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The dialectical potential of Cultural Historical Activity Theory for researching sustainable CSCL practices

Abstract

This article explores conceptual and methodological challenges in researching sustainable computer-supported collaborative learning (CSCL) within authentic educational settings. It argues that to investigate the sustainability of CSCL in such settings, we need to understand how new innovations become enculturated as part of educational communities and the shared repertoires and practices of learners and teachers. The potential for Cultural Historical Activity Theory (CHAT) as a relational, dialectical framework for researching collaborative learning is examined. The article argues that, although CHAT is increasingly being used for researching educational settings, it is often employed only descriptively or as a set of guiding principles and the dialectical method, which focuses on emergent contradictions and tensions, is not always fully explored. An integrated conceptual and methodological CHAT framework is proposed for understanding the complex interrelations between discourse, actions and community and as a result how new technological innovations and knowledge creation practices can be appropriated and sustained. This is illustrated through the analytical processes undertaken in a recent empirical study of undergraduates working on an online collaborative research project. The article concludes by arguing that the dialectical method at the heart of CHAT is both unifying and problematizing and could allow us to develop a richer, more integrated and explanatory picture of sustainable CSCL activities.

Keywords * Cultural Historical Activity Theory * Sustainability * Dialectics * Discourse * Knowledge Creation * Community *Methodology

Introduction

The field of technology-enhanced learning is highly interdisciplinary with significant communities working in and across other fields, for example psychology, sociology, sociolinguistics, cultural theory, anthropology, education, computer science, communication studies and others (Sutherland et al, 2012). This results in wide variations in discourses and purposes; in particular, divides between sociological and psychological perspectives (Selwyn, 2011) and between macro and micro sociology (Lemke, 1990). Related to this, computer supported collaborative learning or CSCL has always been an interdisciplinary research field whose focus of attention is on language, culture and social context (Koschmann, 1996). Chan argues that CSCL research includes a rich array of theoretical and methodological approaches and that the field is growing as new technological affordances for interaction and engagement emerge, alongside an increasing understanding of how students engage in collaborative problem solving and co-construction (Chan, 2011). Stahl & Hesse (2010) also emphasize the need to push understandings and conceptualizations further; to continue to problematize and develop how we understand and conduct research in CSCL (Stahl & Hesse, 2010). This indicates that CSCL is both a maturing and an evolving research field.

Stahl, Koschmann and Suthers (2006, p.424) suggest that there are no well-defined, consistent and comprehensive definitions of CSCL theory or methodology, which can lead to fragmentation in approaches and a lack of shared understanding. Nevertheless, most CSCL researchers share an understanding of the concept of collaboration, namely, the negotiation, construction and maintenance of shared meaning, goals and tasks (Stahl et al, 2005; Dillenbourg, 1999, Roschelle & Teasley, 1995). This suggests that discourse, encompassing communication and joint meaning making, are very important, though not exclusive, aspects of collaboration. Knowledge building or knowledge creation practices can also be regarded as a key aspect of collaborative learning in which new knowledge objects or social practices are created through collaboration (Lipponen, Hakkarainen & Paavola, 2004). I argue that when investigating how knowledge creation and collaboration develop within authentic educational settings, discourse should be a key focus of analytic attention. However, I also argue, in line with Chan (2011) that a broader, multi-level analysis is required to account for the social, cultural and historical dynamics that influence and constrain this. Furthermore, we often understand very little about how these practices can endure or become mainstream or why, in so many cases, this fails to happen. Researching the sustainability[1] of practices in authentic educational settings is very important because all sectors of education suffer from an overload of innovative ideas and new pedagogical methods that are not sustained in the longer term.

This paper proposes a theoretical and methodological approach to understanding the sustainability of CSCL practices in formal and informal educational settings. I argue that to understand how CSCL designs can be sustained over time in educational settings, we need to interrogate the interconnections between meaning making and knowledge creation practices constituted in interactions between learners and the wider dynamics of educational communities. Cultural Historical

[1] Sustainability from an ecological perspective refers to a capacity for endurance over time (Bromley, 2008), which can also be seen as an important aim of education.

Activity Theory (CHAT) is proposed as an integrated conceptual and methodological framework for understanding the complex interrelations between discourse, actions and community and, as a result, how new technological innovations and knowledge creation practices can be appropriated and sustained.

Sustainability and how organizations and groups adapt and change over time are central concerns for CHAT. CHAT developed from the cultural-historical school (Cole & Engeström, 1993; Daniels, 2001; Y. Engeström, 1987) and specifically from the work of Vygotsky on the relationship between mind, activity and meditational means in human development (Vygotsky, 1978, 1986). There has been a dramatic growth in the popularity of CHAT (Roth, 2004; Roth & Lee, 2007) and in its use for studying educational phenomena in particular (Nussbaumer, 2011; Williams, Davis, & Black, 2007; Roth & Lee, 2007). In part this can be attributed to the ability it affords to focus attention on the troubling divides between individual and collective, material and mental, biography and history, and praxis and theory (e.g., Cole, 1996; Roth & Lee, 2007). Fenwick (2010) argues that CHAT forms part of an emerging grouping of socio-material approaches for understanding how the 'material' mediates everyday life. Under 'material,' she includes tools, technologies, bodies, actions, and objects, texts and discourses. She sees all these as meditational means, acting together in concert with social and political analysis of human activity. "CHAT affords a rich approach to analyzing precisely these political dynamics that are so important to workplace organizations while insisting that these dynamics intermingle the material with the social" (Fenwick 2010, p112).

The paper first explores some of the methodological issues arising from CSCL research in authentic educational settings. This is followed by an examination of the potential of CHAT to address these challenges by paying attention to its relational and dialectical approach to analysis and by expanding CHAT to include the concepts of dialogicality and communicative action. Drawing on a recent empirical study, a multi-dimensional framework and analytical process are outlined, illustrated with related findings from the study.

Researching CSCL practices: critiques and challenges

CSCL research has grown very fast during the past two decades and this growth has fostered a divergent range of theoretical and methodological perspectives (Strijbos & Fischer, 2007;Dillenbourg, Järvelä, & Fischer, 2009;Chan, 2011). Yet, CSCL research has paid less attention to research in authentic educational settings, such as classrooms or institutions, than to design experiments (Arnseth & Ludvigsen, 2006; Chan, 2011). Furthermore, these experiments have tended to be 'one-shot' interventions which take place over short periods of time and may not be integrated into institutional cultures or practices. Spatial and temporal dimensions and how learners can be socialized into the use of technology or new knowledge creation practices are not frequently addressed (Ritella & Hakkarainen, 2012).

For Hakkarainen (2009) the *practice* of knowledge building (or knowledge creation) is often neglected and yet from an educational perspective this is really critical to long term sustainability. In educational settings, we need to understand how new innovations become enculturated as part of long-term practice and the shared repertoires of learners and teachers, which implies longer term investigations and analysis. Chan (2011) concurs that whilst discourse is a key

object of analysis in CSCL research, this is frequently confined to small groups, for short durations. She argues that we need to examine the "complex interplay and alignment of cognition, discourse, design and context (...). For CSCL tools to be effective, changes are needed in institutional practices, norms and culture; reciprocally, changing those practices also requires a detailed understanding of student thinking" (Chan, 2011, p150). Moving from the analysis of separate components to examining system-wide properties, dynamics and relationships across different levels of analysis is required to address these issues.

One of the most important, yet challenging aspects of analyzing collaborative learning is in understanding intersubjective learning (Suthers, 2006) or group cognition (Stahl, 2005), namely the "practices of meaning-making in the context of joint activity" (Stahl, Koschmann & Suthers; 2006 p419). The emphasis here is that learning is not just accomplished through interaction but is constituted *within* the interactions of participants, emphasizing the need to understand how learners 'do' learning in these interactions (ibid). It is important not to lose sight of this when widening the unit of analysis, to include both system level structures and discourse. Focusing on the *practices* of meaning making can reveal detailed understandings of how interaction and collaboration are produced and how knowledge construction and meaning making are negotiated within the discourse of participants.

Another aspect of computer-supported collaborative learning for researchers to take account of is the mediational role of the digital and other tools in supporting or constraining the actions and goals of the collaborators. Oliver (2011) argues that we do not adequately theorize the role of technology in the 'field' of technology and learning and this can lead to normative and technologically deterministic studies where the technology is the primary object of attention and the overriding purpose is to show that a particular technology has caused or transformed learning (Oliver, 2011). This can lead to a focus of analytic attention on the effects 'of' rather than the effects 'with' tools and artifacts (Perkins, 1993). Whilst many studies of CSCL do indeed focus on the effects *with* technology, it is important to restate the need to take account of their contributions in supporting or constraining action in authentic settings. From a sociocultural position, tools (material, digital and semiotic) are "cultural objects, social forms that develop historically" (Langemeyer & Nissen, 2005, p188) and therefore provide vital contributions to understanding the sustainability of CSCL practices.

Finally, in exploring how technology-mediated and collaborative practices are enculturated into educational settings, the intentions and purposes of learners in relation to the activities need to be considered. Crook urges us to recognize that not all collaborative work is sufficiently motivated (Crook, 2011). Paying attention to the purposes and intentions of learners in pursuit of collaborative goals is particularly important for sustainability. What sustains learners to engage in these practices and how do their purposes and intentions connect with the stated goals and institutional intentions?

To summarize, the practice of collaborating and knowledge creation in educational settings and how these are sustained over time and enculturated into the community is an area where researchers have noted that approaches that are more integrated might be helpful if we are to understand the complex interrelations between discourse, actions and the wider context. More specifically and importantly in educational contexts, we need to understand how new technological innovations and knowledge creation practices can be appropriated and developed

over time. The following section will discuss how CHAT might be harnessed for understanding and researching such practices.

