of its valence, a statistically significant difference in average frequency was demonstrated that was consistent with the assessment of the relational space of each group by a student from each and by the participants in Study 4 i.e. the outcome from social cognition. Furthermore, the statistical model described in Section 7.5 showed an interaction between the two factors *projectgroup* and *order* that is supported by the patterning of smiling behaviours. Collectively, this is objective evidence

that the difference in the quality of relational space is reflected neurally. When the neural findings are considered together with the subjective and behavioural data the evidence for affective experience and social cognition and by implication, that co-presence is unimpaired, is coherent.

There are two other findings that support the conclusion that the quality of the experience of interacting and learning with others online using CMC need not be compromised. Both emerged from sources that were not pre-registered in the design. Firstly, some participants laughed while reading the narratives and the laughter was associated with spontaneous smiling. This was unexpected and prompted a review of the research literature on laughter. When a group of undergraduate students were asked to keep a laughter diary for one week it became apparent that

> [T]he necessary stimulus for laughter is not a joke, but another person (Povine, 2004, p 215)

and   ethnographic studies of laughter show that laughter is 30 more times more frequent in social situations (Povine, 2004). Therefore, the pattern of spontaneous smiling and laughing in Study 4 can be cautiously interpreted as evidence a sense of others, of co-presence, at a behavioural level.

A second source of unexpected evidence was the eye blink data. Although the immediate physiological needs of the ocular system, such as lubrication of the eyeball, will account for some eye blinks (Stern, Walrath, & Goldstein, 1984) it is not a sufficient explanation for the patterning of blinks. Rate of eye blink varied with both *projectgroup* and *order* while reading the narratives. (Stern et al., 1984) identified a form of blinking, 'the endogenous eye blink',

that occurred in the absence of an identifiable eliciting stimulus. Based on a

review of research available at the time the authors concluded that aspects of

endogenous blinks were related to cognitive variables

> allocation of attentional resources, transition points in information processing flow, and possibly processing mode, are indexed by blink parameters (Stern et al., 1984, p22).

More recently it has been suggested that

> [E]yeblinks are actively involved in the process of attentional disengagement (Nakano, Kato, Morito, Itoi, & Kiazawa, 2013, p 702)

 that they are associated with momentary activation of the default mode

network. The default mode network, as an organised area in the brain, was

first described in 2001 (Raichie et al., 2001). There are recent reports that this

network is implicated in social cognition (Liberman, 2012; Mars et al., 2012)

and that it is used during periods of 'insider' attention, for example reflection,

appraisal (Wise, 2014). If this claim is correct, and the eye blink is associated

with the activation of the default mode network, then the blink data is a useful

source of evidence that the neural processes associated with social cognition

are present when participants engage with a simulation of online group

interactions.

Although the experiential nature of co-presence may be altered during social

learning online a coherent line of evidence (subjective, behavioural, neural)

that includes evidence for the spontaneous expression of emotion and high

order socio-cognitive processing, strongly supports the view that the quality

of relational experience need not be compromised.

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7.8 Conclusion

The neural data is particularly significant for support of the claim that relational experience need not be compromised when using CMC for interpersonal interaction. The neural data is spontaneously expressed and is objective evidence that the reader experiences the others involved in the narrative as human. Furthermore, its coherence with other types of data (subjective, behavioral) validates this claim.

Study 4 was planned as an exploratory study to investigate whether it is possible to combine methods from Education, Psychology and Neuroscience in a meaningful and principled way. It has been surprisingly successful. Although there is no multisensory information about the group members, all the evidence about interpersonal communication is in a written format, and it is a simulation of supervising group work online, the comments from participants attest to an experience of others emotionally and there is behavioural and neural data to affirm the subjective reports.

The narratives provoked some valuable comments from participants about learning and teaching. The experienced teachers who acted as participants raise some important theoretical questions, specifically whether task related issues are compromised when the 'group as a unit' is too aware of the feelings of its members. To what extent should students be empathetic to one another? What is an optimal level of emotional climate during collaborative learning? To what extent should empathy influence the teacher's practice? The question of what constitutes a 'suitable' level of practitioner empathy

occurs in other professions, for example medicine, the emergency services, and is an important issue for both practitioners and researchers to consider. The expectation is that such questions will arise for teachers supervising group work in other disciplines and that the narratives can provide a useful trigger for collective discussion around these topics of importance for teacher practice.

Study 4 makes a significant contribution to the two aims of the thesis. Its contribution to the first research aim, a methodological toolkit for studying co-presence and socio-emotional experience during group work using CMC is evaluated further in Chapter 8 and reviewed in the context of the other three studies and the development of a model for social interaction at distance using CMC. The contribution of Study 4 to the second research aim has been addressed throughout this chapter i.e. the value of the narratives for building on the scholarship available for informing the facilitatory role of the teacher.

Chapter 8 A multidisciplinary, multistage, and multi method approach: an evaluation of the methodology.

8.1 Introduction

This chapter considers the first research aim: the development of methodology for a multidisciplinary approach to the investigation of socio-emotional experience and co-presence. My ontological position is that it is important to develop an understanding of how the brain functions for all human activities and experiences. For Education this position involves investigating the intrinsic motivation to learn. It is why this thesis has attempted to bring a multidisciplinary perspective to the understanding of social interaction during online learning. Accordingly the first aim was as follows:

> *To identify and develop a methodological toolkit for studying the socio-emotional experience of the individual student, the teacher, and the relational space of the group (as constructed by a group engaged in a shared learning task) at three levels, subjective, behavioural, and neural, and to formulate a model of social interaction at distance using CMC that is plausible from three perspectives, Education (participants' practice while learning using CMC) Psychology and Neuroscience.*

In Chapter 1 the rationale for choosing Educational Neuroscience as the overarching framework (the inclusion of Psychology and Neuroscience alongside Technology Enhanced Learning (TEL)) and the related fields of

study of Learning, Communication, and Emotion, was explained. The approach has resulted in a methodological toolkit that incorporates methods and techniques from all the aforementioned disciplines, and it was applied to an authentic learning context. Furthermore, a model for social interaction at distance using CMC has been achieved that is plausible from both a psychological and neuroscience perspective and at the same time it represents communicative actions in practice.

This chapter begins by summarising the contributions from the individual disciplines and the sequential development of the four studies undertaken for the thesis (Section 8.2). The toolkit of methods is described in Section 8.3 and the toolkit is evaluated in Section 8.4. In Section 8.5 the development of a neuro-scientifically informed model of remote social interaction is described and interrogated. Section 8.6 addresses some outstanding issues for the methodology.

8.2 The approach to methodology

The conceptual contribution that each discipline (Education, Psychology, Neuroscience) has made to the development of the methodology is explained in the following sub-sections, alongside the contributions from the three fields of study: Learning, Emotion, and Communication. It was a sequential approach with the outcome of each stage informing the next as the thesis progressed.

8.2.1 Education

The problem space is located in Education. The context for the thesis is 'learning through collaboration' at distance using CMC. The focus is on co-presence and socio-emotional experience and it was stimulated by reports that the quality of social interaction using computer-mediated communication (CMC) was inferior when compared with social interaction face-to-face. Of particular relevance for this thesis is the research of Barron focusing on collaborative groups and her conceptualisation of a dual space, relational and task (Barron, 2003). Two issues were identified that could influence the construction of relational space in an online forum when using CMC.

- The mediated nature of doing group work online.
- Writing as critical for remote interpersonal communication.

These issues were addressed by taking the opportunity to compare group work online and group work face-to-face for the same course (Study 1) and by interrogating the field of Communication. Social presence, for interpersonal interaction mediated by technology was identified as a relevant concept (Short et al., 1976), and was a source of synergy between the three fields (Learning, Emotion, Communication). A review of the TEL literature identified the Community of Inquiry (COI), as relevant since it has involved a great deal of research into social presence, as a concept of significance for the relational aspects of remote interpersonal communication. Study 2 assessed the usefulness of the COI framework for this thesis.

8.2.2 Psychology

A focus on co-presence, as experienced during social interaction at distance using CMC, is why psychological ideas about 'the patterning of affective practice', as co-constructed during interpersonal interaction (Wetherell, 2012) and 'the mental model of other minds', inferring 'others' emotional experience and feelings (Frith, 2007), were used to ground the approach to the research question. Wetherell's view of the 'patterning of affective practice' embraces the idea of social interaction as labile and situated, a 'one off' event that cannot be investigated by experimental techniques i.e. designs that involve multiple repeats of the same event, or by content analysis of a transcript - a method that is almost always agnostic of context. Therefore, the approach taken to Studies 3 and 4 was to investigate socio-emotional experience as it unfolds.

In order to construct a model of socially induced emotion during interpersonal interaction it was necessary to consider three core elements:

1. Recognising emotion as expressed by an 'other'.
2. Expressing emotion (behavioural manifestation of emotion) as communicated through paralanguage, embodied behaviours and speech.
3. Emotion as phenomenological experience.

Frith's conceptualisation of a 'mental model of other minds' was valuable when it came to specifying how socially induced emotion, and the social cognition processes that result (for example, empathy), could be investigated.

During face-to-face social interaction the role of explicit social cognition, the psychological processes of inference and metacognition that mediate the experience and expression of emotion, is pivotal. Another socio-cognitive process to consider is the construction of stereotype, i.e. the tendency to over generalise the information available when individuals are face-to-face. Figure 8.1 is a representation of interpersonal interaction face-to-face that was developed during the thesis as a model for this psychological perspective. For Figure 8.1 the socio-cognitive processes of social interaction are represented together with the communicative behaviours involved for the recognition, experience, and expression of emotion.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
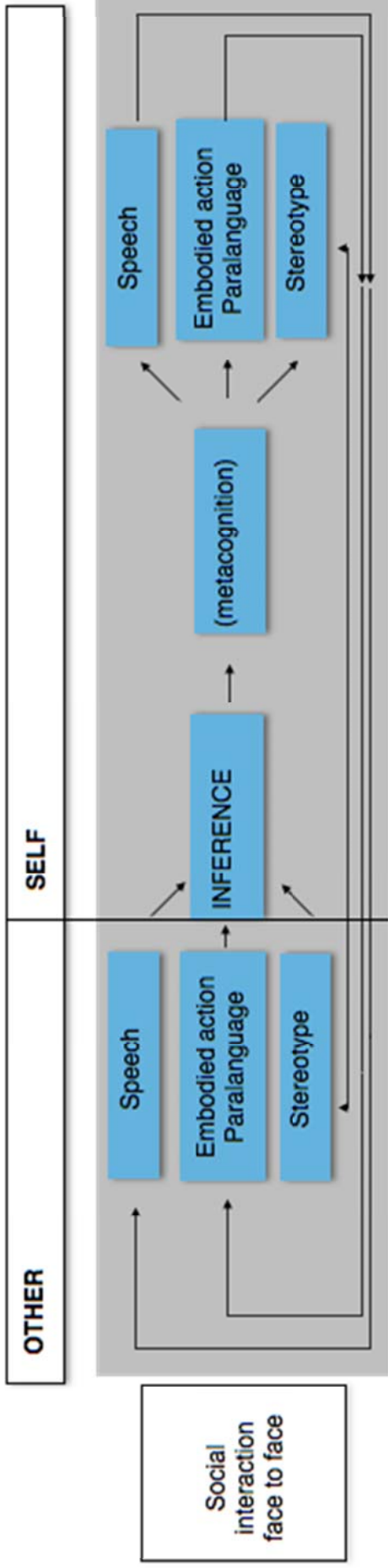
Figure 8-1 Interpersonal interactions face-to-face. A psychological process model

8.2.3 Neuroscience

Frith's formulation of 'a mental model of other minds' was influential in formulating the model of social interaction represented in Figure 8.1 (Frith, 2007). Frith is a cognitive neuroscientist therefore his research seeks coherence across Psychology and Neuroscience. Frith's views can be attributed in part to two key influences that are interrelated:

1. A comparative view of social cognition

2. Knowledge about the neural basis of social cognition

and is consistent with the description of language as a uniquely human competence as described in Section 1.7.3.2. Interacting with conspecifics is not unique to humans; most species have a repertoire of communicative signals, verbal and non-verbal. What is distinctive about human social interaction is the involvement of language and metacognition, the capacity to make the cognitive outcome explicit. This capacity has depended on the evolution of brain structures that are unique to man and the development of associated neural networks. To investigate whether interpersonal interaction using CMC compromises the processes identified in Figure 8.1, and by consequence the quality of co-presence and socio-emotional experience; techniques for investigating this neural network and the associated behavioural (the expression of affect) were required.

To study the patterning and labile nature of affective experience as it unfolds during social interaction, and its embodiment (Study 4), electroencephalography (EEG) and electromyography (EMG) were the only viable techniques. The Neuroscience literature was interrogated to inform the application of these techniques, and the analysis and interpretation of the data. The interpretation of the EEG was informed by:

- Neuro-imaging studies of social interaction (Blakemore, 2012; Frith & Frith, 2006).

- Hemisphere specialisation for the valence of an emotional event (R. J. Davidson, 1992, 2004; Demaree et al., 2005).

- Localisation of reading and writing as determined from neuropsychology (Parkin, 1996).

- The endogenous eye-blink (Stern et al., 1984)

The interpretation of the EMG was informed by

- Smiling: spontaneous and voluntary pattern of activation of facial muscles (Duchenne de Boulogne, 1862, 1990; Fridlund & Cacioppo, 1986; van Boxtel, 2010).

This section has described the epistemology that united the three main disciplines, Education, Psychology, and Neuroscience, in the context of socio-emotional experience during social interaction at distance using CMC. It determined the approach to methodology and influenced the choice of

individual method of each study, as described and evaluated in the following section.