The potential of Cultural Historical Activity Theory for CSCL research

There are many aspects of CHAT that suggest its potential for researching sustainability in authentic, educational settings. CHAT encompasses sociocultural perspectives on tool mediation, combined with a highly developed awareness of culture, collective and socially distributed activities and a longitudinal concept of time and history (Y. Engeström, 1999a). This makes it particularly useful for investigating educational innovations and knowledge creation activities (ibid). CHAT is an evolving tradition and it is generally considered that there are three different generations of CHAT, although these are overlapping and incremental (Daniels, 2001). A brief review of its history and theoretical development will first be explored and then related more specifically to educational and CSCL research.

CHAT comes from the Russian cultural–historical school founded in the 1920s by Vygotsky (1978; 1986)[2]. Vygotsky's (1978) theory of cognition and the development of higher mental functioning emphasizes the role of tools and artifacts in mediating our actions, but also crucially the role of other people in contributing to and participating in individual human activity and development within a social setting. He showed this through a simple triangle heuristic indicating how tools mediated actions. This is known as the first generation of CHAT. Leont'ev (1978; 1981) who worked with Vygotsky elaborated the theory of activity. One of the most important concepts in CHAT is the 'object' of an activity, which plays a crucial role in making activities meaningful. The object should not be confused with physical artifacts or products; rather, it is the motive or purpose that drives the activity. For Leont'ev (1981) "social conditions bear with them the motives and goals of their activity, its means and modes." (p. 47). Activity is therefore purposeful; the object gives it meaning and distinguishes one activity from another. The object is the 'sense-maker' and helps us to understand both the 'what' and the 'why' of human activity (Kaptelinin, 2005). However, the object of the activity is not always clear, and is often the focus of scientific investigation (Leont'ev, 1981). Understanding the object of activity and its interpretations by different actors in the activity system can assist in understanding the purposes and motivations behind actions and communications. It can help to explain the conflicts and tensions that emerge when there is not a shared understanding of the object, resulting in difficulties in negotiating understanding or counterproductive actions that do not contribute to shared actions or meaning.

Leont'ev's (1978, 1981) structure of an activity (Figure 1) involves hierarchical relationships between different structural levels and their associated objects, goals and conditions. An activity consists of combined chains of operations and actions.

[2] The works of Vygotsky and Leont'ev referred to in this paper are all translations from the original Russian texts.

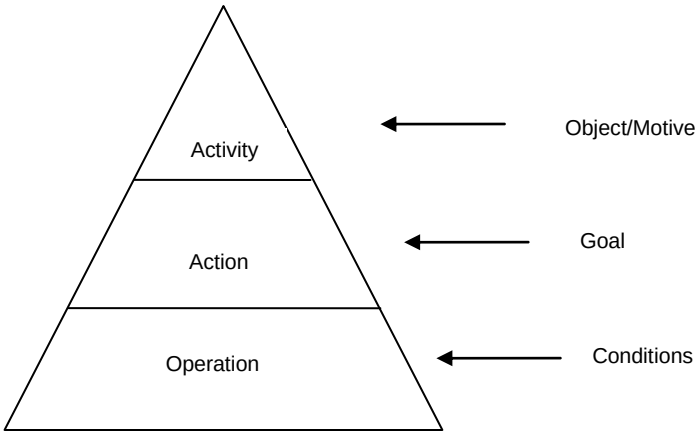

Figure 1: The hierarchical structure of activity (Adapted from Daniels, 2001, p. 87.)

At the top level, 'Activity', activities are differentiated from each other according to their motive (object). This is activity at the collective level. At the 'Action' level, individual actions are distinguished from each other according to their specific and conscious goals. At the third, most granular level of an activity, operations are actions that have become routine, habitual or unconscious, differentiated from each other according to the conditions under which they operate. Continuous transformation from one level to another takes place, and the relationships between these levels are dynamic. In interpreting activities in educational settings, this can reveal understandings of how activities are multilayered and how discourse, action and broader social influences mutually constitute each other.

Drawing on Vygotsky's and Leont'ev's work, Engeström's second generation theorizing (1987) offers an expanded view of an activity system, where the unit of analysis is collective activity. Prior to this, the concept of activity had been considered mainly from an individual perspective. As shown in Figure 2 below an activity *system* includes the subject of the activity, the object (purpose), its outcomes, and the mediating tools (including language and signs) and artefacts. The model also accounts for the social and institutional rules that govern the activity system, contributions of others in the community, and how production of the object is managed through the division of labor. The framework is essentially for analyzing multiple relations and interrelations (Rasmussen & Ludvigsen, 2009). The relationships between these different contributors are often shown in Engeström's (1987, 2001) familiar 'expanded triangle' model.

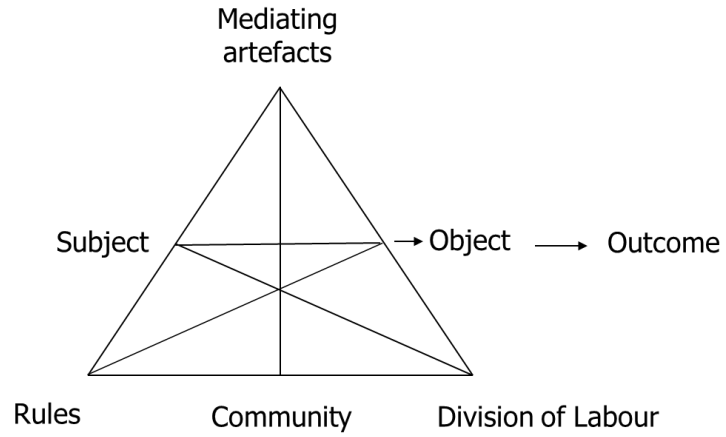

Figure 2: Expanded activity system model (Engeström, 1987)

In the third generation, Engeström extended the framework to include networks of interacting activity systems with the possibility of jointly shared objects, transitions and reorganization within and between activity systems (Daniels 2001;Y. Engeström, 2009) paying attention to the ways in which people have to work and move across boundaries within networks of activities. Boundary crossing "requires negotiation and re-orchestration. It is the most obvious aspect of the horizontal or sideways dimension of development" (Engeström, 2009, p. 314). In addition to crossing boundaries between systems, Engeström argues that the third generation also necessitates more attention 'up and down' within an activity system, placing more emphasis on subjectivity, agency and relationality. However, he cautions against any separation of analysis of history and the system or systems from analysis of subjects, situations and actions which CHAT has fought to resist (ibid). Engeström has also turned his attention more directly to the way in which multiple perspectives participate in activity, drawing on Bakhtin's ideas of multivoicedness and dialogicality (Bakhtin, 1986). Engeström described that as "a collaborative and dialogical process in which different perspectives (…) meet, collide and merge" (Y. Engeström, 1999c, p.382). Whilst there are dangers in adding further complexity, leading to an ever-expanding unit of analysis, it is important to restate that the core principles remain the same. Defining and understanding the activity system at the center of the problem or research questions and scoping the level or focus of analytic attention within or across systems is a necessary first step.

The context-bound nature of human development has long been recognized (Van Oers, 1998) and sociocultural perspectives on context emphasize the situatedness of discourse and action (for example Arvaja, Salovaara, Hakkinen, & Jarvela, 2007; Linell, 2009) and the importance of understanding action as mediated (Wertsch, 1991). Cultural-historical perspectives go further, arguing that context is inseparable from action; contextual elements are dynamic, integrative and mutually constituting (Roth & Lee, 2007). In CHAT, context is always understood to be actively constructed, integral to action and learners are therefore engaged in *contextualizing* and transforming activity over time (Van Oers, 1998).

Taking account of multiple perspectives and relationships within the complex context of educational communities is particularly important and challenging. CHAT researchers purposefully view "'the community' as a cauldron of complex

interactions and elements that each border on other 'communities' by which it achieves its dynamic stability, or sometimes just falls apart" (Williams et al, 2007, p.105). Engaging in understanding and interpreting the relationship between learners' interactions within a community therefore becomes a priority. In communities, learners are also working across different time spans, spaces and settings (Timmis et al, 2010). Space: time configurations are therefore critical; their reciprocal relations should be recognized as part of understanding how practices unfold (Ritella & Hakkarainen 2012) and become appropriated within a community's cultural repertoire.

Activity systems are also continually evolving; brought about through the dialectical contradictions between the different levels and elements of the system. A contradiction is "a historically accumulated dynamic tension between opposing forces in an activity system" (Ilyenkov, 1977, cited in Y. Engeström, 1999b p178). Such dialectical relations again emphasize that elements pre-suppose each other and cannot be considered except in relation to others.

> *"A unit can be analyzed in terms of component parts, but none of these parts can be understood or theorized apart from the others that contribute to defining it "(Roth & Lee, 2007, p. 196).*

For example, subject and object are not separate entities; they are interdependent and mutually define one another and are therefore dialectically related (Van Oers, 1998). Identifying contradictions is important because this helps to reveal and clarify the different goals and objects of different actors and how these might change over time. It is also through the clash of contradictions that creativity and problem solving help resolve contradictions, allowing new forms or adjustments to emerge (de Lange & Lund, 2008).

It is CHAT's insistence on the dynamism and continual transformations within collective, object-oriented and multi-level activities that enables us to pay analytic attention to the complexities that surround activities and practices involving people collaborating with technology in institutional and other educational settings. CHAT's emphasis on tool mediation also allows CSCL researchers to reinstate the contribution of the digital tools and artifacts in use as part of the analysis of interactions, whilst resisting technological determinism and causality.