8.3 The methodological toolkit

Based on a multidisciplinary review, as outlined in Section 8.2, a multistage investigation and the utilisation of a diverse range of methods across four studies emerged. This multidisciplinary toolkit is summarised in Table 8.1.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

Table 8-1 Methods used for each study

Study	Data type	Data collection	Type of analysis	Analysis technique	Source	Data Source
1	Numerical	Survey	Quantitative	FA & PCA & SEM	Student	Experience
2	Discourse[12]	'Observational[13]	Quantitative	Content	Student	Practice
	Discourse	'Observational'	Quantitative	Content	Teacher	Practice
3	Discourse	'Observational'	Qualitative	Interpretive	Student	Practice
4 Pilot	Discourse	Focus group	Qualitative	Discourse Psychology	Teacher	Experience Practice
4	Material[14]	EEG	Quantitative Expert	PCA , GLIM	Teacher	Neural
				Visual	Teacher	Neural
	Material	EMG	Expert	Visual, GLIM	Teacher	Behavioral
	Discourse	'Interview'[15]	Qualitative	Thematic	Teacher	Experience

[12] Student discussion

[13] Recorded asynchronous text in discussion forums

[14] Electrical activity in the brain and facial muscles that is measured using neurophysiological techniques.

[15] The participants accounts of experience as a teacher were conducted as a written exchange and while they were participating in a neurophysiological investigation.

Its construction and application was informed by a literature review that sought coherence between multiple disciplines. Emotional experience is situated and is one reason why a holistic approach was required. The three stages of the investigation represent the three levels of a holistic approach and involved four distinct studies, the individual (Study 1), the group (Studies 2 & 3) and the teacher (Study 4). Emotional experience is also embodied and is why neurophysiological techniques were employed in Study 4. The findings of each study and the methods used by each have been evaluated in detail in Chapter 3 (Study 1), Chapter 4 (Study 2), Chapter 5 (Study 3) and Chapter 7 (Study 4). This section will summarise the rationale for the methodology of each study, to explain how it contributed to the toolkit.

8.3.1 Study 1

An important tenet of 'learning through collaboration' is a focus on 'the group as a unit' and its relation to both the individual student and the wider student community (Stahl, 2011, 2012) and it determined the first stage of Study 1, Study 1a. For Study 1a a model was constructed based on survey data collected retrospectively from open entry and distance students who had undertaken group work remotely. The findings demonstrate that the interactions that underpin group work can impact negatively on student satisfaction while at the same time confirming the value of providing a sense of belonging to an academic institution and providing connection with communities of fellow students (Weller, 2003). A comparison with a face-to-

face equivalent (Study 1b) provided some useful information about the differential effect on group dynamics of identity cues that are shared, and those that are not shared. It meant that the positive effect of 'unseen' identity cues in online contexts was confirmed, and endorsed the proposal to focus on the non-verbal communication cues that were 'unseen' as the factor of relevance for the debate about the quality of relational experience during remote interpersonal interaction. The findings of Study 1 endorsed the idea of the 'group as a unit', which was then the focus for the next stage.

8.3.2 Study 2

During the literature review social presence was identified as a relevant concept. Social presence is a concept that has been applied in Communication research since the 1970s, specifically for research that focuses on technology-mediated communication. It was taken up by the COI framework to form an important element of their model of remote social learning, together with teaching and learning presence, with the role of social presence as support for interpersonal cohesion alongside task related issues. In Communication two components of social presence had been proposed, immediacy and intimacy (Short et al., 1976). For the thesis it was presumed that immediacy is sufficient when interpersonal communication using CMC is of a pragmatic nature for example, social learning; that if intimacy is compromised then it is of no consequence in that context. For Study 2 the linguistic devices that have been used by students to achieve verbal immediacy were examined using an instrument developed for the COI (Rourke et al., 1999). Both groups studied demonstrated verbal immediacy

practice. However, the COI methodology does not provide any information about the patterning of this practice and is limited for studying the relational space of the group from the perspective of the individual student. Furthermore, social presence as measured by the COI (Rourke et al., 1999), is confined to the transmission of affect, is agnostic to context, and the interpretation of presence by the others involved is neglected. This limits the explanatory power of social presence when conceptualising co-presence as experienced remotely. However, both student and teacher practice, and their interrelationship were investigated using the COI methodology. The value of these findings is that they draw attention to the way in which learning analytics could be developed to be useful for teachers.

8.3.3 Study 3

The synergies between Education, Psychology, and Neuroscience and the associated fields of study Learning, Emotion, and Communication, which emerged during the literature review, determined the design for Study 3. When considered alongside the classroom studies of socio-emotional experience (Cooper, 2004, 2011) and by applying 'the mental model of other minds' approach (Frith, 2007) it became apparent that in order to investigate co-presence it was necessary to include empathy in the framework. The result was the development of a framework, Figure 5.1 that has two components:

- The student practices: adaptation of writing style, appropriation of the technologies.

- The outcomes relational and task-based that underpin collaborative group work.

In Study 3 this framework was applied to the interpretation of the student experience during the construction and maintenance of relational space and while progressing task space; a microanalysis of the patterning of interpersonal interaction during group work online. When the transcript of each of two project groups was interpreted using this framework the findings were consistent with the report of emotional experience of one student from each; the procedure has explanatory validity.

8.3.4 Study 4

Emotion and affect are embodied as well as situated, and depend on activity in appropriate neural networks with the outcome of the associated psychological processes expressed behaviourally and experienced subjectively (Immordino-Yang et al., 2009; Immordino-Yang et al., 2014). Therefore, it was proposed that indicators of co-presence at all three levels of description, subjective, behavioral, neural, would be powerful evidence that co-presence when experienced remotely is unimpaired. There was also an ambition to involve a teacher perspective that was ecologically valid. Therefore, a third stage and a fourth study were required. To retain authenticity, and obtain a teacher perspective,

- The outcomes of Studies 2 and 3 were incorporated into the narratives that were used to simulate the teacher's experience of project group students working online.

- The outcomes of Studies 2 and 3 informed the procedure for Study 4.

- Twelve participants with practitioner knowledge of group work online were recruited.

The interpersonal interactions of a relational nature were simulated for two project groups. The findings provided evidence of contrasting experiences of co-presence in each project group at two levels - behavioural, and subjective- that are consistent with the findings derived from the socio-emotional experience of one student from each project group. Furthermore the analysis of the neural data demonstrated that there were significant differences between the neural activity recorded while reading each narrative.

Study 4 was a notable achievement. It was a study of social interaction within an Educational Neuroscience that retained a high level of ecological validity. The simulation involved participants, who were experienced teachers, engaging with the authentic transcripts of forum discussions as if they were the teacher while at the same time collecting objective evidence. The findings make a significant contribution to our understanding of co-presence and socio-emotional experience when using CMC to interact remotely, and were applied to the evaluation of the model of remote social interaction using CMC that was developed concurrently.

8.3.5 Ethics procedures

The four studies involved three sets of ethical procedures, and obtaining permission from three institutions:

- The Open University to survey a cohort of students studying the course on which this thesis is based (Study 1).

- The Institute of Education to conduct the pilot study for Study 4 (piloting the use of a narrative with a focus group consisting of four tutors newly recruited to the course).

- University College London in order to conduct Study 4.

Anonymity of all participants, students and teachers, has been achieved in the thesis report by either assigning a numerical code or by anonymising the name with a change in anonymised name across Studies 2,3, and 4. Furthermore, the only data about students that is available to the researcher is their first name, the year that they undertook the course, and the forum name. There has been full compliance with the Data protection regulations of all three institutions.

The two tutors involved in Study 2 and 3 were both experienced and knew that their teaching practice would be assessed as part of their contractual arrangements. Teachers who took part in the pilot study have received feedback. Participants who took part in Study 4 have all been offered feedback including access to their neurophysiological record.

Informed consent was formally obtained from the participants who took part in Studies 1 and 4. For Studies 2 and 3, all the students involved had the opportunity to take part in the survey and had received the information for participants that included information about why the data was being collected. Since the identifying information for the project group members is anonymous

to me they have not received feedback, or had the opportunity to withdraw any personal quoted material. However, whenever feasible, the quoted extracts in the thesis have been redacted. However, these students were aware that the forums were archived and that staff access continued. Furthermore, my identity, role, and presence was made apparent in several ways, an introductory letter, communication through the course notice board on a regular basis, a presence in the support and enrichment forums, and by taking an active part in the plenary sessions. As a psychologist I have sought to be respectful of the data collected and the owners of that data, the participants. As a practitioner it was my intention to use the participant data for the benefit of future courses and students enrolled on the course were aware that I might use their data to achieve that aim. I have used the findings from Study 1 to inform the update of the course, and the findings from Studies 1-3 to inform the integration of the course into the VLE (this entailed changing from using First Class for CMC to Moodle).

Informed consent was obtained for study 4. However, the venue for the EEG was located in a specialised neurological hospital and one participant subsequently reported that she had found this venue unsettling. The researcher did not foresee this problem thus illustrating the challenge of providing information for participants that addresses all possible consequences. Although participants had been told that they were free to withdraw at any time in practice withdrawing from an investigation can be a choice that participants are reluctant to voice.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

8.4 Comment on the methodological toolkit

The toolkit was constructed from a diverse set of methods as summarised in Table 8.1 and there are implications for how it will be evaluated by the separate disciplines. For Education and Psychology a mixed methods approach that combines quantitative and qualitative method has recently become acceptable (Teddlie & Tashakkori, 2009), while for Neuroscience, evidence that is quantifiable, reliable, and generalisable is what makes the findings credible, and positivism is the only choice. For cognitive neuroscience this has led to a focus on experimental methods and the investigation of cause and effect relationships. For social neuroscience it has meant that emotion and affect have mostly been studied by participants taking an observer perspective. Recently there has been a call for a second person social neuroscience i.e. that the participant is actively involved in the social interaction (Schilbach et al., 2013) and has led to the development of protocols involving a virtual agent as the interaction partner (Bohil, Alicea, & Biocca, 2011; Schilbach, 2014; Scilbach et al., 2006) or by asking participants to engage with a narrative account of real life people (Immordino-Yang et al., 2009; Immordino-Yang et al., 2014). However, these researchers are interested in the anatomical location of the processes involved in social interaction and fMRI has been the method of choice. It has meant that the labile nature of affect and emotion could not be studied and that the neural correlates are not studied in a real life context and with real life people (as is the circumstance when avatars are the interaction partner). Study 4 was

innovative in that it monitored the momentary nature of experience and this was achieved by using the EEG instead of fMRI.

Authenticity of context remains a problem. Although portable kits are available for collecting neurophysiological data there are a number of reasons why using such equipment in situ (for example, while the student or teacher engages with the group project) would not be appropriate. Some concern the level of nuisance for the student whilst others relate to the quality of the neurophysiological data and its subsequent analysis, and are why narrative to elicit emotion and affect by simulating the relational space of each project group was used.

A researcher could be present with the distance student while they engage with group work however; there are significant practical challenges. Figure 4.5 shows that many of the students made at least one contribution to the forum on most days over the six week period. Furthermore, this is not a comprehensive representation of the frequency and duration of student engagement, they will spend some time engaging with the content and reading and reflecting on the contributions of others. Also, we know that some students with a disability (motor, pain) take advantage of this format for taking part in group work so that they can manage their disability by engaging for short periods and often (Robinson, McGregor, & Phillips, 2008). Although distance students do pre plan study time they also tend to take advantage of small pockets of time in diverse locations. By agreeing to confine study to

when a researcher is present would reduce flexibility for the student, significantly in some cases.

A more serious concern for recording neurophysiological data in situ is a methodological one. Despite Study 4 being conducted in a laboratory that has been screened to a very high standard (against electrical interference from the mains) and that the procedure was carried out by a trained neurophysiologist, there was evidence of mains (50c/sec) interference, albeit small, on some records. It is why the spectrum analysis was confined to an upper limit of 48 c/sec. However, more intrusive mains interference (as is likely to be the case in situ) would be problematic for conducting spectral analysis across the frequency band. Another serious problem when using portable equipment is that the number of channels available for recording neurophysiological data simultaneously is of necessity limited. In Study 4 the EEG is recorded from 22 electrodes (21 channels) simultaneously and this protocol has allowed a rigorous evaluation of the analysis of both the EEG and EMG data as follows:

- The choice of reference electrode can be a contentious issue (Allen et al., 2004; Fisch, 1999). However, for Study 4 an optimal choice of reference electrode could be assessed through digital manipulation to compare candidate sites.
- The PCA analysis involved all 21 channels and showed that the EEG recorded from fronto-temporal electrodes over the right hemisphere are distinct from those on the left. This meant that hemisphere, as a

- distinct factor, could be confidently assumed for the analysis of variance (Bishop, 2013).

- The target electrode sites, T4, T3, F4, F3 could be evaluated by reviewing the pattern of activity across all fronto, parietal and temporal electrode placements so that the contribution of eye movements (blinks and saccades) at these sites could be rigorously assessed and their suitability for further analysis evaluated.

- A similar process was applied to check myogenic contamination (eye-movement, frontal and temporalis muscle) of the EMG data collected at the electrodes used for recording activation of the facial muscles involved in smiling.

An ambition for Study 4 was to progress the previous work in social neuroscience by investigating the neural correlates of social interaction by using EEG instead of fMRI so that the momentary nature of affective experience and socio-cognitive process could be monitored every 0.04 secs. It is argued that at this stage of protocol development the quality of the neurophysiological evidence should not be compromised by collecting it outside of a specialized laboratory (i.e.in situ). For Study 4 the construction of the narratives took advantage of the availability of a full textual record of the interpersonal interactions between students, and with their teacher, and the recruitment of twelve teachers with experience of facilitating group work online. Therefore, the findings are based on a protocol with good ecological validity for an educational perspective while retaining scientific rigor when

investigating the neural correlates of co-presence and social emotional experience.

Another advantage of EEG is that it is less constraining for the participant than fMRI. This became apparent during Study 4 when participants engaged in behaviours, unique to each participant, such as stroking the forehead, clicking a pen. These embodied actions were part of the experience of engaging with the narrative as a teacher. Such movement resulted from, and contributed to, the on-going neural activity and was an integral part of the participant's experience and material data. Automatic artifact analysis would mask significant amounts of this detail. Therefore, another innovative feature of Study 4 is that the protocol involved a visual inspection of the EEG record. Only those parts of the recordings that contained instrumental artifact were removed from the digitised EEG. The QEEG data was then analysed using quantitative method. This represents a significant departure from the protocol adopted in Cognitive Neuroscience i.e. automated artifact rejection (Dick, Lloyd-Fox, Blasi, Elwell, & Mills, 2014). The participants in Study 4 were relaxed and compliant, factors that made it possible to include the majority of the data in the analysis. It is acknowledged that this is not always the case and it could be argued that visual inspection diminishes the value of the EEG as a defined and replicable measurement. On the other hand, it is significant that visual inspection remains the preferred option in clinical contexts (Fisch, 1999). Therefore, it is recommended that the feasibility of including EEG data that occurs at times of movement associated with a social interaction (as simulated) be explored further, so that the usefulness of the EEG as a method

for investigating interpersonal during 'learning in situ', and in other contexts, can be progressed.

8.4.1 Limitations

All the students involved were female. This was unsurprising. The majority of students enrolled on the programme are female reflecting enrolment in this discipline nationally, and that part-time distance study allows those with caring responsibilities (predominately female) flexibility. However, it means that the thesis does not have any information about gender and its influence on discursive practice in these contexts.

The findings are also limited by the fact that, apart from Study 1b, none of the data was collected in a real time learning context. The direct evidence comprised the subjective, behavioural and material data collected from teachers using a simulation of the text corpus (Study 4), and the student responses to a survey (Study 1a). The data on student practice was achieved by an observer view, an analysis of the text corpus from each of the two forums (Studies 2 and 3). The previous sub-section explains the rationale for the Study 4 protocol and argues that, irrespective of this limitation, it represents a way to progress the application of social neuroscience method while retaining contextual authenticity.

8.4.2 Summary

The momentary nature of emotional experience constrains the direct collection of subjective evidence, and collecting material data directly when

students and teachers are geographically dispersed is also problematic. Although in subsequent studies the retrospective nature of subjective report could be addressed by sampling more frequently, this thesis has relied on students' overall appraisal at the end of the course so that two contrasting project groups could be selected. A more challenging methodological issue concerns the collection of objective data (EEG and EMG). It is argued that the development of the EEG as a method for a second person neuroscience requires specialist laboratory conditions at this stage, and that compromising some authenticity by using narrative to simulate interpersonal interaction is warranted. The approach to the analysis of the EEG data is promising and there were some useful, if unexpected, findings i.e. the eye blink results; the prediction for the future is that a protocol that uses less complex instrumentation is feasible and could lead to the investigation of social interaction at a neural level in situ.

From an Educational Neuroscience perspective the overriding problem for achieving synergy across all three disciplines and integrating the methods from each in a principled way lies in the complex nature of learning and the 'in the moment' experience of interpersonal interaction. It means that evidence collected in the laboratory will retain only limited credibility for social learning contexts. A toolkit has been developed that involves going beyond traditional disciplinary boundaries and setting aside the contentious issues that can arise when disciplines take an integrative approach. However, the interrogation of theory was systematic and sought coherence between disciplines. By doing so it has demonstrated that the disciplinary provenance of each

methodological tool can be respected, and that adherence to the principles governing appropriate application of each method is possible, when using methods from the different disciplinary areas.

A holistic approach to the student experience is another methodological achievement. The interpersonal interactions within project groups have been studied in depth from both the student and the teacher perspective, and the way in which the technology was used and the module was embedded in the program of study has been taken into account. There are consequences: it has meant that only two project groups have been studied. However, this approach has led to a procedure for investigating interpersonal interaction during group work online, as described in Chapter 5, Section 5.4 that could be used to study interpersonal interaction during group work in other modules and/or situations. Furthermore, the granularity of the discourse is preserved in the narratives that have been developed as resources for teachers' professional development and co-presence and socio-emotional experience have been investigated at subjective, behavioural and neural levels of description. Also, the methodology developed for Study 4 is transferable to other contexts of social interaction.

8.5 A neuro-scientifically informed model for interpersonal interaction in online forums using asynchronous CMC.

By interrogating the disciplinary area of Psychology a model that encapsulates co-presence during social interaction face-to-face, Figure 8.1 was developed. In Chapter 1 a proposal to use neuropsychological methods to model the implication of using CMC for social interaction from a

Neuroscience perspective was outlined in Chapter 1 Section 1.5.2. The benefit of a neuropsychological approach is that it

> provides a greater understanding of how the brain carries out mental operations based on the observation of people who have developed specific deficits as a result of brain damage (Parkin, 1996, p 2).

The rationale for using this research method arose from claims in the research literature; that using CMC 'disrupts' interpersonal interaction.

To address the research question from a Neuroscience perspective a neural model for the processes illustrated in Figure 8.1 has been developed. During face-to face interpersonal encounters the processing of salient sensory information (for example, facial expression, tone of voice) at a neural level depends on the mediation of that information by activity in sub-cortical brain, sensory cortex, and associated cortical areas, while emotional regulation, and therefore the voluntary expression of emotion, is moderated by activity in prefrontal cortex, predominately, as described in Chapter 1 Section 1.5. From a Neuroscience perspective we can assume that the absence of all multisensory information about others during CMC means that none of the discrete sensory pathways involving subcortical areas, sensory cortex, and associated cortical areas that are foundational for the socio-cognitive processes that underpin social interaction face-to-face are activated. It is why the experience of co-presence might be disrupted. In Chapter 1, Section 1.5.2, a previous experience of interacting with patients who had undergone surgical removal of the pre-frontal cortex (leucotomy) was described. Leucotomy can also be modeled at a neural level. For leucotomy patients the

neural processes that underpin perception of salient information and initial mediation of that information is intact. However, for these patients it is the brain area involved in the moderation of that emotional information that is damaged (it has been surgically removed) which means that some neural processes that underpin inference and metacognition are not activated. A neural model for each for these three forms of social interaction is provided in Figure 8.2. The dashed line between the subcortex and cortex for social interaction at distance using CMC, which will not be activated by the sensory information expressed by the other participants, indicates the relevance of this representation to the research.

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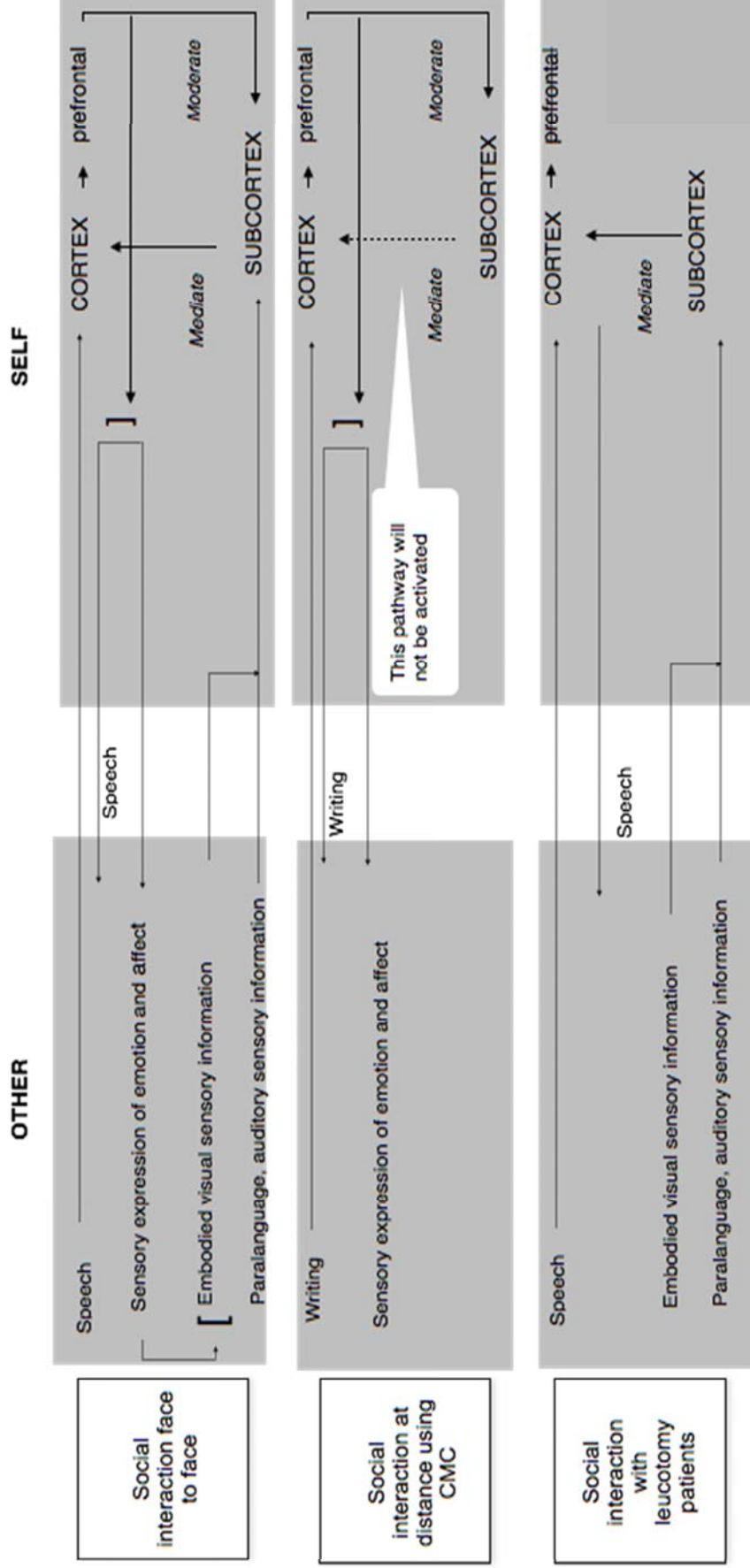
Figure 8-2 A neural network for the recognition, experience, and expression of emotion and affect during social interaction

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It is presumed that the 'strange' phenomenological experience when interacting with the leucotomy patients resulted from the fact that the neural processes that rely on a normally functioning pre-frontal cortex were disrupted for these patients, thereby disrupting the communication of affect. Of relevance for the research question is whether a 'disruption' in the neural patterning when using CMC remotely, albeit at a different location in the neural network, has a similar effect. In Figure 8.3 the process model of social interaction, as illustrated in Figure 8.1, is extended to represent this question. According to this model the quality of interpersonal experience could be compromised during CMC. However we know from Studies 2 and 3 that students adapt their communicative practice and act to appropriate the technology to meet their communicative needs. Reference back to the neural model, Figure 8.2 shows that, at a neural level of description, these writing practices are sufficient for communicating co-presence; that although sub-cortical and primary sensory areas may be by-passed the mode of communication should not compromise the experience of learning in this context.
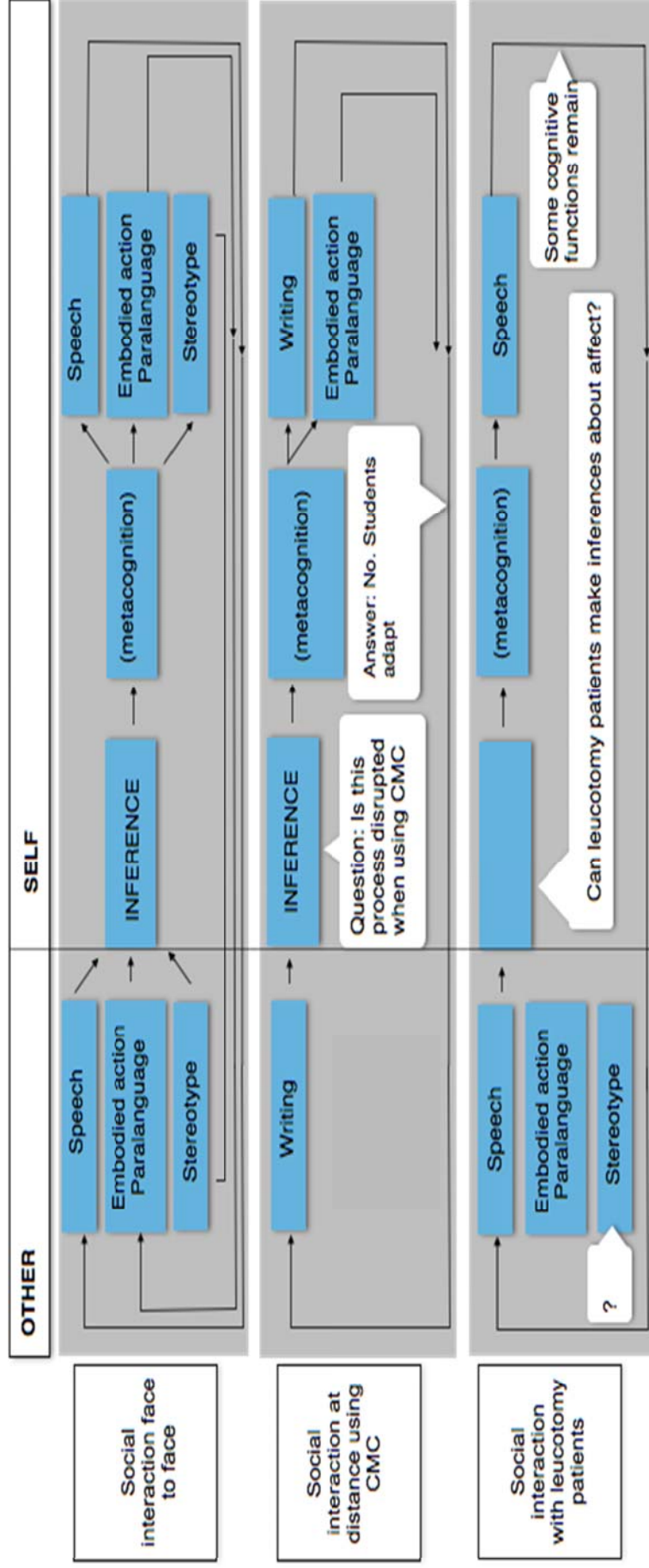
Figure 8-3 A psychological process model of interpersonal interaction

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8.6 Outstanding issues

Deciding what to measure, and how to measure it, are prerequisites for collecting evidence. When the four studies that comprise the toolkit are reviewed collectively, and in the context of the models of social interaction represented in Figures 8.2 and 8.3, there are three issues that require further attention.