Developing a CHAT framework for researching CSCL in education

In order to explore the potential of CHAT for researching the sustainability of CSCL practices in authentic, educational settings and develop a workable analytical framework, it is necessary to understand how CHAT could be applied methodologically, including possible pitfalls and limitations. Nussbaumer (2011) conducted a review of the use of CHAT in classroom research between 2000 and 2009. Out of an initial 129 studies, only 21 were actively using CHAT for analysis of data (rather than as a brief explanatory or guiding principle). These studies had limited their analysis to either the basic Vygtoskian meditational triangle or Engeström's expanded triangular model. Only three studies employed the deeper dialectical analysis of tensions and contradictions or more recent developments of CHAT (3rd generation) to analyze networks of activity systems with shared objects. In other studies, it has been noted that where a multilevel analysis is conducted, different levels of analysis (micro and macro) can remain quite separate

(Jaworski & Potari, 2009). Equally, CHAT is sometimes employed as a meta framework or as guiding principles rather than using it more centrally within the analysis (e.g. Siyahhan, Barab, & Downton, 2010) or by combining a CHAT meta framework with content analysis (e.g. Karasavvidis, 2009; Van Aalst & Hill, 2006). Undertaking a dialectical analysis of the contradictions that emerge from the interactions of different elements and levels with the system is necessary to do justice to the explanatory power of CHAT (Roth & Lee, 2007).

There is also a danger of over-reliance on *descriptions* of the expanded system triangle heuristic, with too much attention focused on mapping the elements within a static and *seemingly* highly structured format (Jaworski & Goodchild, 2006; Jonassen, 2000; Yamagata-Lynch, 2003), whereas the heuristic is intended only as a first step in developing understanding (Jaworksi & Goodchild, 2006; Daniels, 2011). The process of exemplifying these elements can lead to over-simplification without full engagement with the underlying concepts and an over static representation of a dynamic and evolving system. A descriptive analysis of system elements should be seen only as a first step in CHAT analysis to be followed by an analysis of the dynamic and dialectical relations between the different components (Jonassen, 2000, Roth & Lee, 2007). It is CHAT's dialectical unit of analysis that allows us to link together analyses of the different levels of an activity, including the discourse and meaning making activities, within the system.

In considering the usefulness of CHAT for CSCL research, it is also important to note that CHAT is an evolving tradition, rather than a settled theory, as the different generations attest; as such, it is open to adaptation and development. CHAT researchers, especially those researching and working in authentic, educational contexts, have recognized that the role of agency and relations between people within the activity system is one such development and more recently acknowledged by Engeström (2009). Edwards (2005) argues that joint action on the object has an impact back on the subject, and that this 'relational agency' has been made less visible within activity theory analyses which focus mainly on the system (Edwards, 2005, p.172). This distributed form of agency enables a dynamic realignment of thought and action between different actors in response to particular problems and challenges. The analysis of the agency of actors in a community and how members make meaning in relation to actions (including how this deviates from expectations) and other members is always critical to an understanding of how an activity system achieves or does not achieve its aims and purposes (Jones & Healing, 2010). When employing CHAT analytically, it is necessary to account for relations amongst participants, in order to understand how people develop the capacity for working relationally and for mutual benefit (Edwards, 2005).

It has also been acknowledged that in second and third generation CHAT frameworks, there is an over emphasis on tool-mediated production of objects, and a neglect of communication and sign-based mediation (Engeström, 1999b). Daniels (2006) has critiqued the Engeström interpretation of activity theory because of the difficulties of using this to analyze educational settings, which he suggests,

> *"…seeks to analyse contradictions between rules, community and division of labour and cultural artefacts but does not appear to benefit from a language of analysis and description that permit a cultural artefact (such as discourse) to be analysed in terms of the cultural specificities of its production." (Daniels, 2006, pp. 55 -56)*

This suggests that for use in understanding how meaning making contributes to activity, a CHAT analytical framework needs to incorporate discourse analysis based on a conceptual understanding of discourse that is commensurate with CHAT's core idea of activity as socially and historically constructed.

There are many approaches to the interpretation of discourse. Daniels (2006), for example, has argued for incorporating analysis based on Basil Bernstein's work within a CHAT framework in order to interpret social positioning and identity within activity systems. In CSCL research, there are also many approaches to the interpretation and analysis of discourse and joint meaning making. In particular, ethnomethodology (Garfinkel, 1967) and dialogicality and multivoicedness that derives from Bakhtin's work (1986). Drawing on phenomenology, ethnomethodologists pay particular attention to members' own accounts and sense making and how participants themselves produce and reproduce meaning through their social interactions, arguing that this is always contingent on actors' abilities to interpret meaning within actions (Koschmann, Stahl, & Zemel, 2007). Whilst a case could be made for combining CHAT with ethnomethodological analysis, many argue that Bakhtin's socio-historical view of language and relationality of meaning are more closely aligned to CHAT (R. Engeström, 1995; Hiruma, Wells, & Ball, 2007; Wells, 2007).

Ritva Engeström[3] claims that Bakhtin "bridges the general properties of mediated action to talk" (R. Engeström, 1995 p.200) and for Wertsch (1991) that utterance is a form of mediated action. Utterances form chains of meaning over time so that the historical is ever present in dialogue. In addition, utterances are inherently reciprocal, emphasizing the importance of addresser and addressee namely "its *addressivity*" (Bakhtin, 1986, p. 95, italics in original). This is encapsulated in the concept of *dialogicality* "a term meant to capture the relational nature of all texts" (Koschmann, 1999 p.310).

Ritva Engeström (1995) proposes an expanded unit of interaction in CHAT that combines three main components: the goal of the action; the relationship between utterances and how the utterances function as mediational means and in relation to others forms of mediation (ibid). Firstly, there is always a social goal to utterances and exchanges whether or not these are achieved. Secondly, an utterance is always dialogic; in relation to other utterances and always addressed to someone. The third component of the framework is meditational means. Bakhtin's dialogism, however, is concerned only with utterances as meditational means, whereas CHAT pays attention to the meditational role of all cultural-historical artifacts, tools and technologies as well as talk. Nevertheless, through its emphasis on voices in use, Bakhtin's dialogicality embodies both the cultural specificities of discourse and the necessity of joint construction of meaning.

Related to meaning making, another area that has had less attention in CHAT is the affective and socioemotional relations between people and which can be missed out of CHAT analyses (Roth, 2007). This is very important as the object of the activity and the relationship between goals and the object are also influenced by affective relations between actors in the system and as discussed earlier, we need to pay attention to how and why relational agency is (or is not) produced. In computer-supported collaborative learning, investigating the shared history and

[3] Ritva Engeström is related to and has worked with Yrjo Engeström, the leading proponent of CHAT, but should not be confused with him.

intersubjective relations amongst participants is very important for understanding what motivates and sustains collaboration (Crook, 2000, 2011; Rommetveit, 2003). Learning or working together does not always mean collaboration and Crook stresses the importance of the collaborative effort to construct shared knowledge (Crook, 2000). He argues that intersubjectivity refers to reciprocity of understanding and mutual self-awareness, "To say that knowledge becomes 'shared' is to say that you know what the other knows but, more especially, you know that they know that you know this" (Crook, 2011, p156). Expanding CHAT's analytic focus to account for historically accumulating affective and intersubjective dimensions is also critical for understanding how CSCL practices can be sustained over time in authentic educational settings.

To summarize, CHAT has the potential to act as a conceptual and methodological framework for understanding how technology mediated collaborative learning situations can become sustainable and integrated into existing practices. However, this needs to be extended to make use of the full explanatory power of CHAT. The research needs to be conducted over sufficient time to understand how innovations become stabilized or transformed. Moving beyond static and descriptive triangle diagramming and towards the dialectical relations, contradictions and tensions within and between elements and levels is also critical in seeking to understand meaning making and relations across all levels (including unconscious operations, discourse, actions, motives and goals) within a community. Finally, I argue that relational theories of discourse and affect can be integrated with CHAT to explore authentic, sustainable, collaborative practices.

However, despite the complexity of this undertaking, there appears to be limited commentary on how to conduct this or how different levels of activity relate to one another and the movement between them. How to operationalize CHAT in educational settings and conduct analysis within and across the different levels of the activity system is given little attention in the education-focused CHAT literature and reported empirical studies (Nussbaumer, 2011). Consequently, questions are frequently raised about how to delimit the data and methods to address problems posed and what analytical methods are required for analyzing discourse for particular purposes (Nardi, 1996; Williams, et al, 2007).

In the following section, a recent empirical study of undergraduate online collaboration is introduced to provide an example of how CHAT has been used to explore sustainable CSCL practices and shows how the analysis was conducted and interpreted using two illustrative examples of findings from the study.

A study of online collaborative group work in Information Systems

The aim of this research study was to investigate how undergraduate students worked together on an online collaborative research project, focused on an area of 'special interest' chosen by the group members. The study involved two groups of third year undergraduates at a large, teaching-focused UK university. The online collaborative project was included in an optional module the students were taking as part of their BSc program on Information Systems. The two groups were selected as case studies of authentic online collaborative group work in undergraduate education, specifically because the students were using a variety of personally chosen and institutional digital tools, rather than being directed to use one specific environment. The study aimed to investigate what kinds of

communication and collaborative knowledge creation practices took place over the course of the modules and the social, cultural and institutional influences on the activities.

The following research questions framed the study:

1. How do students communicate and work across personal and study boundaries?
2. What kinds of collaborative and communicative practices using digital tools took place in the online special interest groups?
3. What patterns of interaction and division of labor took place over time?
4. What were the rules, organizational factors and constraints which influenced communications and collaboration?

The Optional Module

The module extended over twelve weeks and consisted of fortnightly lectures and tutorials; the collaborative project involved working in online groups, known as special interest groups (Sigs). The main aim of the Sigs was to provide an opportunity for students to collaborate in online groups to research a cutting-edge area of the subject (IT Audit or e-Business). This is particularly important for applied subjects such as Information Systems where domain knowledge changes very quickly. The inclusion of the Sig project in the module also created an opportunity for the students to engage in an authentic work related research task, part of a wider move towards inquiry-based learning and undergraduate research in higher education (Brew, 2006; Healey & Jenkins, 2009). The other aim, as stated by tutors, was to provide an opportunity for collaborative group work using a variety of digital tools chosen by the group rather than by the tutors. The aim was to enable students in the Sigs to make decisions about how they worked as a group and the research topic they worked on.

Learning outcomes for the activity in both subject areas were broadly similar and covered subject specific knowledge and skills combined with developing independent and the ability to work with others. These were:

A. Show detailed knowledge and understanding of the key business, economic, social and technical implications of Information Technology Audit/e-Business & e-Commerce

B. Demonstrate subject specific skills with respect to:

1. Recognizing business opportunities arising from developments in IT Audit/e-Commerce

2. Assessing IT Audit/e-Commerce strategy and implementation

C. Show cognitive skills with respect to:

1. Identifying trends in IT Audit/e-Commerce technologies and applications

2. Fitting technological and application development to changing organizational contexts

D. Demonstrate key transferable skills in progression to independent learning and working with others

Students worked on the research project in the Sigs throughout the 12 week module. Each Sig comprised between three and six students. On the IT Audit module, 25 students formed six Sigs; the e-Business module had 59 students who

formed 12 Sigs. Membership of groups was mainly self-chosen. Once established in week three, Sig members were asked to work together to produce a focused title for their project, research the topic area using a variety of internet and other sources throughout the remainder of the 12 week module and produce a website to share their results. One tutor was assigned to each Sig as a facilitator. Students were encouraged to use a variety of digital communication tools, both institutionally provided and personally chosen, to collaborate on the Sigs. They were required to post key information at two fixed dates onto the discussion board on the virtual learning environment (VLE). Beyond week three, no further specific guidance was issued. This was a very open task with little structure or orchestration by tutors and students were encouraged to work across different kinds of study spaces and use a variety of digital tools.

Research Design and Sample

The research study focused specifically on the special interest group project and associated assessment. During the first lecture, informed consent was sought from all students to use online communications data associated with the Sigs. In addition, students were invited to volunteer to participate more actively in the research in what was known as a 'study group'. The intention was for the study group to collect personal communications data associated with the Sigs that would otherwise be difficult to obtain. In all, 16 students volunteered, seven from IT Audit and nine from e-Business. They were members of 11 Sigs. All students in the two study groups were under 26 years of age, apart from three in mid to late 20s[4]. All except three were men.

Data collected included communications from personal and social digital tools: emails, text messages, recorded mobile phone calls, instant messaging conversations, blog postings. As communications always involve more than one person, data collected by the study group members involved *other* students working on the Sigs, which is why permission to use the data was sought from everyone taking the modules[5]. Communications data from the institutional VLE discussion boards was collected by the research team. Students from the study groups participated in student-led, video-recorded group interviews in week six of the module and again at the end, after the assessment for the module was completed. As preparation, a short questionnaire was completed in advance and used by students to refer to in interviews. These were then collected and used as secondary data. Interviews were conducted with tutors at the start and end of each of the two modules. Video data was fully transcribed but video was also used alongside transcripts in the analysis. Institutional documents (web and paper based) such as institutional policies, program specifications, module specifications and handouts were collected to inform historical and cultural analysis[6].

[4] Names used in the paper are all pseudonyms.
[5] Where permission was not given, communications were removed from the data set.
[6] This account of the research design and data collection methods has been limited by constraints on space and the need for brevity (see author et al, 2010; author 2012 for more information)

Analytical framework

The framework that is presented here is not intended as a generalizable model but gives one example of how CHAT can be operationalized to exploit its multidimensional and dialectical principles and explanatory power discussed earlier. Following CHAT's emphasis on the importance of identifying and clarifying the boundaries of the activity system under scrutiny, in this research study, the system was delineated as the *modular work system* - meaning all the activities associated with the IT Audit or e-Business module that the students had opted for. This study can be located within the third generation of CHAT because of the emphasis placed on dialectical contradictions, multivoicedness and expansion of the analysis both inwards and outwards (Engeström, 2009). This includes the wider network of activity systems that interacted with the central, *modular work system*. The wider network is discussed in detail elsewhere (Timmis, 2012). In this paper, the aim was to focus principally on the levels and processes of analysis within the main activity system, although where relevant, the wider network was included as part of the broader historical, social and political level of analysis.

In CHAT, an activity is understood as a hierarchical structure (or multiple levels) made up of operations that combine into actions, which in turn make up the whole system. Defining the activity system level is necessary to account for institutional, cultural and historical level influences. However, the main analytic focus in this research study was not on the module as a whole but on the collaborative special interest group project and related assessment. This represented a significant part of the modular work activity system but did not account for the whole system. The decision to introduce an additional level of analysis built on the work of Hyysalo (2005) who further developed the multi-level framing of activity in CHAT. He argued that when analyzing significant areas within an activity system, which may fall short of the whole, an intermediate level of analysis between action and activity is needed. This has been employed by De Lange & Lund (2008) in a study on the use of technology in an educational setting. Adapting their framework, Figure 3 illustrates how the hierarchical levels within the activity structure relate to one another analytically within the context of this study.

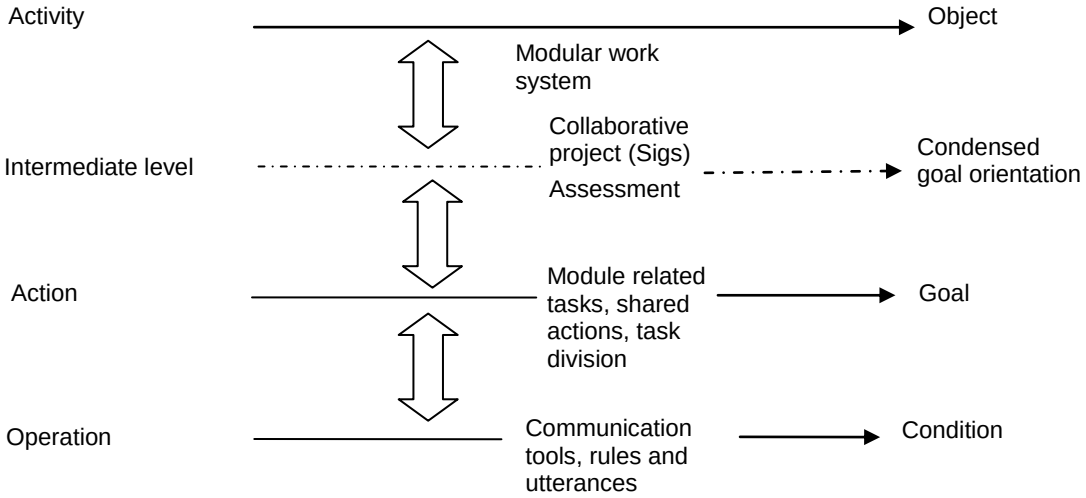

Figure 3: Four level hierarchical model of the modular work activity system (adapted from de Lange & Lund, 2008).

Figure 3 shows all the different levels of activity within the system as conceptualized in this study. Each level makes a substantive contribution but does not represent all activity within the work system. There are also continuous transformations between all levels; for example, communicative contributions occur within and move between all levels. Analysis was conducted at the four levels shown in Figure 3.

The *operational level* paid attention to time, space, tools and utterances. The aim was to identify when and how the different digital tools/spaces in use were appropriated by members of the special interest groups and under what conditions.

The *action level* paid attention to how communicative and collaborative actions and goals associated to the Sigs were enacted. It examined how goals of the Sigs were established and maintained, how knowledge was constructed within the interactions of the groups and how tools and artifacts mediated these actions.

The *intermediate level* focused on the special interest group project task and the relationship between the task and assessment. It examined the relations between the object of the activity and how the activity and object were interpreted by students and tutors.

The *activity level* - the module work system as a whole. The focus here was on the broader historical, cultural and institutional setting. It examined the object of the special interest group task in relation to the object and outcomes intended for the whole module. It also examined relations with the wider network of related activity systems.

Key concepts

The following table (Table 1) summarizes the key concepts that were drawn together to frame the study and inform the analytical framework. These concepts and their relationships were outlined in the earlier discussion on integrating dialogic, relational and CSCL concepts with CHAT.

	Key concepts employed
Cultural historical activity theory (CHAT)	Dialectical method - contradictions Culture and context Historicity Four levels of activity Object of activity, goal directed and mediated actions Mediation and mediational means Rules and division of labor (Leont'ev, 1981, Engeström, 1987, 2001)
incorporating **Discourse and dialogism**	Dialogic utterances, reciprocity, addressivity, multivoicedness (Bakhtin, 1981, 1986, R. Engeström, 1995) Unit of expanded interaction (R. Engeström , 1995)
and **Collaboration**	Shared goals, joint action, co-creation of knowledge (Lipponen, et al, 2004) Intersubjectivity (Rommetveit,2003) Shared history, experience and effort (Crook, 2000, 2011)

Table 1: Key concepts used to frame the study and analysis.

Table 1 shows the key CHAT concepts employed in the study following the principles previously outlined (Engeström, 2001). As discussed earlier, in order to develop a relational understanding of discourse and meaning making with CHAT's key principles, Bakhtin's theoretical concepts (dialogicality, addressivity and multivoicedness) have been employed through the unit of expanded interaction proposed by Ritva Engeström (1995). This focuses on the goal of the action; the relationship between utterances and how the utterances function as a mediational means and in relation to others forms of mediation (ibid). In addition, the CHAT concepts of the division of labor and mediation of tools and artifacts were developed further to focus more specifically on the practices of co-creation of knowledge, shared goals and joint action, where new knowledge objects or social practices are created through collaborative activity (Lipponen, et al, 2004). Agents negotiate a shared understanding of the new activities and artifacts, and in this process, new knowledge and practices are created (ibid). Rommetveit's (2003) understanding of intersubjectivity and concepts of shared history and collaborative effort (Crook, 2000) contributed to the interpretation of the affective and motivational mediation of goal-directed action and object-oriented activity.