Firstly there were substantial challenges due to the subjectivity of the concepts under investigation, co-presence and socio-emotional experience, and their abstract and changing nature. Two concepts of relevance emerged from the literature review: *social presence* from the Communications and TEL literature, and *empathy* from more general areas of education research and also in Cognitive Neuroscience. A current formulation of empathy for Neuroscience, its cognitive and affective components, made a significant contribution to the interpretation of empathy, i.e. the specification of what distinguishes affective empathy (the response to a mental model of the feelings of others) from other outcomes of a social interaction: emotional mimicry, emotional contagion, imitation, sympathy, personal distress, and cognitive empathy (the response to a mental model of the thoughts of others) (Walter, 2011). This formulation for affective empathy was applied to the interpretation of teacher comments as conveying empathy in Study 4. When this approach is evaluated in the context of the process model developed to represent co-presence, Figure 8.3, it demonstrates the limitations of confining

the study of affect in TEL research to social presence. However, the research that coheres around the COI framework and by implication, social presence, has made a significant contribution to our understanding of distance learning using CMC and should be progressed. Therefore, it is recommended that the theorisation of such abstract concepts as social presence and empathy could benefit from further development through an integrated approach across disciplines.

The second issue is whether behaviour and practice represent different concepts, and if affirmative in what way are they different? For psychologists behaviour and mental operations are the subject matter of the discipline and a quantitative approach to the study of behaviour requires that behaviour is predefined (Rourke et al., 1999; Tolmie, 2014) before carrying out an investigation:

> Aspects of behaviour that are of focal interest are operationalized into precise variables in advance of the research, and these are adhered to throughout (Tolmie, 2014, p 112).

This was the approach adopted for Study 2. However, as a practitioner researcher, defining teacher actions in this way conflicted with the need for teachers to be detached. The teacher had a role to play and the outcome of each decision, as reflected in the content of a posting, emerged from a professional judgment process that could involve complex factors. A similar argument can be applied to the students themselves as they take part in group work, that they will moderate their responses according to a number of factors, some pertaining to progress with

the task, while others will concern relational issues. For Studies 2 and 3 any quantifiable data resulted from interpretation of practice: what students actually did by contrast to what the researcher proposed to study.

The question of a conceptual difference between behaviour and practice is important as it influences the way that evidence is reported and interpreted. For example, a comparison between project groups that relies on quantification should depend on calibrating the measurements according to the total word (or character) count. However, the substantial difference in word (character) count between the two groups is a reflection of practice (Section 4.6 elaborated this point). Student and teacher practices, as co-constructed during collaborative learning, are what the thesis sought to study in order to inform the second aim for the thesis. This is why a decision to represent the findings as practice was taken. The value of this approach will be explained in more detail in Chapter 9 when a contribution of the thesis to practice (the second research aim) is summarised and exemplified.

The third issue arose from a reflection on ethics. While the ethical guidelines for Psychology and Education share much common ground researchers working in an Educational Neuroscience tradition will need to develop their ethical thinking to accommodate all the disciplines involved.

There are some reflections on Study 4 that are particularly pertinent for the emerging field of Educational Neuroscience. The study was conducted in a department that provides a specialist neurophysiology service both locally and nationally. It is a requirement of the UCL ethics procedure that all participants agree to be informed about any unexpected findings. The neurophysiological records of all the participants were medically assessed for unexpected findings (indicators of a neurological condition) by a consultant before being released to me. Furthermore, a fully trained (2 years post graduate) physiologist carried out the practicalities of the procedure. As a consequence, there were benefits of both timing and the precision with which the electrodes were placed. More importantly, the physiologist had extensive experience of facilitating and managing individuals for whom the experience was both new and strange as evidenced by the following email received after a session.

> 'Please pass on my thanks to Hxxxx for making the EEG an easy experience'.

All the participants in Study 4 were academics / professionals in psychology or a cognate discipline and it can be argued that they were less vulnerable than many in the general population. Therefore, a question raised is whether this level of support should be available as routine in neuroscience research with human participants.

Some ethical issues have emerged that are only now receiving attention from an ethics perspective. Present day neuroscience techniques and TEL share a common history; both depend on the availability of digital technologies and the development of associated software. Both are fertile areas for innovation involving the development of software and instrumentation for storing, linking, and analysing large datasets, crowd sourcing information, collecting and sharing information socially, and for health and education purposes. While there will be benefits from these developments they also pose ethical questions, particularly regarding privacy. The patterning of an EEG is a unique personal identifier for example, cognitive biometrics have been produced from linking EEG data sets with other relevant data sets (Revett & Magalhães, 2009), and the EEG has been used to map level of engagement with city features, by mapping mobility against EEG data (Revett & Magalhães, 2009; Stopczynski, Greenwood, Hansen, & Pentland, 2014). Therefore privacy issues are paramount when collecting, storing, and reusing neurophysiological data. In response to a request from President Obama a first set of recommendations have been published.

> (I)ntegrate ethics explicitly and systematically into the
> relatively new field of contemporary neuroscience
> (Bioethics.gov, 2014).

In Europe the use of bio data and other neuroscience products for neuro-enhancement is being debated publicly so that the social, ethical and legal issues can be addressed at this relatively early stage of development (nerri.eu, 2014). A

similar situation exists in TEL; there is debate as to how learning analytics data that predict student failure should be used (Sclater, 2014). It is recommended that the Educational Neuroscience research community embrace the ethical guidance emerging from these initiatives. In the interim, the neurophysiological data collected for this thesis does not contain any identifying information and will not be made available as open data.

8.7 Conclusion

It has been possible to formulate a model of social interaction at distance using CMC that is plausible at three levels, participants practice while learning using CMC, psychological and neural. These models provide an explanation as to why co-presence need not be disrupted when using CMC for remote interpersonal interaction. Furthermore, the collective findings from Studies 1-4 confirm that co-presence need not be compromised provided that the participants have appropriate digital fluency and are empathetic.

The development and application of this toolkit demonstrates that identifying conceptual collisions between disciplines can inform the appropriate choice of diverse methods. The relevance for TEL research is as follows:

- Social presence, as conceptualised in TEL research, is not sufficient for investigating and explaining socio-emotional experience and co-presence when interacting with others using CMC.

- One element of the toolkit, the framework illustrated in Figure 5.1 has potential for application in other areas of TEL research on 'learning through collaboration' and also Education research more generally.

- The understanding of co-presence when students communicate remotely using CMC has been progressed by developing a model of that is informed by Psychology and Neuroscience and cognate disciplines. The neural and psychological models of social interaction that have been developed provide a valuable contribution to our understanding of interpersonal interaction at distance using CMC. It would seem that the verbal immediacy behaviours that students adopt as a substitute for embodied action and speaking are sufficient; that co-presence can be adequately experienced when interacting with others remotely. The models, Figure 8.2, 8.3 support this claim. Digital fluency; the writing practices that students develop, and their appropriate use of technological tools, mean that 'learning through collaboration' at distance using CMC is not compromised.

The findings also have implications for the second research aim. By bringing together diverse methodologies to focus on the relational space of a group, its interrelationship with task space, and its value, have been more clearly defined that would be the case had each method been used in isolation. Furthermore, by focusing on the teacher as well as the student attention has been drawn to what is

unique about their interrelationship online. This is knowledge that can inform the design for 'learning through collaboration online'. Recommendations as to how learning analytics data could be usefully shared with other teachers are offered, and resources have been developed for teachers that are of practical benefit for their professional development.

The concluding chapter will include further comment on the methodology; how it has benefited by searching for synergy between disciplinary approaches, and the unique contribution that it has been made to our understanding of socio-emotional experience during group work online.

Chapter 9 Conclusion and implications of the thesis

9.1 Open entry and distance learning, past, present, and future

In 2009, the year that I began this thesis, the Open University (OUUK) celebrated

its 40th anniversary. The Vice Chancellor at that time commented on its impact.

> The Open University has turned an educational system
> devised in another age into a tool of the knowledge society,
> and used open and distance education to make the world a
> better place: abandoning entry criteria has enabled us to
> provide education to millions of people who might otherwise
> be condemned to poverty and hardship. (Gourley, 2009).

2009 marked another significant 40th anniversary. In 1969, computer scientists at

the University of California Los Angeles created a network connection between

two computers and thereby enabled computer mediated communication (CMC).

Fifteen years later, in the mid 90s, the OUUK began to exploit the use of

communications technology thus enabling students to interact remotely and

thereby benefit from social learning pedagogies. However, a much debated issue

concerned the quality of social interaction online. For example, some claimed that

it was compromised (Sproull & Kiesler, 1986) whilst others emphasised the

supportive nature of some online learning communities (Preece, 2000). It was a

debate that was never satisfactorily resolved. This thesis has sought to inform this

debate by collecting both objective and subjective evidence, phenomenological

(the student and teacher experience of learning and teaching in social contexts

online), spontaneous and voluntary behaviour (by investigating teachers'

embodied behaviours) and neural (when teachers engage with the discourse of students engaged in authentic group work). The overall conclusion, that the quality of social interaction, and by implication learning, need not be compromised in an online context is timely given the increasing number of Higher Education (HE) institutions that are incorporating distance learning into their strategic plans (Johnson, Adams Becker, Estrada, & Freeman, 2014; OUUK, 2012; Rovai & Downey, 2010; Söderström, From, Lövqvist, & Törnquist, 2012).

This concluding chapter will consider the conceptual, methodological and practical contributions of the thesis (Section 9.2, 9.3, 9.4) and an analysis of what is unique about group work online (Section 9.5) and then assess the relevance of these contributions for the future of open entry and distance learning in Section 9.6. Finally, some proposals about how our understanding of group work online using CMC could be progressed through using an Educational Neuroscience framework are offered in Section 9.7.

9.2 Socio-emotional experience and co-presence during interpersonal interaction online

From a theoretical perspective, the absence of physical, identity and embodied information is one argument for the view that social interaction online is compromised (Kreef-Peyton & Bruce, 1993; Sproull & Kiesler, 1986, 1991); the implication of not being co-present in time and place on the 'realness' of others is

another (Bayne, 2008, 2010; Robinson, 2013). For distance students the effect of these contextual circumstances may be compounded by the fact that the other students are likely to be strangers. Singly, or in combination, these circumstances could disrupt the sense of others online, co-presence, and thereby influence socio-emotional experience. Taken together these contextual circumstances determined the research question.

> *What are the consequences of doing group work online and asynchronously, using text-based forums, on co-presence and the socio-emotional experience of the students and teachers involved?*

The main conceptual contribution of the thesis is to theorise 'co-presence' when interacting with others online and at distance and to consider why co-presence need not be compromised when sensory and identity information about others is not available. The argument put forward is that social presence, as an explanation for sense of others formulated in the current TEL literature, is insufficiently powerful as an explanation for the socio-emotional experience that results from communicative practices online.

For TEL the conceptualisation of 'social presence' has been influenced by media richness theory (Daft & Lengel, 1986) and its relevance for Human Computer Interaction (HCI) studies. For these disciplines 'social presence' was developed as a concept to explain how understanding might be achieved during technologically

mediated communication when the interpersonal information that is critical in the 'real' world is missing. 'Social presence' is a concept that was taken up by researchers in CMC and has dominated the scholarship of online social learning using CMC and it is rarely challenged in that context. The models of social interaction (face-to-face and online) developed for a psychological and a neuroscience perspective (as illustrated in Figures 8.2 and 8.3) show that social presence needs to be elaborated as 'co-presence'. 'Co-presence' is more than communicating 'social presence'; it involves forming a model of the minds of 'others'. A significant contribution of Psychology and Neuroscience to the model of social interaction (face-to-face and online) is to highlight the importance of a 'self' and 'other' distinction. 'Social presence', as a concept for studying affect during remote social interaction, does not address this distinction. By contrast a Cognitive Neuroscience view of interpersonal interaction has as its focus how a mental model of other minds is achieved i.e., how we infer the thoughts and feelings of others, empathise with those thoughts and feelings and self refer to those inferences during interpersonal interaction. For Cognitive Neuroscience affective empathy is a manifestation of emotion and requires a self - other orientation (Frith, 2007; Walter, 2011). Socio-emotional experience will depend on affective empathy to some extent therefore; socio-emotional experience can be enhanced when others communicate empathy. It is why extending the study of relational experience to include a Cognitive Neuroscience perspective has been so

valuable, the importance of empathy for interpersonal relationships has been demonstrated in a TEL context.

A degree of integration between these conceptual approaches ('social presence', 'co-presence' and empathy) has been achieved, and is viable as an explanation of group work online and at distance in practice (as illustrated in Figure 5.1). Empathy is what distinguishes 'co-presence' and 'social presence' conceptually. This distinction is important: it is proposed that the quality of the emotional climate of a group and by consequence, the socio-emotional experience of the individual students, is achieved by group members communicating presence, being aware of the emotions and feelings of their peers, experiencing them as 'real' people, and communicating empathetically. Social presence is sufficient as a description of the group functioning as a cohesive unit however; it may not be sufficient for engendering positive socio-emotional experience and 'realness' of 'others'. Empathy, expressed and experienced is a key additional component (as is the case when interactants are face-to-face). The evidence for affective empathy amongst students as demonstrated in Study 3, and by teachers in Study 4, is what distinguishes 'co-presence' as theorised by this thesis. The thesis has demonstrated that for a satisfactory experience of interaction online presence needs to be experienced as well as communicated. It requires more than an individual communicating their presence and acknowledging that others in the

group are involved in the interaction, it also comprises perceiving and experiencing 'others'.