Stages and methods of analysis

The stages and methods of analysis are now presented, showing how the CHAT model outlined above in Figure 3 was operationalized. This shows how aspects not normally associated with CHAT analyses were undertaken and how they were linked to CHAT conceptually and analytically. It should be noted that due to limitations of space, a full analysis of all the data in the study is not presented. The aim is to show how the different stages and levels of analysis were conducted and the relationship among them. Worked examples are provided as illustrations of the argument and to give examples of the kind of outcomes that were made possible, rather than seeking to fully report the results of the study.

The analysis employed multiple methods and stages in order to pay attention to the different levels of activity and data types. This was conducted in 5 stages and Table 2 outlines each of these.

Stage	Analytic activity	Activity levels	Data
Stage 1: 'Dwelling' in the data	Preliminary reading and re-reading of all data with detailed notes.	Operation Action Intermediate Activity	Communications data Transcribed Interview data Questionnaire data Historical documents
Stage 2: Delineation of the activity system and network of related systems	1) Prior history of the modules and programme, institutional history and policies relevant to the study were summarized.	Intermediate Activity	Historical documents
	All elements and relationships within the module work activity system and its network of related systems were articulated	Operation Action Intermediate Activity	Communications data Transcribed Interview data Historical documents
Stage 3 – Thematic analysis	Thematic analysis combining data-driven and theoretically informed categories	Operation Action Intermediate Activity	Interview transcripts and original video data Questionnaire data Historical documents
Stage 4- Discourse Analysis	Analysis of learning trajectories – patterns of communication over time	Operation Action	Communications data
	Expanded unit of interaction: Goal of the action; relations of utterances, addressivity; utterance as meditational means and relations with other meditational means	Operation Action	Communications data
Stage 5: Dialectic analysis of relationships within the activity system	Draws on analysis from previous stages. Dialectic analysis of relationships within the system, contradictions and tensions	Operation Action Intermediate Activity	Activity system models, interview themes and preliminary findings from discourse analysis

Table 2: Stages and methods of analysis

As the table shows, at each stage, the different activity levels (operation, action, intermediate, and activity) were addressed, working multi-dimensionally with the hierarchical model of the modular work activity system set out in Figure 3. Stages 3, 4 and 5 were also conducted iteratively as further evidence emerged, and as new conceptual ideas appeared or required further analysis. It should be noted that this two-dimensional representation is not ideal, as it suggests a linear process whereas, through iteration and multidimensionality, the process was holistic and relational, particularly in later stages. There were also overlaps in timing between the stages, for example, Stages 3 and 4 took place concurrently. However, Stage 5 brought together all the previous stages, including preliminary findings. Each stage is now explained in detail.

Stage One: Dwelling

The aim of the first stage was to ensure a thorough immersion in the data at the outset. This involved reading, re-reading and familiarization with all of the data over several weeks, making notes and observations. Engeström has emphasized this early stage of phenomenological 'dwelling' in the data. This was intended to give insight into the nature of the discourse and problems as experienced by those involved in the activity and before delineating the activity system under investigation (Engeström, 1987, Ch. 5).

Stage two: Delineation

This stage had two aspects: Firstly an analysis of the historical and system level influences was conducted; secondly, the activity system and the network of related activity systems were delineated. The historical and system level analysis at this stage involved reviewing and summarizing relevant policy and historical documents and web pages in order to understand the stated policies on teaching, learning and assessment and (briefly) the history of the institution. The analysis also explored how the Information Systems program and the modules within the program had developed; their intended learning outcomes were also included. The review was undertaken critically, exploring any evidence of potential contradictions or misalignments that emerged for further analysis in the later stage (5). The historical analysis was also explored in the following stage (3) through the thematic analysis of tutor and student interviews to identify the personal histories and backgrounds and tutors' interpretations of the history of the modules prior to the research.

The second aspect of system delineation included the articulation of the key elements and agents in the activity system, using the expanded triangle model (see Figure 2). This was informed by the historical analysis and included identifying key elements at the four hierarchical levels in the activity system (Figure 3). "Delineation is this very act of identifying the personal and geographical locus and limits of the activity." (Engeström, 1987, Ch. 5). As discussed previously, this was mainly a descriptive process, drawing on preliminary data, although the models and diagrams were amended later as further stages of analysis were conducted and new interpretations emerged.

Stage 3: Thematic analysis

The aim of this stage was to analyze students' and tutors' own accounts of the activities and relationships within the special interest groups and the historical background to the modules, including prior history of students, tutors and institution. This is important for CHAT in terms of understanding the historical perspectives and multivoicedness within the activity system. Thematic analysis techniques that combined data-driven and theoretically informed categories (Boyatzis, 1998) were used iteratively to identify emerging patterns within the accounts in relation to the research questions. As Suthers (2006) argues neither data-driven nor theoretically informed analytical methods are sufficient on their own and integrated, iterative approaches to CSCL analysis are required. Theoretically informed categories were derived from the conceptual framework (Table 1) and the research questions. These included:

History of the activity, cultural practices, interpretations of the object, tool /artifact mediation, temporal /spatial dimensions, division of labor, peer relations

These were used alongside data-driven categories to re-interrogate the data and problematize the dynamically evolving activities and structures of the activity system (Roth & Lee, 2007). Theoretical and emergent categories were then consolidated into stable themes, which were validated and adjusted by iterative cross-referencing to full transcripts and the original data.

For example, one of the theoretically informed categories was *tool and artifact mediation* and data was interrogated to identify the role and affordances of the tools in mediating the collaborative work of the Sigs. At the same time, 'checking' emerged as a data driven category. Students repeatedly used the word 'check' or 'checking' in interviews when talking about using the VLE. They reported the need for constant checking to see if others had responded to messages, how difficult they found it to remember to check, how they resented having to keep checking and had expected that the VLE discussion boards would alert them to new communications. The data driven category was integrated with the tool and artifact mediation category to highlight how the practice of checking or not checking and the affordances of the VLE where communications are asynchronous and less visible, acted as constraints on collaboration in the Sigs.

As the stages of analysis were iterative, this stage provided early indications of areas of contradiction and tension that would be examined in stage 5.

Stage 4: Discourse analysis

At this stage of the analysis, the focus was on developing a deeper understanding of how the discourse in the special interest groups contributed to the pursuit and fulfillment of collaborative activities over time. It also analyzed how collaborators co-constructed knowledge and shared meaning and developed peer relations within the group interactions. All interactions collected for the 11 Sigs[7] that the research study group members participated in were included in this stage of analysis.

In order to understand how the collaborative group activities had unfolded over the course of the modules, an analysis of the trajectory (development over time) of each special interest group was undertaken. This trajectory analysis is similar to analysis of uptake (Suthers, 2006) and event analysis (Jordan & Henderson, 1995) employed in other CSCL studies. A timeline of all communications data was created, showing all contributions to each Sig. Conversational turns, responses and non-responses to questions and communicative contributions to the task were mapped out as part of the trajectory analysis. As well social contributions, not directly related to the task but part of the communications data, were also included. The trajectory maps provided a longitudinal view of the work of the Sigs. They also helped to identity critical incidents within the evolution of the groups. This emerging knowledge informed the interaction analysis undertaken next.

Ritva Engeström's expanded unit of interaction was employed as a frame for interrogating the goal of the action: the relation of one utterance to another, its addressivity, the role of the utterance as meditational means and its relations with other meditational means (1995, p. 197). A unit of interaction was defined as a

[7] There were a total of 18 Sigs across the two modules.

thread (for email, text messages, discussion board and blog postings and comments). For instant messaging conversations, this was a conversation[8]. Analysis identified how meaning and shared understanding were constructed in each unit of interaction. It also examined misunderstandings through different interpretations of and enactment of goals and the relationship between utterances and mediational means such as artifacts and resources introduced into the communicative space. Specific attention was paid to the role of artifacts in mediating interactions, joint action and knowledge construction and how reciprocity in relationships between collaborators was established.

Stage 5: Dialectic analysis of relationships within the activity system

At this stage, findings from all previous types of analysis were brought together and subjected to further analysis using CHAT's dialectical method. A *dialectical* analysis examines how different elements or aspects of the system are related oppositionally, pulling in different directions. This is what is meant by contradictions or disturbances. This analysis was informed by ideas such as those of Lewis (1997) who suggests that examining three-way relationships within the activity system (e.g., community - object - division of labor) as a lens for interrogating contradictions; and Roth & Lee (2007) who identify dialectical opposites as 'mutually exclusive category pairs'. These oppositional categories (individual-collective, body-mind, subject-object, agency-structure, discourse-social relations and material-ideal) were used to identify the opposition and misalignments more conceptually through CHAT's theoretical underpinnings and seek deeper explanations. The dialectical analysis also looked for evidence of multivoicedness within the system, where different perspectives emerge or compete or where creative resolutions and problem solving are jointly constructed. Essentially, this stage involved a process of reconstruction. Each of the previous stages can be seen as deconstructing the system in different ways; in this stage the parts are reassembled, without losing the rich and detailed interpretations from the more granular analysis.

To summarize, the accounts of each of the stages outlined above and in particular the final stage which brings everything together have sought to show how the multilayered and multidimensional analysis was operationalized within the study.

In the following section, two illustrative examples are presented as a meta narrative in order to show the kinds of outcomes that the multidimensional analysis and interpretations made possible[9]. The first illustration concerns the different understandings and interpretations of the object and how new objects emerged. This relates to research question 4 which investigated the rules, organizational factors and constraints, which influenced communications and collaboration. The second example illustrates some dimensions of the knowledge creation practices found in the Sigs. This relates to research questions 2 and 3, which focused on the kinds of collaborative and communicative practices using digital tools that took place in the online special interest groups and the patterns of interaction and division of labor that took place over time. Understanding and interpreting the

[8] A new conversation was counted once an elapsed time of 60 minutes or more had taken place

[9] For a fuller account of the results of this study, see (Timmis et al, 2010; Timmis, 2012)

object and the co-creation of knowledge also formed part of the conceptual framework outlined in Table 1.

Example 1: Different conceptions and competing objects

Early in the analysis, the expanded triangular model was used to delineate the different relationships within the module work system (Figure 4). The individual student is shown as the subject, working with other members of the community including members of their special interest group towards the object of the activity. Also presented are institutional and tutor imposed rules and regulations, namely, the guidance set out by tutors, assessment regulations and institutionally implemented regimes such as timetabling. Tools and artifacts including communications and digital tools, which mediate action are shown in relation to the subject and object of the activity.

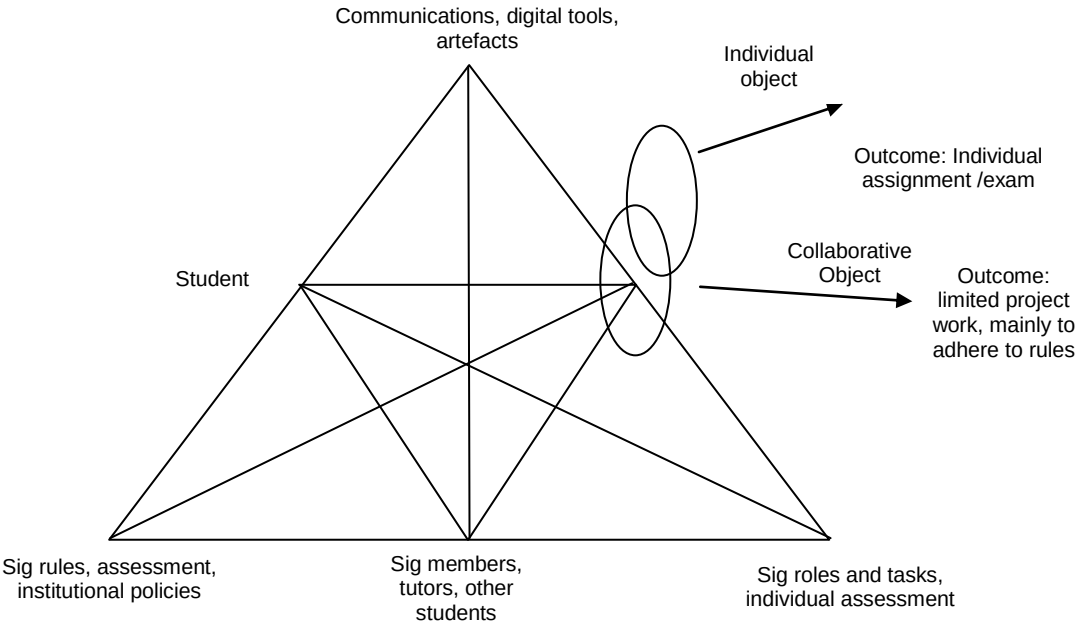

Figure 4: The module work system in the Sig study, showing individual and collaborative objects and outcomes

As shown in Figure 4, the analysis revealed a potential tension resulting from the presence of two objects, one individual task and one collaborative task, which students were required to engage with. The object of the work system was identified in module specifications as *'to complete the group research project and the module, and to acquire the relevant knowledge and experience of the subject domain'*. However, the official assessment requirements of the university were designed for individual completion, which conflicted with the object as stated. Following CHAT's multi-level approach, the dialectical analysis showed how this contradiction between a collaborative object (Sig project) and an individual object (official assessment) reverberated through the different levels of the activity system.

Analysis of communications showed students struggling to establish shared goals or to sustain collaboration beyond the mid-point of the module (week 6).

Most of the groups did not sustain their involvement in the Sig project because it was in conflict with assessment demands. This was a major theme in interviews and the discourse analysis of interactions showed how the goals of utterances changed in the second half of the module, from establishing the shared goals of the project to individual needs and requests.

Analysis of interview data also showed that, in addition to conflicts between official assessment and the collaborative object, tutors and students did not have a shared interpretation of the object. In interviews, tutors interpreted the object in very similar ways to the official documentation. They also did not see any conflict between a collaborative project and individual assessment requirements. Students' responses and interactions showed their confusion. Most felt that the assessment was the main object, but they also tried to make sense of the two competing objects (a collective outcome and an individual assessment), which made the activity confusing and its purpose unclear. Analysis of the trajectories over time reflected the increasing disengagement by students in the Sigs once the assessment was foregrounded at the mid-point in the module.

The analysis of institutional documents also identified that the university's assessment policies did not encourage collaborative assessments, despite its declared support for collaborative learning as a major pedagogical approach, seen as supporting the employability agenda. That Learning Outcome D of the Sig projects was less than fully achieved could be linked to contradictions at the institutional level. Recent changes in timetabling in the institution also played a role in constraining collaboration in the Sigs by placing the module in close proximity to the dissertation module and assessment. This was again a major theme in interviews with students and tutors.

The multi-level analysis revealed that two objects were competing for attention in the module work system: an individual object that would lead to an individual assignment or examination, and a collaborative object to work together to research the topic and develop an understanding of its application to IT Audit or e-Business and jointly create a website. The conflict in objects and different conceptions of the object emerged as a key theme in interviews, in the learning trajectories for the Sigs and in the analysis of interactions. This exemplified **individual:collective** and **subject:object** contradictions emerging from the relationship between the **subject – object – community** dimension of the activity system and helped to explain why the collaborative group work of the Sigs was not sustained over time or well integrated into the other work of the module.

Example 2: Knowledge creation practices in the Sigs

The multi-level, dialectical analysis showed how the sustainability of collaborative and knowledge creation activities in the Sigs were highly contingent on time:space configurations, tool mediation and historical relations amongst members of the Sigs.

Trajectory analysis of communications and the digital tools in use showed how time and space (as mediational means) influenced the frequency and continuity of interactions that took place in the Sigs. When using asynchronous tools as all the Sigs did, particularly institutional email and the VLE discussion boards, interactions were infrequent and sporadic with long delays between responses. There was also limited reciprocity amongst Sig members, evident in the frequency

of questions posed by group members that remained unanswered and the reported need for constant 'checking' highlighted earlier. Threaded messages in discussion boards appeared to be poorly understood by many Sigs members and compounded the loss of reciprocity as questions were answered on different threads, losing both the sense and continuity of conversations. By contrast, in the six Sigs where instant messaging conversations took place, trajectory analysis showed that these took place mainly over long time frames, sometimes lasting several hours or overnight. Discourse analysis showed that the continuity of these conversations and their synchronicity helped to maintain dialogues and establish a time:space configuration that supported negotiation of shared goals and actions.

Another key theme emerging from students interview data concerned pre-existing relationships or lack of shared history amongst group members. The importance of students' historical relationships to one another also played a role in their choice and use of the communication spaces. In those Sigs where members had a shared history, they reported that they used pre-existing modes of interaction, in the communication spaces they habitually used. Instant messaging was part of existing cultural practices and students' social space. Discourse analysis showed how in personal communications, study related and social discussions were integrated helping to sustain communication and collaboration. Discussion of the Sigs was shown in the instant messaging data to be often unplanned or fragmented, so that sustaining collaboration was sometimes at the expense of being focused or productive, suggesting that there were conflicts in communicative goals in these conversations.

Discourse analysis also revealed how mediating artifacts (mainly documents they were working on) were introduced by collaborators and transformed into new knowledge objects within the digital space. Collaborators working in synchronous spaces (instant messaging) were co-present and acting together to create new knowledge objects and to transform artifacts. This was also contingent on time and space as the synchronicity of instant messaging supported the goals of co-creation and intersubjective meaning making. This was not evident in other communicative spaces where artifacts were often exchanged but not transformed.

The development of collaboration and knowledge creation on the Sigs was also influenced by the competing objects (the Sig project and the assessment requirements), discussed in the previous section and the division of labor amongst members of the Sigs. The organization of groups in the Sigs as reported by students and tutors in interviews, did not take account of pre-existing friendships or working relationships and tutors felt this was not relevant to successful collaboration. Students took a different view and felt that in self-selected, friendship groups they would have worked more productively, established clearer goals and working methods more quickly. This also represented a tension between students' agency and the structure and requirements of the project.

At the activity system level, institutional constraints on collaboration were identified in interviews and document analysis. Tutors reported that conducting collaborative work with students in 12 week discrete units is very challenging for tutors who may not see the same students again and where time on modules is very limited. This was also very challenging for the students who were moving between different groups and did not necessarily encounter the same group of peers again. Another time-related finding from the historical and cultural analysis concerned absenteeism. At the time, attendance policies at the university were not well

enforced or very clear on requirements. Tutors reported that this played a critical role in limiting the collaboration of groups as students did not always have contact with members of their groups and negotiating goals and tasks became difficult because of discontinuities in engagement from students who were absent.

The sustainability and development of collaboration and co-creation of knowledge in the Sigs were therefore subject to multiple contradictions within the discourse, actions and peer relations. The extent to which the activities were sustained was also contingent on how the different temporal and spatial configurations of tool mediated interactions unfolded over the twelve week project. Furthermore, institutional structures and rules were shown to work in dialectical opposition to the development of collaborative practices and relational agency. These contradictions can be exemplified dialectically in terms of **individual:collective, discourse:social relations, time:space** and **agency:structure** dimensions, which helps in understanding why the development of sustainable collaborative and knowledge creation practices within an educational setting such as this example, presents a profound and multi-dimensional challenge for institutions and individuals, making this an important area for continuing research.