Uniquely, the thesis has provided objective evidence of 'co-presence'. Neural and behavioural indicators of the spontaneous expression of emotion were identified that are consistent with the participants' subjective accounts of socio-emotional experience (when the participants took on the role of teachers) while taking part in a simulation of group work online that is consistent with the theoretical research in both Psychology and Neuroscience that informed the models of social interaction (described in Chapter 8). Furthermore, these findings are also consistent with the subjective experience of a student from each of two groups, and a researcher analysis of the flow of interaction (Study 3). A coherent line of evidence supports the assertion that 'co-presence' can be achieved during social interaction online and is a powerful indicator that 'co-presence' when using CMC need not be compromised provided that the students and teachers involved are digitally fluent and empathetic. Collectively three sources of evidence, subjective, behavioural (spontaneous and voluntary), neural, mean that learning based on social learning pedagogies is as viable when using CMC as when students are face-to-face.

To achieve an ambition for this thesis, information that can make a contribution to the quality of open entry and distance learning, it is important to specify how the shared task, relational space and empathy are achieved in practice during group work online. Referring to each other by name (vocatives), using inclusive pronouns

(we, us), a nuanced use of question tags and metaphor, and an unconventional use pattern for the exclamation symbol were the linguistic devices used by students in both groups (The Mandevilles, The Wenlocks) that were studied for the thesis. Both groups used them to support progress with the task; to achieve joint attention, coherence, and a cohesive group approach during negotiation, as illustrated in Figure 5.5. A subset of these devices (metaphor, exclamation symbol, question tag) was employed (by one of the two groups studied) to express presence and convey empathy. It is proposed that these language practices are a sufficient replacement for the absent multisensory information; that at a neural level alternative pathways are activated (as indicated in Figure 8.2). These findings add to existing research (Lapadat, 2007; Rourke et al., 1999) on the use of linguistic devices when learning remotely using CMC and, at a theoretical level, a neuro-scientifically plausible account of interpersonal interaction at distance using CMC is offered.

9.3 A multi-disciplinary methodology: the first research aim

A considerable amount of experience and research about 'learning through collaboration' online has accumulated over the previous three decades. The thesis has sought to extend knowledge about 'learning through collaboration' online and at distance using CMC by focusing on the relational aspects of group work. This has been achieved by modeling interpersonal interaction through group work from

a Psychology and Neuroscience perspective and by investigating socio-emotional experience and co-presence at a neural level, and motivation to engage with learning from a psycho-biological perspective.

Having spent a significant number of years involved in applied research in Mental Health and Neurology I considered that the methodologies of Neuroscience could be used to investigate and model the claims about the quality of remote social interaction. Accordingly, the claim that the quality of social interaction and by consequence, learning online, was inferior when compared with social interaction face-to-face was modelled using a neuropsychological methodology (i.e. the idea of a specific cognitive or affective deficit arising from damage to a neural structure or pathway) as illustrated in Figure 8.2. The emergence of a new field, Educational Neuroscience, afforded the opportunity to investigate and progress these ideas and interrogate the models (Figures 8.2 and 8.3) in a principled way.

Therefore, the first aim of the thesis was

> *To identify and develop a methodological toolkit for studying the socio-emotional experience of the individual student, the teacher, and the relational space of the group (as constructed by a group engaged in a shared learning task) at three levels, subjective, behavioural, and neural, and to formulate a model of social interaction at distance using*

> *CMC that is plausible from three perspectives, Education (participants' practice while learning using CMC), Psychology and Neuroscience.*

It involved developing a toolkit of methods drawn from three disciplines, Education, Psychology, and Neuroscience that is viable, yet credible for the individual disciplines. The challenge was the mismatch between the dominant methodology of a psycho-biological approach in which confounds are carefully controlled, by contrast with the sheer number of factors that can be salient for the open entry and distance student, as illustrated in Figure 3.2. Nevertheless, based on the evaluation described in Chapter 8 this challenge has been met. The significant methodological achievements are as follows:

- A coherent line of evidence, subjective – behavioural – neural was achieved by using methods that meet the criteria for science yet the ecological validity of the findings is not overly compromised. In turn this line of evidence is consistent with a Neuroscience model for social interaction at distance using CMC (Figure 8.2) and a Psychological model (Figure 8.3) that clarifies why the quality of the interaction need not be compromised.
- A student's motivations to engage with learning, and their future decisions about learning, have been considered from a psycho-biological perspective. As a preliminary investigation of intrinsic motivational drive using neurophysiological methods, the outcome was encouraging.

9.3.1 A bridge between two disciplines or synergy between many

For the previous two decades a bridge analogy for integrating the knowledge between Psychology and Education, and in turn Psychology and Neuroscience, has dominated thinking in Educational Neuroscience and comment on it (Bruer, 1997, 2014). By contrast the development of the methodology for this thesis benefited from interrogating a wider range of disciplines: evolutionary biology (Dunbar, 1996), linguistics (Crystal, 2006; Herring, 1999), organisational psychology (Van den Bossche et al., 2006), the science of learning (Laurillard, 2009, 2012) and TEL (Anderson et al., 2001; Stahl, 2011, 2013; Stahl et al., 2006) and by identifying synergies between the knowledge base of these disciplines.

A multidisciplinary view on language has been particularly valuable for investigating remote and asynchronous interpersonal interaction through writing. Firstly, the work in linguistics that compares asynchronous CMC with face-to-face conversation (when turn taking is the norm and illocutionary force is achieved through paralanguage) has highlighted the importance of 'threading' and 'styling' (Herring, 1999). Secondly, when considered together with the synergy between Crystal's proposal that written communication online is more speech like (Crystal, 2006), the work on dialect (Nettle & Dunbar, 1997) and the TEL research on the linguistic modifications that students employ when using CMC for learning (Delfino & Manca, 2007; Lapadat, 2007; Rourke et al., 1999) these multidisciplinary contributions were an important influence on the framework developed for the

micro-analysis of the flow of interaction between the members of two groups engaged in a joint project (Study 3). Thirdly, Dunbar's work on the evolution of spoken and written language, as an adaptation for larger scale interaction between con-specifics, ratified the idea that investigating how students and teachers adapt communicative practice in an online context would be appropriate (Dunbar, 1996) as reviewed in Section 1.7.3.2. More importantly Dunbar draws attention to what it means to be human and the brain structures and functions that are unique for humans. This knowledge supports the idea that explicit social cognition (language and metacognition) is uniquely human (Frith, 2012; Frith & Frith, 2010, 2012) and a proposition of this thesis; that the medium for language, spoken or written, should not matter provided that the digital fluency of the participants is adequate.

This proposition was formalised at a neural level in the model illustrated in Figure 8.2. Although the model of the regulation and expression of emotion during social interaction at distance using CMC (Figure 8.3) and its neural representation (Figure 8.2) is massively oversimplified (whether viewed as a neuroscientist, a psychologist, or an educator) it does highlight the self-other distinction, that a sense of self is as important as the sense of the other during social interaction. It is argued that the self/other distinction is the element that makes empathy possible and therefore, that relational experience need not be compromised when using CMC to communicate remotely.

This example of synergy between a range of disciplines was a significant influence on the thesis. Drawing on other related disciplines has been beneficial. An approach that depends on a simple bridge analogy and involving just two disciplines could restrain development. It is proposed that when applying an Educational Neuroscience framework it is preferable to adopt the approach suggested by Connell and colleagues i.e. have a model that conceptualises progress as an iterative process, with the capacity to produce questions that challenge a range of other disciplines (Connell, Stein, & Gardner, 2012). The value of interrogating a wider range of disciplinary knowledge will be developed in Section 9.7 when the recommendations for future research are outlined.

9.4 Designing for group work online and teacher support (facilitation) for group work online: the second research aim.

The second research aim was

To contribute to a better understanding of the experience of learning with others when using CMC for interpersonal interaction. This should inform the integration of forums and other technological tools into the design of online learning, and will enable us to improve our support for teachers in understanding the role of the emotional climate when students are engaged in collaborative learning online.

The student data that informs this thesis was collected in 2007 at a time when activities and facilities that are now ubiquitous, such as using search engines, social networking, owning a smart phone and access to broadband were just beginning to spread beyond the early adopters. There was the risk that any findings would be of limited value or even superfluous. However, based on professional experience for example, of how supportive of each other distance students could be, there were compelling reasons to believe that interpersonal communication at distance using CMC would retain a place as a significant technology for teaching and learning online. Given the growing interest in online learning (blended and at distance) in the HE sector (Rovai & Downey, 2010; Söderström et al., 2012), and its projected evolution and expansion during the next five years (Johnson et al., 2014) the prediction is being realised; the findings of this thesis are relevant for contemporary design for group work online.

The discourse of innovation can be a potent influence, negatively, on design decisions. In Chapter 1 this was exemplified by tracing the history of the application of Second Life, a technology that is now largely abandoned by Education. That learning theory and evidence not innovation per se should determine whether a new and 'innovative' technological tool is appropriate, and also to inform its use, motivated the second aim. There are three contributions that the thesis can make to the design for, and support of, open entry and distance learning. The first concerns the design for collaborative learning at distance using

CMC so that both task space and relational space are appropriately supported. The second contribution is resources for the professional development of teachers with a specific focus on the facilitative role of the teacher i.e. monitoring the 'group as a unit' and also the socio-emotional experience of the individual student. The third concerns the support needs of open entry students and is considered in a further section (Section 9.6) when the potential of MOOCs as a potent influence on the future of open entry and distance learning is considered.

9.4.1   Designing for group work at distance using CMC

From a learning theory perspective three forms of student action are necessary for group work (face-to-face, online) task based and relational discourse, and the experiential (Laurillard, 2012). The findings of Study 3 (a qualitative investigation of group work online) have been used to assess the text-based forum as an online space for achieving these actions, alongside other more recently available collaborative technologies for example, the wiki, Chapter 5 Section 5.8. Although the wiki is a useful technology for collating the contributions to the task the text-based forum, embedded in the institutional VLE, remains the most appropriate technology for supporting discourse. Using text based forums as the place for interpersonal interaction affords the opportunity for students to acknowledge each other's ideas and to support each other emotionally and academically.

9.4.2 Resources for supporting the facilitatory role of teachers

The resources for teachers include some suggestions about how learning analytics data could be collected and collated so that it is useful for teachers and these suggestions are summarised in Chapter 6 Section 6.1. However, the main contribution is the narratives, a resource that can provide teachers with insight into the relational space of the group and the socio-emotional experience of individual students. The key properties of these narratives are authenticity, that they are topic neutral, they represent the patterning of affective practice (Wetherell, 2012) and are of sufficient granularity to allow the reader to infer a mental model of other minds (Frith, 2007). The value of the resources for the professional development of teachers is that they can be used to seed discussion amongst teachers about their facilitative role when supervising group work online. Furthermore, they should prompt discussion about other related issues such as: optimal group size, 'group think', and the advantages of team teaching.

9.5 The unique characteristics of group work online and the pedagogical advantages

The advantages for distance students from using CMC are well documented; flexibility about when and where the learning takes place, time to reflect and the opportunity to revisit the learning conversations (Laurillard, 2002; Weller, 2003). However, a multidisciplinary approach to methodology has meant that a longstanding debate about the quality of interpersonal interaction when using CMC

remotely could be resolved, namely that the quality of the experience depends on the students and teachers involved and need not be compromised when interacting with other students at distance by using CMC to communicate. Furthermore it is a claim that is neuro-scientifically plausible and by consequence emphasises the irrelevance of questions about the 'realness' of others online. These outcomes provide the authority for the claim that there is considerable pedagogical advantage from offering social learning online and at distance. Cues to identity do not disrupt interpersonal relationships and teaching can be better supported. There is an imperative, the design for interpersonal interaction should endeavor to accommodate digital fluency and teachers should be supported by analytics data, encouraged to consider the emotional needs of students and to take the opportunity to team teach. The rationale for these recommendations for practice, and the findings that support them follow.

One important outcome of the comparison between the VRS and the RS for Study 1 concerned the impact of cues to identity. In face-to-face contexts, and when identity cues are not shared by participants, they can have a negative effect on group cohesion whereas the absence of identity cues online means that a strong within group identity will develop (Lea & Spears, 1991, 1992) and by consequence, that group cohesion is enhanced when social learning takes place at distance. This knowledge endorsed the intention to focus on the absence of non-verbal cues as the factor of relevance i.e. the implication in practice of

interpersonal interaction that is asynchronous and effected by writing rather than speaking. The processes that comprise group work were identified through the literature review and were incorporated into a procedure to guide the analysis of the flow of interaction during collaborative group work, as represented by the written exchanges between students (Study 3, Chapter 5). The findings demonstrate that students develop and use a number of linguistic devices and that they appropriate the technology for communicative purposes. Students develop these practices as a substitute for the embodied actions (for example, pointing) and emotional communications (for example, facial expression, paralanguage) of group work face-to-face. However, these student actions depend on whether the design for group work allows for these forms of digital fluency. The thesis recommends that a text-based forum embedded in the institutional VLE is the most appropriate technology for supporting these practices.

An online context for group work can confer considerable advantage for teaching. The dynamics of a group are unique and ideally the teacher should be aware of those nuances that comprise a group's unique character. In general teachers are required to supervise a number of individual groups (face-to-face, online) and it can be challenging for the teacher, who is also monitoring progress with the task, to be fully aware of the relational aspects of each group. A full account of the interactions of all groups is available when using CMC. Furthermore, provided the forum is embedded in a VLE learning analytics methods could be developed that

capture the characteristic of each group for example, the engagement patterns of the individual students, a profile of each 'group as a unit'. Such information could be fed back in summary form to the teacher through a personalised 'dashboard' so that they can more easily monitor the dynamics of each group.

The findings from Studies 2 and 3 show that students do not always 'pick up' on the help provided by a single teacher for example, when they model the appropriate use of the technology. Teachers working as a pair, or a team, can model good digital practice through the interactions between them and also demonstrate how to conduct an academic discussion so that it challenges ideas yet is not contentious. Managing group work online confers considerable advantage for team teaching as teachers have access to a full textual record of the group conversations and learning analytics visualisations. Team teaching could also be useful when 'group think' occurs, when the 'group as a unit' loses the advantage of critical appraisal by the individual students. The advice of a single teacher can be ignored; teachers working as a pair could have more impact in these circumstances. To summarise, team teaching should confer significant pedagogical advantage and team teaching is better supported online as it can be enabled by technology.