Discussion and conclusions

This paper has emphasized the importance and value of investigations into the *sustainable practice* of computer supported collaborative learning within educational settings. It has highlighted some of the challenges of CSCL studies that seek to pay attention to evolving and dynamic contexts and the need for a more relational perspective. Ritella and Hakkarainen (2012) highlight the gap in CSCL between one off experiments and static studies of generalized understandings, arguing that what are needed are more development studies, investigating how innovative knowledge-creation practices emerge over time. Cultural Historical Activity Theory (CHAT) has been explored for its potential to address these challenges, including a proposed multi-level relational approach to analysis. This has been illustrated by showing the analytical processes in a recent empirical study of undergraduates engaged in an online collaborative project.

In employing CHAT analytically, I have argued that we need to move beyond description and overreliance on the expanded triangle models to embrace the dialectical approach at the heart of CHAT. This involves identifying contradictions and tensions that emerge from the relations within and across the different levels and elements within an activity system and sometimes between systems (Engeström, 1987, 2001, Rasmussen & Ludvigsen, 2009). Developing the multi-dimensional aspects of the analysis helps in understanding how the object influences discourse and action at all levels within the activity system and over time. Integrating CHAT with Bakhtin's dialogic interpretation of discourse and theories of affect and relational agency (Crook, 2000, Rommetveit, 2003; Edwards, 2005) through an expanded unit of interaction (R. Engeström, 1995), places greater emphasis on the multivoicedness imbued in utterances, interactions and human relations within the activity system.

Understanding how collaborative and knowledge creation practices can be sustained in educational communities requires researchers to both acknowledge and address the 'cauldron' of activity, relationships and creative disturbances (Williams

et al, 2007) that dynamic educational communities embody. Education across all sectors is subject to continual multi-dimensional transformations, which may conflict or jeopardize the integration and sustainability of new innovations and collaborative knowledge creation practices and yet some practices and innovations endure. Conceptual and methodological approaches that can help to explain the 'how' and 'why' are therefore critical for the development of teaching and learning at all stages of education. CHAT's insistence on understanding the purpose of activity (the object) and how this is interpreted by different actors in the system and instantiated within activity, discourse and practice can show how shared understandings and joint actions emerge (Lipponen et al, 2004). Equally, the central pillar of mediation (Vygotsky, 1978) within activity systems supports the investigation of new knowledge objects, discourse and practices, created and transformed through their relations with mediational means, including digital tools and artifacts within a cultural setting. Recent attention to activity systems as sites of affective relations and dialogic communications (Roth, 2007, Hiruma et al, 2007; Engeström, 2009) also enriches the investigative possibilities and as shown in this article, throws a different light on how collaborative practices are sustained over time. CHAT's multi-dimensionality, as this article has sought to show, is much more than a multi-level approach, it is holistic, iterative and relational; the dialectical method deliberately problematizes, seeking to avoid simplification and reductionism.

There are risks in trying to expand the analytical focus and consider multiple dimensions where the analysis could become too diffuse. Indeed, one of the dangers of CHAT is the tendency to try to explore everything. Engeström (2001) cautions against this in favor of focusing attention on one or more specific aspects or subsystems of a larger system, as shown in the empirical study presented here. One of the powerful aspects of CHAT is how it opens up further avenues for research through the deconstruction – reconstruction process. Applying a CHAT framework for analysis produces further questions at all stages and levels of the activity which can be drawn together for final analysis and help to identify important areas for further research.

The importance of an historical analysis and the need to conduct studies over sufficient timescales in order to understand how practices become enculturated into the community are also critical to CHAT. In the special interest group study, a 12 week module appeared at the outset to be a long timescale. However, it became clear that focusing on one module was limiting, in part because it was not possible to investigate the effects of the work on the module on students' longer term practices or how this related to other work that the students were doing in other parts of their program of study. The study also illustrates how understanding the historical context and how a curriculum innovation has developed historically adds another valuable explanatory layer and raises questions for further research. Although there are many constraints on longitudinal research, to understand how practices can be sustained and embedded in institutions, longer-term studies are needed.

The articulation of the analytical process followed in the research cited here was undertaken because little can be found in the literature about how to 'do research' using Cultural Historical Activity Theory, in particular in educational settings. However, it would be a mistake to see the analytical framework and process outlined in this paper as a 'road map' or blueprint to be followed step by step and

stage by stage in an uncritical manner. It is rather an illustration of how CHAT's philosophical principles and core activity concepts can be interpreted, augmented and operationalized without losing its theoretical and dialectical values. As Roth & Lee argue "CHAT cannot be viewed as a master theory or quick fix, for true to its origins, it is subject to inner contradictions, which compel researchers to update, transform, and renew constantly so that it becomes a reflection of its object" (2007; p.218).

Furthermore, I am not arguing that CHAT is the answer to all research challenges and it should also be acknowledged that taking a multidimensional approach to CHAT can be complex and time-consuming to conduct. However, in seeking to increase understanding of how and why the practices of collaborative knowledge creation take place and are sustained in naturalistic settings, the multidimensional and dialectical method at the heart of CHAT provides a powerful explanatory tool. The dialectical method is both unifying and problematizing, allowing us to interrogate the different goals and objects in collaborative activity and explain why disturbances occur (Roth & Lee, 2007). This can help to develop a richer, more integrated and explanatory picture of CSCL activities and how they are sustained through the relations between people, their actions and interactions within activity systems. It enables us to understand how collaborative and knowledge creation practices can be enculturated and sustained in educational communities and the reasons why this is sometimes resisted or constrained.

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References

Arnseth, H. C., & Ludvigsen, S. (2006). Approaching institutional contexts: systemic versus dialogic research in CSCL. *International Journal of Computer-Supported Collaborative Learning, 1*(2), 167-185.

Arvaja, M., Salovaara, H., Hakkinen, P., & Jarvela, S. (2007). Combining individual and group-level perspectives for studying collaborative knowledge construction in context. *Learning & Instruction, 17*(4), 448 - 459.

Bakhtin, M. M. (1986). *Speech Genres and Other Late Essays* (V. W. McGee, Trans.). Austin, Texas: University of Texas Press.

Boyatzis, R. E. (1998). Transforming qualitative information: thematic analysis and code development. Thousand Oaks, CA: Sage Publications.

Brew, A. (2006). *Research and teaching :beyond the divide*. Basingstoke: Palgrave Macmillan.

Bromley, D. W. (2008). The New Palgrave Dictionary of Economics (Second ed.).

Chan, C. (2011). Bridging research and practice: Implementing and sustaining knowledge building in Hong Kong classrooms. *International Journal of Computer-Supported Collaborative Learning, 6*(2), 147 -186.

Cole, M. (1996). *Cultural Psychology: A once and future discipline*. Cambridge, Massachusetts: Harvard University Press.

Cole, M., & Engeström, Y. (1993). A cultural-historical approach to distributed cognition. In G. Salomon (Ed.), *Distributed Cognitions: Psychological and educational considerations* (pp. 1 - 46). Cambridge: Cambridge University Press.

Crook, C. (2000). Motivation and the ecology of collaborative learning. In R. Joiner, D. Miell, K. Littleton & D. Faulkner (Eds.), *Rethinking collaborative learning*. London: Free Association Press.

Crook, C. (2011). Versions of computer supported collaborating in higher education. In S. Ludvigsen, A. Lund, I. Rasmussen & R. Säljö (Eds.), *Learning Across Sites: New tools, infrastructures and practices* (pp. 156 - 171). Abingdon, Oxon: Routledge.

Daniels, H. (2001). *Vygotsky and Pedagogy*. London: RoutledgeFalmer.

Daniels, H. (2006). Analysing institutional effects in Activity Theory: First steps in the development of a language of description. *Outlines: Critical Social Studies, 2 2006*, 43 -58.

Daniels, H. (2011). Analysing trajectories of professional learning in changing workplaces. *Culture & Psychology, 17*(3), 359–377.

de Lange, T., & Lund, A. (2008). Digital Tools and Instructional Rules: A study of how digital technologies become rooted in classroom procedures. *Outlines: Critical Social Studies 10* (2), 36-58.

Dillenbourg, P. (1999). What do you mean by 'collaborative learning'? In P. Dillenbourg (Ed.), *Collaborative Learning: Cognitive and Computational Approaches* (pp. 1-19). Oxford: Elsevier.

Dillenbourg, P., Järvelä, S., & Fischer, F. (2009). The Evolution of research on computer-supported collaborative learning: From design to orchestration. In N. Balachef, S. Ludvigsen, T. deJong, A. Lazonder & S. Barnes (Eds.), *Technology-enhanced learning: Principles and Products* (pp. 3 - 20). Dortrecht: Springer.

Edwards, A. (2005). Relational agency: Learning to be a resourceful practitioner. *International Journal of Educational Research, 43*, 168 - 182.

Engeström, R. (1995). Voice as communicative action *Mind, Culture, and Activity, 2*(3), 192-215.

Engeström, Y. (1987). Learning by Expanding: An activity theoretical approach to developmental research. Helsinki: Orienta-Konsultit.

Engeström, Y. (1999a). Activity theory and individual and social transformation. In Y. Engeström, R. Miettinen & R. Punamaki (Eds.), *Perspectives on Activity Theory* (pp. 19 - 38). Cambridge: Cambridge University Press.

Engeström, Y. (1999b). Communication, discourse and activity. *The Communication Review, 3*(1), 165 — 185.

Engeström, Y. (1999c). Innovative learning in work teams: Analyzing cycles of knowledge creation in practice. In Y. Engeström, R. Miettinen & R. Punamaki (Eds.), *Perspectives on Activity Theory* (pp. 377 - 404). Cambridge: Cambridge University Press.

Engeström, Y. (2001). Expansive Learning at Work: toward an activity theoretical reconceptualization. *Journal of Education and Work, 14*(1), 133 -156.

Engeström, Y. (2009). The Future of Activity Theory: A Rough Draft. In A. Sannino, H. Daniels & K. D. Gutiérrez (Eds.), *Learning and Expanding with Activity* (pp. 303 -328). New York: Cambridge University Press.

Fenwick, T. (2010). Re-thinking the "thing": Sociomaterial approaches to understanding and researching learning in work. *Journal of Workplace Learning, 22*(1), 104 - 116.

Garfinkel, H. (1967). *Studies in ethnomethodology*. Englewood Cliffs, NJ Prentice-Hall.

Hakkarainen, K. (2009). A knowledge-practice perspective on technology-mediated learning. *International Journal of Computer-Supported Collaborative Learning, 4*, 213–231.

Healey, M., & Jenkins, A. (2009). Developing Undergraduate Research and Inquiry. Retrieved from http://www.heacademy.ac.uk/assets/documents/research/DevelopingUndergraduateResearchandInquiry.pdf

Hiruma, F., Wells, G., & Ball, T. (2007). The Problem of Discoursing in Activity. *Actio: An International Journal of Human Activity Theory 1*, 93 - 114. doi: http://kuir.jm.kansai-u.ac.jp/dspace/handle/10112/7574

Hyysalo, S. (2005). Objects and motives in a product design process. *Mind, Culture, and Activity, 12*(1), 19-36.

Jaworski, B., & Goodchild, S. (2006). Inquiry Community in an Activity Theory Frame. In J. Novotná, H. Moraová, M. Krátká & N. Stehlíková (Eds.), *Proceedings 30th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 3, pp. 353-360). Prague: PME.

Jaworski, B., & Potari, D. (2009). Bridging the macro- and micro-divide: using an activity theory model to capture sociocultural complexity in mathematics teaching and its development. *Educational Studies in Mathematics, 72*(2), 219 - 236.

Jonassen, D. H. (2000). Revisiting Activity Theory as a Framework for Designing Student-Centred Learning Environments. In D. H. Jonassen & S. Land (Eds.), *Theoretical Foundations of Learning Environments*. New Jersey: Lawrence Erlbaum.

Jones, C., & Healing, G. (2010). Net generation students: agency and choice and the new technologies. *Journal of Computer Assisted Learning, 26*(5), 344 -356.

Jordan, B., & Henderson, A. (1995). Interaction Analysis: Foundations and Practice. *The Journal of the Learning Sciences, 4*(1), 39 - 103.

Kaptelinin, V. (2005). The object of activity: Making sense of the sense-maker. *Mind, culture, and Activity, 12*(1), 4-18.

Karasavvidis, I. (2009). Activity Theory as a conceptual framework for understnading teacher approaches to Information and Communication Technologies. *Computers and Education, 53*, 436 - 444.

Koschmann, T. (1996). Paradigm shifts and instructional technology: An introduction. In T. Koschmann (Ed.), *CSCL, Theory and Practice of an Emerging Paradigm*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Koschmann, T. (1999). Toward a dialogic theory of learning: Bakhtin's contribution to understanding learning in settings of collaboration. In C. Hoadley (Ed.), *Computer Support for Collaborative Learning* (pp. 308 -313). Mahwah, NJ: Lawrence Erlbaum.

Koschmann, T., Stahl, G., & Zemel, A. (2007). The Video Analyst's Manifesto (or The Implications of Garfinkel's Policies for Studying Practice within Design-Based Research) In R. Goldman, R. D. Pea, B. Barron & S. Derry (Eds.), *Video research in the learning sciences* Mahwah, NJ: Lawrence Erlbaum Associates.

Langemeyer, I., & Nissen, M. (2005). Activity Theory. In B. Somekh & C. Lewin (Eds.), *Research Methods in the Social Sciences* (pp. 188 -196). London: Sage.

Lemke, J. L. (1990). Making Meaning: The Principles of Social Semiotics, Chapter 8 in Talking Science: Language, Learning and Values Westport, CT: Ablex.

Leont'ev, A. N. (1978). Activity, Consciousness, and Personality Retrieved from http://www.marxists.org/archive/leontev/works/1978/index.htm

Leont'ev, A. N. (1981). The Problem of Activity in Psychology. In J. V. Wertsch (Ed.), *The Concept of Activity in Soviet Psychology* (pp. 37 - 71). Armonk, New York: M.E. Sharpe Inc.

Lewis, R. (1997). An Activity Theory framework to explore distributed communities. *Journal of Computer Assisted Learning, 13*, 210 -218.

Linell, P. (2009). Rethinking Language, Mind and World Dialogically: Interactional and contextual theories of human sense-making Charlotte, NC: Information Age Publishing.

Lipponen, L., Hakkarainen, & Paavola, , S. (2004) Practices and orientation of computer-supported collaborative learning. In J. Strijbos, P. Kirschner & R. Martens (eds.). *What we know about CSCL, and implementing it in higher education* (pp. 31-50). Boston, MA: Kluwer Academic Publishers.

Nardi, B. A. (1996). Studying Context: A Comparison of Activity Theory, Situated Action Models and Distributed Cognition. In B. Nardi, A. (Ed.), *Context and Consciousness* (pp. 69 - 102). Cambridge, Massachusetts: MIT Press.

Nussbaumer, D. (2011). An overview of cultural historical activity theory (CHAT) use in classroom research 2000 to 2009. *Educational Review 64*(1), 37-55.

Oliver, M. (2011). Technological determinism in educational technology research:some alternative ways of thinking about the relationship between learning and technology. *Journal of Computer Assisted Learning, 27*(5), 373–384.

Perkins, D. N. (1993). Person-plus: a distributed view of thinking and learning. In G. Salomon (Ed.), *Distributed Cognitions: Psychological and educational considerations* (pp. 88-110). Cambridge: Cambridge University Press.

Rasmussen, I., & Ludvigsen, S. (2009). The Hedgehog and the Fox: A Discussion of the Approaches to the Analysis of ICT Reforms in Teacher Education of Larry Cuban and Yrjö Engeström. *Mind, Culture, and Activity, 16*(1), 83 — 104.

Ritella, G., & Hakkarainen, K. (2012). Instrumental genesis in technology-mediated learning: From double stimulation to expansive knowledge practices. *International Journal of Computer-Supported Collaborative Learning, 7*(2), 239-258.

Rommetveit, R. (2003). On the Role of "a Psychology of the Second Person" in Studies of Meaning, Language, and Mind. *Mind, Culture & Activity, 10*(3), 205 - 218.

Roschelle, J., & Teasely, S. D. (1995). The construction of shared knowledge in collaborative problem solving. In C. O'Malley (Ed.), *Computer Supported Collaborative Learning* (pp. 69 -97). Berlin Heidelberg: Springer Verlag.

Roth, W. M. (2004). Activity Theory and Education: An Introduction *Mind, Culture, and Activity, 11*(1), 1 - 8.

Roth, W. M. (2007). Emotion at Work: A Contribution to Third-Generation Cultural-Historical Activity Theory. *Mind, Culture, and Activity, 14*(1), 40 - 63.

Roth, W. M., & Lee, Y. J. (2007). " Vygotsky's Neglected Legacy": Cultural-Historical Activity Theory. *Review of Educational Research, 77*(2), 186.

Selwyn, N. (2011). Education and Technology: Key Issues and Debates. London: Continuum.

Siyahhan, S., Barab, S. A., & Downton, M. (2010). Using activity theory to understand intergenerational play: The case of Family Quest.. *International Journal of Computer-Supported Collaborative Learning 5*(4), 415 – 432.

Stahl, G. (2005). Group cognition in computer assisted collaborative learning. *Journal of Computer Assisted Learning, 21,* 79 -90.

Stahl, G., & Hesse, F. (2010). Beyond folk theories of CSCL. *International Journal of Computer Supported Collaborative Learning, 5*(4), 355-358.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences* (pp. 409-426). Cambridge, UK: Cambridge University Press.

Strijbos, J. W. and F. Fischer (2007). " Methodological challenges for collaborative learning research." Learning and Instruction **17**: 389-393.

Sutherland, R., Eagle, S. and Joubert, M. (2012) A Vision and Strategy for Technology Enhanced Learning: Report from the STELLAR Network of Excellence. Last accessed 7 August 2012 from: http://www.stellarnet.eu/kmi/deliverables/20120803_stellar_d1.8_final.pdf

Suthers, D. (2006). Technology affordances for intersubjective meaning making: A research agenda for CSCL. *International Journal of Computer Supported Collaborative Learning, 1*(3), 315 - 377.

Timmis, S., Joubert, M., Manuel, A. & Barnes. S. (2010). Transmission, transformation and ritual: an investigation of students' and researchers' digitally mediated communications and collaborative work. *Learning, Media and Technology* 35(3): 307 - 322.

Timmis, S. (2012). Constant Companions: Instant Messaging Conversations as Sustainable Supportive Study Structures amongst Undergraduate Peers. *Computers & Education* 59 (1): 3 -18.

Van Aalst, J., & Hill, C. M. (2006). Activity Theory as a framework for analysing knowledge building. *Learning Environments Research, 9,* 23 - 44.

Van Oers, B. (1998). From context to contextualizing. *Learning and Instruction, 8*(6), 473 - 488.

Vygotsky, L. S. (1978). *Mind in Society: The development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1986). *Thought and Language* (A. Kozulin, Trans.). Cambridge, Massachusetts: MIT press.

Wells, G. (2007). The Mediating Role of Discoursing in Activity. *Mind, Culture and Activity, 14*(3), 160 -177.

Wertsch, J. V. (1991). *Voices of the Mind: A socio-cultural approach to mediated action*. Cambridge, MA: Harvard University Press.

Williams, J., Davis, P., & Black, L. (2007). An agenda for CHAT in educational research: An editorial response. *International Journal of Educational Research 46*, 104–107.

Yamagata-Lynch, L. C. (2003). Using Activity Theory as an Analytic Lens for Examining Technology Professional Development in Schools. *Mind, Culture, and Activity, 10*(2), 100-119.