9.6 MOOCs and the future for open entry and distance learning

A methodological aim was to take a holistic approach. An outcome is the story of the open entry and distance students who comprised the membership of two project groups; a focus on their profile as students studying at distance led to some recommendations for design and teacher practice. During the eight years since these students were enrolled on the virtual residential school the concept of open in an educational context

> has undergone many interpretations and adaptations,
> moving from a model which had entry to study as its primary
> focus to one that emphasises openly available content and
> resources (Weller, 2014, p2).

Therefore, a focus on their experience (experiential and pedagogical) based on the open entry aspect of their profile is also required.

In theory, anyone with access to the internet can take advantage of its content which now includes outputs from HE in the form of open education resources (OERs) (for example, the podcasts at iTunes U) and research publications, and use open technologies (for example, google groups, twitter, blogs) to network, including with academics and researchers. During 2007/2008 the first free (gratis), global, online courses took place; a symbol of the 'logical extension of the open education movement' (Weller, 2014, p93). Critically, tangible courses were constructed by academics consisting of a program of study and some curated resources. A large and global enrollment was the outcome i.e. the MOOC concept

was borne, based on connectivism as a learning theory for the digital age (Siemens, 2005). Commercial interest (for example Coursera, edX and Futurelearn) in providing infrastructure to host MOOCs followed and in 2015 manifests numerically at about 17 million open entry students enrolled (approximately 81% of distance students). During 2011-2015 hundreds of millions of dollars was invested in the development and operation of MOOC platforms and by the universities that offer MOOCs on these platforms (Siemens, 2015). Media interest in MOOCs has been intense (Weller, 2014). These factors have limited a balanced consideration of the educational value of MOOCs (Kalman, 2014) an issue that this section seeks to address from the perspective of the open entry student.

An advantage of MOOCs for students is that they can enroll without incurring a financial cost therefore, one claim for the societal value of MOOCs is that they widen participation; they are positioned as a way in which the access divide between the global south and north might be addressed. However, most MOOCs currently on offer are unsupported and based on an instructionist pedagogy. They do offer some peer contact but it involves using forums that cater for thousands. Students can become disorientated when making sense of the large volume of discussion that is generated and by the navigational challenges that arise from the fact that the use of online technologies for collating personal knowledge, and for communicating with other students, needs to be self organised by the student,

predominately (Siemens, 2011). Furthermore, teacher presence is extremely limited with teacher activities almost exclusively confined to instruction. Based on the findings of this thesis, the claim that MOOCs widen participation cannot be justified without addressing four issues, the emotional needs of students, the extent to which 'learning through collaboration' can be offered, digital fluency in a global context, and the support needs of open entry students.

9.6.1   The emotional needs of students when learning.

The importance of addressing a student's emotional needs has been emphasised throughout the thesis. That the emotional needs of open entry and distance students can be supported remotely using CMC to communicate has been well documented in the past, and designs for maximising that value have been offered (Palloff & Pratt, 2007; Preece, 2000). Study 3 endorsed this work by highlighting the value of social learning from the perspective of Emotion, that if the institution provides the appropriate conditions, the students will help and support each other. Furthermore, although students report that they find group work challenging Study 1 showed that providing distance students with opportunities to engage with the wider student community through optional activities, social and support forums is valued by students. Students studying on a MOOC need to find and co-construct peer networks. An issue to foreground in this section is that many open entry students may not have either the confidence or the digital competence to do so.

Furthermore, MOOC design can be agnostic to the emotional needs of students. FutureLearn addresses the problem of a student following discussions when massive numbers of students share just one forum by allowing them to filter contributions to those that are most liked by others (Ferguson & Sharples, 2014, p. 5). The findings of this thesis raise questions about the practice of filtering the discussion forums, specifically, what the impact might be on the emotional experience of the many students whose comments are not labeled as 'liked'. By focusing on a student's intrinsic motivation to engage the thesis has drawn attention to the interdependence of emotion and cognition, and the influence of emotional experience on the motivation to engage has been emphasised. The outcome of 'filtering' could be a detrimental effect on the engagement of many students on the course, and also the engagement of these students with this form of learning in the future.

9.6.2 Maximising social learning opportunities

Another pedagogy developed by FutureLearn in order to manage the massiveness of student enrolment is the 'discussion bus' with room for up to 20 people. While a 'discussion bus' can confer advantage for social learning in that the students on the bus are active at the same time (for at least one point during a course) it is important to distinguish the pedagogy of 'learning through discussion' from 'learning through collaboration' (Laurillard, 2012) when assessing its value. For 'learning through collaboration' the thesis makes two recommendations that are

not currently met by the 'discussion bus'. Firstly, for group work to be successful less than 8 members working on a shared task is ideal. The analysis at group level (Studies 2 and 3) show that the group size should be limited so that there is a reasonable opportunity for all members of the group to be actively contributing to both task and relational space throughout. Secondly, when group work takes place remotely using CMC there should be sufficient time for the norms and a group dialect to develop, as demonstrated by the findings of Study 3, and for the dynamic nature of a group to evolve (Tuckman & Jensen, 1977; Walther, 1994, 1996).

9.6.3 Digital fluency in a global context

The experienced teachers who acted as participants for Study 4 discussed how social sharing could be compromised without full awareness of, and support for, the language and cultural differences amongst students on courses with a global intake. Although open entry and distance students at a national university can achieve a productive and supportive online space for group work by adapting their style of writing to be more informal and speech-like, i.e. 'Netspeak for learning online', it involves unconventional use of language and this practice could be problematic for students who need to communicate in a second or third language as is likely to be the case when a MOOC is offered globally.

9.6.4 Support for students.

Unsurprisingly, it is extremely rare for the support needs of students who enroll on MOOCs to be addressed and the question is whether inadequate support could mitigate the value of the opportunity to study through a MOOC. The distance students, on whose learning this thesis is based, benefited from supported open learning (SOL) an approach that has been developed by the Open University UK over four decades. It is argued that the knowledge and experience that motivated those investments (Kalman, 2014; Weller, 2014), together with the findings of this thesis, affirm the importance of providing for the support needs of students and should be an issue that is considered when assessing the pedagogical and societal value of MOOCs. The importance of multiple forms of support, both explicit and implicit, for open entry and distance students has been demonstrated as follows. The findings from Study 1, a student perspective, demonstrate how support from the institution in the form of enrichment and social opportunities and a dedicated 'help' forum can diminish some of the barriers that distance and open entry students face and the findings from Study 2 support the claim of the COI (Anderson et al., 2001) that teaching presence is a vital component for facilitating and promoting effective social learning at distance.

9.6.5 Open entry students studying at distance in the future

'Learning through collaboration' is an esteemed pedagogical form (Laurillard, 2012; Weller, 2003) and it is predicted that it will become a key competence in the

workplace. To date MOOCs have been unable to achieve optimal design for group work specifically, by failing to provide appropriate time or places for groups to form so that they ultimately subscribe to a shared goal and start performing as a group. The social needs (emotional and pedagogical) of all but the most connectively competent have not been met and there is little support to help them achieve the competencies required for a connectivist pedagogy.

This section has recognised that the influence of MOOCs for the future of online and distance learning could be significant and has sought to contribute to the current dialogue (Kalman, 2014; Weller, 2014) and research for example, as represented by the analysis of the 26 studies that formed the MOOC Research Initiative (MRI) funded (€835,000) by the Bill & Melinda Gates Foundation (Gašević. D., Kovanović, Joksimović, & Siemens, 2014). The thesis is based on the premise that emotion, cognition and motivation are inextricably interdependent therefore; both cognitive and emotional aspects have been addressed. A unique contribution of the thesis is the link to the previous three decades of research based on open entry and distance students, and that the findings are based on a holistic investigation of students' experience of engaging with one course during 2007, According to Weller how much both universities and students value support is 'a profound question for the future direction of education' (Weller, 2014 p, 118). The recommendation of this thesis is that access to a range of sources of support

benefits the student's experience and is valued by open entry students; providing support is essential for student motivation and retention.

9.7 Recommendations for Future Research and Development

Three theoretical issues that would benefit from further research and/or development using an integrated approach by the relevant disciplines have been identified; two pertain to achieving a better understanding of the aptitudes required for digital fluency when using CMC at distance, the third concerns the influence of empathy and affect; when learning can benefit and when it might not.

9.7.1 The synchrony 'drive': its biological basis and function

Each project group was provided with a private Live Chat facility alongside a dedicated asynchronous forum. The Wenlocks (negative emotional climate) persisted in trying to use synchronous communication despite the fact that it compromised task coherence and the cohesiveness of the group. The Wenlock behaviour suggests that the asynchronous nature of the communication remains problematic for some students. Other TEL researchers have come to similar conclusions (Haythornthwaite et al., 2000; Kear, 2010). Delay in response time and progress with the task are the reasons given by students for their frustration (Capdeferro & Romero, 2012; Robinson, 2013). However, many students choose distance education for the flexibility that it offers as to when and where to study. Therefore it is important that we try to understand what motivates the synchrony

'drive' that some students display. Whether to include a Live Chat facility is a design issue, advising students about when to use it is a facilitation issue, and knowing when it is appropriate to use synchronous communication and how to use asynchronous communication when it is not, is an aspect of digital fluency that students should be encouraged to develop. To address this very important teaching and learning issue a better understanding of what motivates the synchrony drive is required.

A psycho-biological perspective can provide some useful insights. The value of synchrony amongst team members for sustaining the motivation and resilience of the individual has been demonstrated in a study conducted with elite rowers (Cohen, Ejsmond-Frey, Knight, & Dunbar, 2009). Physical exercise is known to increase endorphin levels and threshold to pain. The endorphin levels of twelve rowers were measured before and after individual training sessions, and team sessions, as predicted pain threshold levels were higher following exercise (due to the opionergic effect of the endorphins). The finding of interest for this thesis is that the increase in endorphin levels was greater after the team exercise. The authors argue for the extra value of working together as a highly coordinated team, that the social cohesiveness adds value. The elaborate practices for signing off postings to the forum (pre-close statements, exaggerated use of 'x') could be adaptations that students make in the absence of opportunities to be synchronised in time, a form of digital fluency that simulates real time synchrony. However the

report by (Cohen et al., 2009) implies that physical exertion is involved, alongside the social. Therefore a question for Neuroscience from TEL is the extent to which the physical is involved in the beneficial effects of synchrony, and whether synchrony can be simulated and/or imagined.

9.7.2 Linguistic devices used during CMC and the activation of modality specific sensory cortex

The use pattern of metaphor and the exclamation symbol suggest they perform a similar function for co-presence (as evidenced in Study 3). There is some research in Cognitive Neuroscience that could provide an explanation. Decoding metaphor is a linguistically complex cognitive process. Current thinking in Neuroscience about how metaphor is processed neurally, is that it depends on coordinated activity across those brain areas known to subserve the discrete cognitive/linguistic elements of metaphor comprehension (Coulson, 2008). Included in this account is the idea that discrete modality specific regions of the brain are activated during the processing of a metaphor. That sensory cortical areas linked to the sensory grounding of the metaphor are activated during metaphor comprehension has particular resonance for this thesis. It provides an explanation for how the missing sensory stimuli of CMC are compensated; that the subcortical pathway from stimulus to primary sensory areas of the brain is taken over by a direct route from language areas (as illustrated in Figure 8.2). Although this proposed network would involve an altered route for brain connections the

outcome, as experienced socially, should not be compromised. This explanation would support the finding that inferring meaning, task related and relational, need not depend on primary sensory stimuli.

The question that arises is whether this explanation could be extended to the use pattern for the exclamation symbol. During informal written communication, or fictional writing, the exclamation symbol can indicate an emotion such as surprise, alarm, or to emphasise, and the meaning is shared by the reader. It is therefore possible that, at a neural level of processing, the communicative power of the exclamation symbol is similar to that of metaphor. The investigation of metaphor and exclamation symbol for communication, and at a neural level of processing, are areas where further multidisciplinary integration could be useful.

9.7.3 Relational space during group work: is there an optimum level of affect?

In everyday life the functions that are attributed to empathy as a foundational aspect of social life are wide ranging. For example, from a cultural/ philosophical perspective it is claimed that experiencing empathy can be a trigger for creative thinking and a sense of being connected to others, that being the subject of another's empathy is a basic need for humans. In Education demonstrating empathy is considered important for social interaction, social learning pedagogies (being able to take the perspective of others) and morality, and that

> teachers create a mental model for a group of students
> (Cooper, 2011, p 88)

so that they can adapt their practise accordingly. However, some findings of this thesis have prompted questions about whether an exaggerated interpretation of the need to be relational can be counterproductive. It is an argument that supports the concept of 'group think' as described in Chapter 2, 2.4.4 (Exemplar 12). In Study 4 the participants (experienced teachers) raised questions about the functional representation of empathy, and whether, like stress, there is an optimum level, with too little affective empathy having a reducing effect on the motivation and engagement of individual students, while too much empathy can compromise the pedagogical advantage that group work should offer and can lead to groupthink for example, the group members of the Mandevilles who were reluctant to challenge the ideas of others. Periods of academic conflict should be expected indeed welcomed. Collaboration benefits learning most when there is a need to resolve differences between the ideas and actions of individual group members. The teacher's role as facilitator is to monitor the balance between retaining harmony within the group and their progress towards a successful outcome, and to intervene if the group themselves are unable to achieve this balance. It is an extremely important aspect of the teacher role that cannot be addressed without a better understanding of the dynamics of the interrelationship between affective and cognitive empathy in learning contexts.

9.8 Concluding remarks

All theory and research is historically situated. 2014 was the centenary of the First World War, a war that involved the heavy use of ballistic missiles with the consequence that many casualties sustained horrific injury, including to the brain, yet survived. The investigation of cognitive function, following injury to discrete brain areas in combatants, laid the foundation for much of what Neuroscience now knows about the localisation of function in the brain. When digital computers first became available in the 1950s, the influence on theory in cognitive psychology was significant, the development of information processing models based on analogy with the inputs, outputs, memory, and processing of a computer. The knowledge that flowed from these points in time remain valid today and has been developed and refined, and on occasion misappropriated or oversimplified. The recent emergence of Educational Neuroscience (applying the knowledge of neuroscience to benefit educational practice) and TEL (the application of technology to enable and enhance learning and teaching) share a common influence: the development of cheaper, smaller, digital computers and devices with appropriate memory capacity and speed, and the availability of software to support their use 'off the shelf'. In the case of TEL, the Internet and specifically access through wifi has also been hugely significant.

There is the potential for both Educational Neuroscience and TEL to co-develop and make a considerable difference to the quality of education and access to

education. However, the allure of Neuroscience and the hype of TEL could prevent each discipline from achieving its full potential, in terms of knowledge, for Neuroscience, and educational practice for TEL. For example much of the work undertaken in Educational Neuroscience remains committed to studying where in the brain a cognitive function might be located at the expense of furthering the study of the actual process (Bruer, 2014) and the hype associated with MOOCs is receiving critical comment (Laurillard, 2014; Weller, 2013). On the other hand, by integrating TEL with Educational Neuroscience in a principled way some important findings have emerged from this thesis, primarily that the social, emotional and learning brain processes of students are not disrupted by learning with 'strangers' online, and without access to sensory information about their co-students. The quality of emotional experience, and the experience of learning, need not be compromised when interacting with other students and teachers at distance using CMC.

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Appendices

Appendix A: The Project proposal form (PPF).

16

Project Work and Project Proposal.

You must go through the following stages before starting project work

<u>Step 1.</u>

Work with other project group members to produce a research proposal using the project proposal form (PPF) provided. Please make sure that you are using the correct project proposal form (PPF). The PPF for memory options (options 1-4) is different to that for communications projects (options 5-8). The lead tutor for your project will advise as necessary and confirm when it is appropriate for the proposal to be sent for ethical and procedural scrutiny. Please note that your lead tutor will not scrutinise the finer detail of your proposal, that task will be done by tutors who have not been associated with your project.

You may like to know that the project proposal form that you use is based on one that professional researchers must complete before conducting research with human participants.

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[16] This is the PPF for the four memory options. The Communications options have the same format.

Step 2

The project proposal will be returned to you together with comments from the tutors who formed the panel scrutinising your proposal. You are obliged to make any changes that are suggested before commencing data collection. There are two reasons for this:

- Firstly psychologists are obliged to conduct research that conforms to BPS ethical criteria.
- Secondly, you will find that a formal and well produced project proposal acts as a key resource both for conducting your research and also for writing up the project for the ECA.

Step 3

When your lead tutor is satisfied that you have modified the initial proposal appropriately it will be passed over to the Senior Tutor for signing off. Before doing so it is important that the table giving details of names and PI numbers of students in the group is filled in completely. Although this is a clerical stage the information is needed at the assessment stage

You also need to initial the fact that you are aware of ethics considerations.

Step 4

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

Finally make sure that you download a copy of the completed and signed project proposal.

You are required to include a copy with your ECA and the examiners will be checking that you have done so

DZX222 Project Proposal Form for Memory projects (Options 1-4)

Investigators **(names and PI numbers of all group members, and names of tutor advisors)**

Declaration: **Type your initials below to say that you have read the relevant parts of the BPS ethical guidelines and agree to abide by them**

Name	PI number	Initials

Project Option Number		
Tutor 1 (Lead tutor)		
Tutor 2		

1. Project title

2. Project Type: Please indicate your choice in the table below

Memory (quantitative)	
Memory (qualitative)	

3. Research question and/or hypothesis

Memory (quantitative): What is the research hypothesis you wish to test.

Memory (qualitative): What is the research question that you wish to explore.

4. Context: Describe which theory, which research studies, which preparation day activities, which offprint/s this project is based on.

5. Briefly explain the rationale for your research   i.e. describe the link between your research question/hypothesis and the background material that you identified in Section 3.

6. Method.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

Details of Method (complete either Section A or Section B)

Section A: Memory quantitative projects

a) Design

b) Conditions

c) Variables (what they are and how defined/measured)

d) Controls

e) Participants. (PLEASE NOTE ANY PARTICIPANT SHOULD BE OVER 18 YEARS OF AGE (including family members))

f) Procedure (as appropriate to your design e.g. what participants will do)

g) Data collection and analysis (describe the data you will collect and outline how it will be analysed. Which statistical tests will you be using)?

h) Schedule give a brief outline of how time will be used (e.g. stimulus creation, carrying out pilot work, data collection, analysis, etc)

i) Details of pilot work to be carried out

Section B: Memory qualitative projects

a) Sampling (e.g. what is the behaviour context, how is material selected)

b) What will be your data and how will it be collected/recorded

c) Transcription procedures (where applicable, including how discrepancies will be dealt with, use of a reflexive log etc)

d) Data analysis   (e.g., track the process of recall etc)

e) Schedule give a brief outline of how time will be used (e.g. material/behaviour selection, data collection, discrepancy resolution, data analysis, evaluation, etc)

7. Ethical issues

Either

Ethical issues arising from videotape/DVD/audio/textual analysis

What are the issues and how will you deal with them

or

Ethical issues when recruiting participants

Who will you collect data from, how and where will you recruit participants and how many will you need?

Consent (What issues of informed consent arise in your proposed research? How have you decided to approach these? Where you are using a consent form and/or information sheet, attach these here)

Deception (are you going to be deceiving your participants at all? What will you be doing and how do you justify this?)

Data Protection (how do you propose to retain participants' anonymity/ confidentiality?)

Risks (are there any risks to your participants or to you as researchers? How do you propose to minimise these and what justification is there for any that remain?)

Debriefing (how do you propose to retain participants' anonymity/confidentiality?)

Protection from harm (please indicate whether you need to consider this aspect and briefly describe why).

Appendix B: The survey items used for Study 1a.

Please note [17]

Your study experience

(definitely agree,   mostly agree,   neither agree nor disagree,   mostly disagree,   definitely disagree,   don't know/not applicable)

1a. Overall the workload on the Virtual Residential School was higher than expected.

1b. Overall the amount of interaction with other students was higher than expected.

1c. Overall the pacing of the study program was faster than expected.

1d. Overall the online activities that took place during the first 4 weeks were appropriate preparation for the project work.

1e. Overall I was satisfied with how the online preparatory activities were facilitated by the tutor team.

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[17] The items 2g and 5g were omitted from the final analysis. Both items relate to the use of the online chat facility and in retrospect seem ambiguous in their wording. Furthermore, from my thesis work I know that whether or not a group used synchronous chat, and how they used it, varied from group to group

1f. Overall I was satisfied with how the project work was facilitated by the project team.

1g. Overall I have gained academically from working intensively with other students.

1h. Overall I was satisfied with the printed course material.

1i. Overall I now have greater sense of belonging to the Open University.

1j. Overall I was satisfied with my study experience on the virtual residential school.

1k. Overall I valued the opportunity to engage in an intensive student experience.

1l. Overall I gained some useful skills from working online.

1m. Overall I gained some useful information that is relevant for my long term plans.

1n. In my online learning I would like to provide some extra cues about myself such as a digital photograph, voice recording, or video.

1o. In my online learning I would like to have access to some extra cues about my fellow students such as a digital photograph, voice recording or video.

1p. Overall by using Computer Mediated Conferencing (CMC) to communicate and learn I was disadvantaged due to the lack of Non Verbal Cues.

1q. Overall the facility to access a complete textual records of all discussions advantaged my learning.

1r. Overall if I was making a choice between the Residential School or the Virtual Residential course I would choose the Virtual Residential Course again.

Engaging with the online community

(definitely agree,   mostly agree,   neither agree nor disagree,   mostly disagree,   definitely disagree,   don't know/not applicable)

2a. Working with other students on the preparatory activities increased my sense of engagement with the online community.

2b. Access to the precourse conference facilitated my engagement with the online community.

2c. Access to the Help conference facilitated my engagement with the online community.

2d. Access to the asynchronous chat conference with fellow students increased my sense of   engagement with the online community.

2e. Working within a group to design and carry out a research project increased my sense of engagement with an online community.

2f. Taking part in the optional activities increased my sense of engagement with the online community.

2g. Taking part in online chat sessions increased my sense of engagement with the online community.

2h. Listening (reading) to the DZX222 conversations (see Website link) increased my sense of engagement with the online community.

2i. Being able to comment on the issues raised in the DZX222 Conversations increased my sense of engagement with the online community.

Taking part in the careers forum increased my sense of engagement with the online community.

Please select the option that best describes your experience with the following activities.

(Very difficult, difficult, neutral, easy, very easy, not applicable)

5a. Posting your first message to a discussion conference.

5b. Keeping abreast of the activity based discussions in the first 4 weeks.

5c. Working with other members of the group to construct a project proposal.

5d. Working with other members of the group to collect data/evidence.

5e. Working with other members of the group to analyse data/evidence.

5f. Working with other members of the group to present the project outcome.

5g. Taking part in online chat sessions.

5h. Managing your time.

5i. Sustaining your involvement in the course.

5j. Identifying the relevant conference for each task during the preparatory activities.

5k. Working with a team of tutors rather than an individual tutor.

5l. Finding the information that you needed.

Relevant previous experience. Please select all that apply [18]

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[18] Each item in Section 7 was scored (Yes =1, No = 0) totalled, and reconstructed as three variables

IT experience

group work

online collaboration

7a. I use email at work.

7b. I use email at home.

7c. I have taken part in other online forums.

7d. I have taken part in discussion in face –to-face tutorials/day schools/ work related situations.

7e. I have previous experience of group working.

7f. I have previous experience with using online chat, instant messaging such as MSN.

7g. I get involved with OUSA events including online discussion conferences.

7h. I use the internet to browse and search for information.

7i. I use the internet for Social networking.

7j. I use a computer at work.

7k. I use the internet at work.

7l. English is my first language.

Appendix C: Study 1a. Information for participants.

Dear Student

Thank you for studying with us on DZX222 in 2007.

As you now probably realise the course has been designed to mimic the student experience on the Residential School, DXR222, as closely as possible including providing you with an opportunity to have a broader and more intensive experience of studying with The Open University. At Residential school tutors would provide enrichment activities in the form of evening lectures, workshops etc. and there would be opportunity for informal conversations with both tutors and Open University staff. We are trying to develop DZX222 so that you get a similar experience and therefore we would be grateful if you could complete this questionnaire so that we can have a better insight into the individual student learning experience.

You are also probably aware that the Open University is developing a range of technological tools to improve the student experience with online learning and therefore your survey responses will help us choose those tools that are likely to be of most value to students working on future presentations of DZX222.

Your response to the survey will be completely anonymous, we will not be linking this to any other data that is held by the Open University.

If you would like any further information about this survey please do not hesitate to contact me.

With very best wishes for you future plans.

Kathy Robinson

Course Team Chair DZX222

Email K.Robinson@open.ac.uk

The follow up email

Dear Student

I hope that you have been able to enjoy some leisure time since completing DZX222.

If you have not yet had the time or opportunity to complete the survey questions sent out to all DZX222 students then we would be very grateful if you could consider doing it for us now. We are continually trying to improve the course presentation and your responses are invaluable for that process. All the data is anonymous.

Thank you to everyone who has already completed the survey.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.
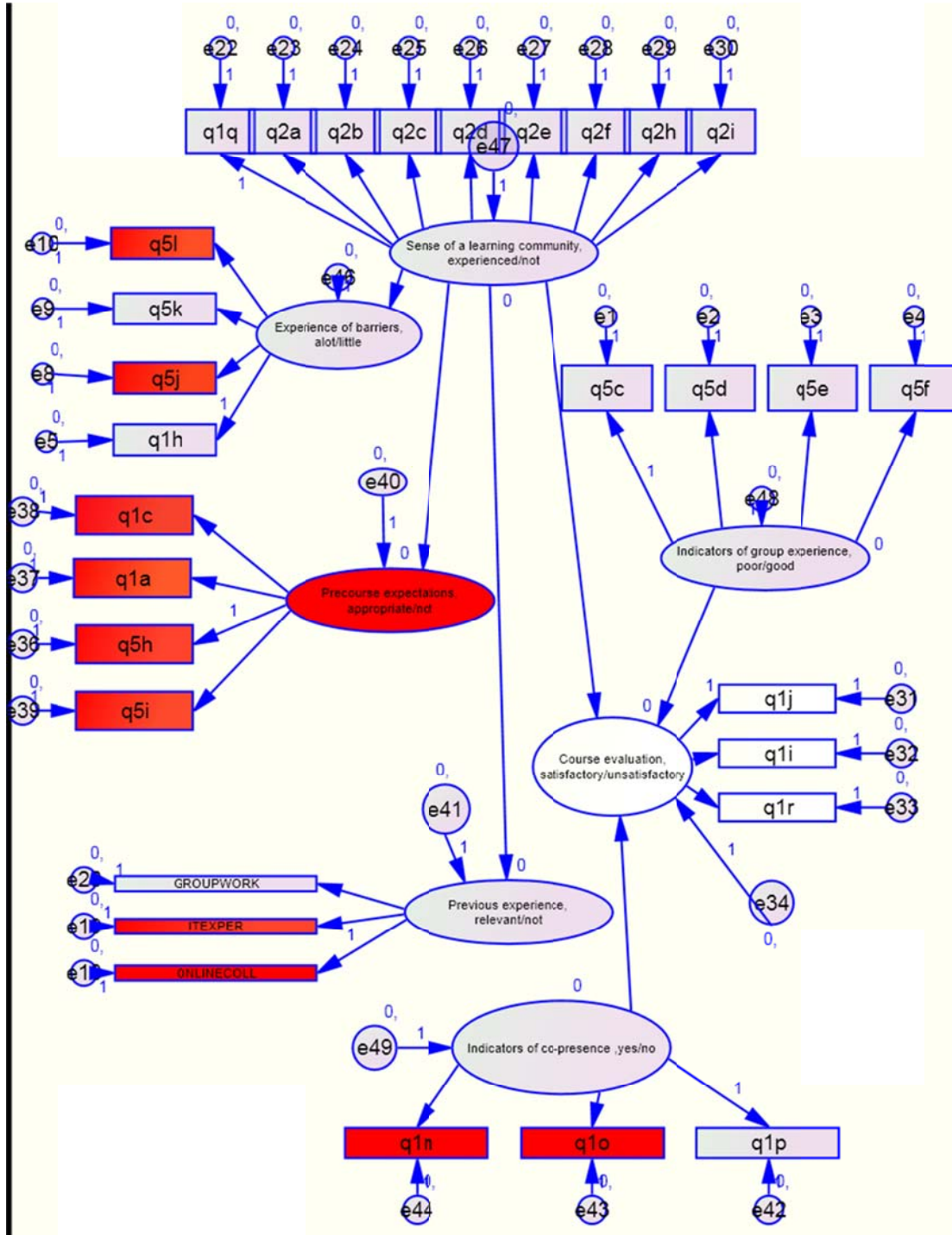
 Finally our very best wishes to those of you starting new courses in February and thank you again for working with us on DZX222. Please remember that the course website remains available to you in the short term.

Best Wishes

Kathy Robinson

DZX222 Course Team Chair

Appendix D: AMOS model for the VRS

Appendix E: Examples of group dynamics at RS.

<u>Project group 7.</u>

Student, Y, experienced some difficulties with joining a group with students who were embarking on student Y's second choice project option. I assigned a very calm, able and facilitative teacher to this group. However, during the early stages of the group work this teacher asked me to remove the student Y from the group for a while. I talked with student Y who was tearful and obviously very tense; she reported that she was taking tranquiiisers. She told me about her employment history, which was impressive, and the fact that she had a PhD. The student was from mainland Europe and therefore, in comparison to UK students, her fee for the course was significantly higher; something that she mentioned more than once. The student queried why there had been a preparatory activity on the project option that was her first choice if no one took it up. We then discussed her options in the context of the organisational guidance already provided in the Study guide. After 15-20 minutes student Y rejoined the group. At the end of the RS all members of the group, including student Y, were highly satisfied with the task outcome and with the group experience.

<u>Project group 11.</u>

One of the teachers reported that a group had needed to '*take time out*.'

I then sat with this group (4 students, M, N, O, & P) whilst they completed the project proposal form. Two from the group, M & N, were actively collaborating on a joint project design with N acting as the scribe. One other student, O, admitted that she was struggling with group work and that she found the idea of designing a project proposal challenging as she had not encountered this sort of task previously. One other student, P, who had arrived at Residential school with a very large portfolio case containing her ideas for project work, was having problems accommodating the ideas of other members of the group. This group did manage to develop an appropriate project proposal and from that point onwards there were no report of anything untoward about the relational space of the group.

Project group 4

On Day 6, sometime before 8a.m, I came across a student, student R, in great distress. Apparently her young daughter who was staying with a relative was crying all the time. The student sought permission to leave the Residential school early. I agreed to her leaving provided that she took part in the data collection session. Shortly afterwards I was confronted by the rest of this student's project group who pointed out to me that everyone had something on the 'back burner' and that student R had made very little contribution to the project work so far. Although student R had shared her distress and situation with the other group members since they had first formed into a group there was very little evidence of any real sympathy for her situation from the other group members. They continued

to agitate about the arrangement for student R to leave and were aggrieved that the student would be able to submit a report on the group project work for summative assessment despite not completing her time at RS. Interestingly, this project group was made up from members who had not been together with during the preparatory activities (the first 3 days of the RS).

Appendix F: Information for participants who took part in the pilot study

Dear

One of the agenda items, in fact it will take up most of the afternoon, involves a session on facilitating and moderating online project groups as they engage in a collaborative project.

This will be the last time that the course will use First Class as the conferencing system, for future presentations it will migrate to a Moodle platform. Some of you already have experience using Moodle with Open University courses, and with courses that have migrated from First Class to Moodle; significantly this course is one of the last courses to migrate due to its complexity. Some amongst you have experience with the Residential version of the course and one or two people are completely new to the Open University environment. It will be useful to share this varied experience including from 'new eyes'. During the afternoon session I would like you to listen to two narratives each of which summarises the formation and development of an online project group over the 6 week period while they work together with their tutors to develop a project proposal, collect and analyse data and present their findings at a mini plenary. I would then like you to form into two small groups to discuss the narratives.

I am requesting your permission to record the discussions. I am interested to collect this data for two reasons. During the coming year I will be working with LTS (Learning and Teaching Solutions department at the OU) on the migration of the course and I will also be preparing the new documentation and therefore important to continue to review tutoring practice. I am also undertaking a PhD at the Institute of Education, London looking at socio-emotional experience as small groups of learners collaborate online in a text based context, and at how emotional experience might impact on collaborative learning. The construction of the narratives has been informed by my work on the PhD to date. The narratives are at an initial stage of development. For the PhD work I need to pilot the narratives and evaluate them and that is why I am seeking your permission to record the discussion sessions

The first session of the day involves you meeting with your senior tutor and therefore allows me time to sensitively manage group allocation based on your responses on the consent form.

If you give permission for your contributions to be used in this way it will be anonymised unless you request otherwise. You will be fully debriefed on October 2nd and be able to change you mind about a prior consent and withdraw at any time.

Please feel free to contact me with any queries you may have about this request or any other questions you may have about working on the course.

I agree/disagree to an audio recording of the group discussions.

I agree/disagree to this data being used for research purposes.

I would prefer to have my contributions anonymised YES/NO.

Signed

Appendix G: Study 4. Information for Participants.

Title of Project: Co-presence and socio-emotional experience. Investigating students' emotional experience whilst engaging in collaborative learning online using text based forums.

Names of Researchers: Kathy Robinson, Tim Wehner

Contact Details: Email krobinson@ioe.ac.uk;

Details of Study:

The study is being conducted as part of my doctoral thesis. The aim of the thesis is to deepen our understanding of the socio-emotional experience of learners who are required to engage in collaborative group work online using text based forums. Students may never meet each other face-to-face and there is no sensory information available to the interactants i.e. interactants are not co-present in body, time, space and there is no speaking. The aim of this study is to evaluate resources that have been developed for tutors who are required to facilitate the collaboration between learners in online text based forums. Participants are being recruited from anyone who is interested in teaching and facilitating in online contexts. If you agree to participate in this study I will provide full access to the thesis and any research publications as these become available. All data that I collect will be stored digitally and anonymised.

The study will involve approximately 1 hour 30 minutes of your time.

 It will take place in the Department of Neurophysiology at the National Hospital for Neurology and Neurosurgery, Queen Square. It will involve recording of electrical activity generated by the brain and up to three facial muscles while you read the tutor resources (narratives based on the exchanges that took place between members of two online groups engaged on a collaborative task). We would like to attach 22 electrodes on the surface of your head and 6 electrodes over selected facial muscles.

You may withdraw your data from the project at any time up until it is transcribed for use in the final report (approximately 1 year after data collection)

Please discuss the information above with others if you wish or ask us if there is anything that is not clear or if you would like more information.

If you do decide to take part you are still free to withdraw at any time and without giving a reason.

All data will be collected and stored in accordance with the Data Protection Act 1998.

Neurophysiological monitoring is a standard procedure that is routinely carried out in the department. It does not hurt and does not cause any side effects. The following information provides you with more detailed information about what is involved.

WHAT IS AN EEG?

The abbreviation EEG stands for Electroencephalography. *Electro* indicates that electrical impulses are measured, *Encephalo* is the area of the recording, namely the brain, and *Graph* describes the way the impulses are recorded on a computer. An EEG is a routine investigation performed on all age groups of patients. An EEG records the electrical activity that your brain produces while sending and receiving messages to and from your body.

THE PROCEDURE OF THE INVESTIGATION

The investigation will be carried out by a clinical physiologist *(or the researcher).*

Throughout the investigation you will be seated in an armchair.

Using a sticky, water-soluble paste the clinical physiologist will place 22 small disposable discs onto your head. Because the discs are only used once they cannot transmit any diseases. To improve the contact the skin will be rubbed with some gritty paste beforehand. This preparation takes about 15 minutes.

Please inform the clinical physiologist (or the researcher), if you have any allergies to latex or plaster tape before the procedure.

Once the discs are in place the brain activity will be recorded for approximately 45-60 minutes.

AFTER THE INVESTIGATION

When the investigation is finished, the discs are removed without any pain. You may then continue immediately with your normal activity. There may be some small amount of paste left in your hair which will wash away with shampoo.

The EEG is routinely carried out as an investigative procedure therefore it is important that you fully understand that

- Taking part in this study cannot replace a clinical appointment should you have any clinical concerns.
- In the event of incidental findings that could have implications for your health you will be offered an appointment with a clinician from the Department of Clinical Neurophysiology at the National Hospital, Queen Square.
- In the event of the study revealing incidental findings that are grossly abnormal we require your permission to inform you about such before offering participation.

FREQUENTLY ASKED QUESTIONS:

Is the test painful? No. Slight discomfort may be felt when the scalp is rubbed.

Will electrical shocks be applied? No. We are only recording electrical activity that your brain produces naturally.

Are needles involved? No

Can you read my mind? No. We are only recording electrical impulses and not thoughts.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

Appendix H: Study 4. Informed Consent Form.

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Project: Co-presence and socio-emotional experience. Investigating students' emotional experience whilst engaging in collaborative learning online using text based forums.

This study has been approved by the UCL Research Ethics Committee (Project ID Number): 4555/001

Thank you for your interest in taking part in this research. Before you agree to take part, the person organising the research must explain the project to you.

If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you to decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Participant's Statement

I

- have read the notes written above and the Information Sheet, and understand what the study involves.
- understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately.
- consent to the processing of my personal information for the purposes of this research study.
- understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.
- agree that the research project named above has been explained to me to my satisfaction and I agree to take part in this study.

- agree to be informed of any incidental findings of a grossly abnormal nature that may have implications for my health.
- understand that the information I have submitted will be published as a report and I will be sent a copy. Confidentiality and anonymity will be maintained and it will not be possible to identify me from any publications.

Signed: Date:

Appendix I: Study 4. Preparatory material

Title of Project: Co-presence and socio-emotional experience. Investigating students' emotional experience whilst engaging in collaborative learning online using text based forums.

Names of Researchers: Kathy Robinson, Tim Wehner

Contact Details: **Email krobinson@ioe.ac.uk;**

Thank you for agreeing to take part in this study.

The aim is to evaluate two narratives as training resources for tutors of online discussion groups.

Each narrative is an authentic extract of the interpersonal exchanges between members of a group of students who are working on a shared task online. The students have never met face-to-face and the outcome of the shared task is high stakes. Each group has access to an asynchronous text based group forum and also a group Live Chat (Instant messaging) function. We will supply you with the names (anonymised) of the students in each group and their tutor.

This study is based on the assumption that understanding the student experience of this kind of social encounter requires empathy.

The process

While monitoring your EEG we will ask you to read the two narratives.

We would like you to **enact the role of a tutor moderating group work online** while you read. It is a complex role. In practice you would need to make a number of judgements based on

- discipline knowledge (**task space**)
- pedagogy (the teaching-learning space). A good understanding of the pedagogy of collaborative group work is important, i.e. that knowledge and understanding emerge from the interactions amongst group members and build on sources that exist in the context of the ongoing discussion. Therefore, conflict and negotiation are fundamental for a successful outcome.
- empathy (an awareness of **relational space**). A well-developed relational space (the interactions between group members of a relational nature) should support the group through times of conflict, negotiation, frustration, and other potentially negative influences on their group progress with the task.
- digital literacy (an understanding of the digital space). This is how using technologies to support collaborative group work might affect the student experience of both task and relational space.

The narratives you will read have to be academically neutral, so the discussion relating to the task (task space) has been 'blanked out', although it is represented proportionately. For example,

xx   less than 20 words

20-30 words

120-130 words

Tutor contributions have been omitted.

For this study we would like you to concentrate just on judgments about discussion that contributes to **the relational space** as it is constructed in each of the project groups. So you will only see extracts of this kind.

While you read the narratives you could have in mind a collaborative task relevant to your discipline area, a maths problem, a psychology project, a drama production, for example.

We will pause the reading of each narrative twice. At the first pause the group has just completed a draft submission of the task. At the second pause the group has just submitted a presentation to a plenary session. At each pause point we would like you to imagine yourself as the tutor while you think about the interpersonal exchanges of the students so far (2 minutes). In practice a tutor would be moderating the progress of several groups and are likely to make notes about each. We will invite you to make notes at the end of each pause point. At the end of each narrative we will ask you to provide a short written evaluation of the emotional climate of the group.

Co-presence and socio-emotional experience. Investigating students' emotional experience during collaborative learning online.

Appendix J: Study 4. Instructions for participants embedded in the narratives

<u>First pause for reflection and comments while reading a narrative.</u>

So far this group has spent an intensive 12 days agreeing a topic area, preparing a draft proposal, acting on feedback (from a pair of tutors not involved with their supervision) in order to submit a final proposal. They cannot continue until this final version is approved by a Senior tutor.

Before reading on please activate the timer provided and spend 2 minutes engaging emotionally with this group of students. Put yourself in their place as they go about the rest of their lives before they log into the course again in order to find the outcome. Please do not close your eyes during this time. The timer will alert you after 2 minutes.

Then if you would like to take an extra minute or two to write some comments to share with me later that would be extremely valuable.

Please indicate when you are ready to resume reading.

<u>Pause for reflection and comments after completing the reading of a narrative.</u>

After 6 weeks of working together this group has completed the final version of the group task. They have just submitted a presentation to a plenary session. From

now on they will be working individually, acting on the feedback from the plenary as they write up a project report for assessment.

Before reading on please activate the timer provided and spend 2 minutes engaging emotionally with this group of students. Put yourself in their place as they go about the rest of their lives before they log into the course again in order to find the outcome. Please do not close your eyes during this time. The timer will alert you after 2 minutes.

Then if you would like to take an extra minute or two to write some comments to share with me later that would be extremely valuable.