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Complexity, theory and praxis: Researching collaborative learning and tutoring processes in a networked learning community

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Abstract. This paper explores the complexity of researching networked learning and tutoring on two levels. Firstly, on the theoretical level, we argue that the nature of praxis[1] in networked environments (that is, learning and tutoring) is so complex that no single theoretical model, among those currently available, is a sufficiently powerful, descriptively, rhetorically, inferentially or in its application to real contexts, to provide a framework for a research agenda that takes into account the key aspects of human agency. Furthermore, we argue that this complexity of praxis requires a multi-method approach to empirical investigation, in order that theory and praxis may converse, with both being enriched by these investigations. Secondly, on an empirical level, and as an example that draws upon our theoretical argument about complexity, we present the findings of a multi-method analysis of the learning and tutoring processes occurring in an on-line community of professionals engaged in a Master's Programme in E-Learning. This investigation is informed by two mainstream theoretical perspectives on learning, and employs computer-assisted content analysis and critical event recall as complementary methodologies. This study reveals the differentiated nature of participants' learning, even within a highly structured collaborative learning environment, identifies some of the key functions and roles of participants, and provides an indication of the value of such multi-method studies. Future prospects for this approach to research in the field are considered.

Keywords: content analysis, critical event recall, networked learning, on-line communities, praxis, theory, tutoring

Introduction

This paper is an attempt to address some of the complexities of researching networked learning (NL) in higher education contexts. Our wider set of concerns and interests in this work cluster around trying to research and illuminate how theory and praxis interact in a range of networked learning environments. One might view this 'interaction' as a kind of exploratory conversation between theory and praxis (in which workers in this field are engaged). In its creative phases this might develop from a mutual articula-

tion of theoretical underpinnings and rich analytical descriptions of praxis, to a systematic and rigorous searching for ways in which each might deepen and enrich the other, leading to improvements in learning for participants in networked learning environments. This idea, of a theory-praxis conversation or interaction, was developed by Stenhouse (Stenhouse, 1983). He argued that the development of a theoretical understanding of *educational* action and doing *educational* research into the practical problems of education are inseparable. If educational research focuses on the problems which arise in trying to realise a form of *educational* praxis, then it will pose questions both about which actions in the context are constitutive of such praxis and about the educational criteria employed in deciding this. To summarise, educational research, on Stenhouse's account, is a process which involves the joint development of educational praxis and theory in interaction (see Elliott, 2001 for a summary of Stenhouse's arguments).

Our approach, in this paper is, firstly, to explore some of our general concerns about the complexity of the interactions of theory and praxis in the field of networked learning. We then go on to provide a specific example of this conversation and its difficulties through an account of some of our own recent research into learning and tutoring in a networked learning community.

Halverson (2002) has cogently articulated four ways in which theory might contribute to this conversation in the context of networked learning environments. These are through its:

- Descriptive power: providing a conceptual framework that helps us to make sense of and describe the phenomena we are engaged in;
- Rhetorical power: helping us to talk about these phenomena and speculate about ways in which the theoretical ideas 'map' onto our experience of them;
- Inferential power: providing us with ways of advancing our understanding by helping us to ask new questions and intervene in creative ways, as educators, in the contexts that we are investigating and in which we are participating;
- Applicatory power: informing the ways in which we design and engage in pedagogy to support learning.

One of the themes of the present paper is complexity. We argue that this applies both to theory and praxis. Such is this complexity that, given the current state of the conversation between theory and praxis in the field of networked learning, we contest that no single theoretical framework is yet capable of offering us a sufficiently powerful articulation of description, rhetoric, inference or application. This point has been well argued by Paavola, Lipponen and Hakkarainen (2002) who describe the ways in which some

of the theoretical models currently available to workers in this field may complement each other, while pointing out that there are many fundamental differences between these models in terms of both focus and power; yet, all the models they describe are currently in use by workers in the field. One explanation of this situation may be that, as a research community, we are still in the process of coming together to engage in theory-praxis conversations, still emerging from the fields that informed the genesis of our interests in networked learning. Furthermore, perhaps we have not yet, as a research community, fully and openly acknowledged the complexity of researching the central educational processes of learning and teaching. However, this complexity does not end with theoretical plurality, immaturity, and a reluctance to acknowledge this complexity in the field. The nature of our educational interactions (our praxis), as learners and educators, with each other, and with the artefacts (texts, computer systems, language) of our networked environments is also complex, consisting of multiple individual and group processes. More progress has been made in articulating a coherent synthesis that provides a framework for teaching (pedagogical) processes (Goodyear, 1999). However, as Goodyear acknowledges (2001, pp. 7–8), the task of analysing online texts and connecting this analysis to learning is troublesome because of the theoretical difficulties of linking language to learning. Parallel problems arise when analyses of online tutoring are undertaken. Our research context for this paper (see below for details) is a course in which participants engage in learning processes, tutoring processes and action research processes. All of these are located primarily in the overlap between their own individual professional contexts and the more formal shared context of the Master's programme. We acknowledge that this complexity of praxis requires further articulation than is possible in the present paper, and will form a focus for future work.

The learning and tutoring processes that form the focus of the research described in this paper are only one aspect of human agency in educational contexts (see Taylor (1992) for a broad analysis of the philosophical scope and social evolution of human agency). As well as learning, tutoring, and research, this agency also includes processes of identity formation, motivation, intentionality and achievement.

While our ambitions for future work include our intention to address these processes in NL environments, they are also outside the scope of the study reported here. However, other workers have already begun to investigate these aspects of agency in NL. Mann (2003), for example, has begun to investigate the implications for pedagogy of learner identity. Young, Depalma and Garrett have begun to explore the role of human intentionality in interactions

between participants and learning environments (Young, Depalma & Garrett, 2002). Niven, Harris and Williams (2002) have investigated the significance of motivation in the development of an online learning community. Broader academic discussions about the interactions between individual characteristics of learners and web-based environments are now also beginning to emerge in mainstream educational research journals, albeit focused more on school level studies than higher education (see, for example, Hartley & Bendixen, 2001).

There is yet a further set of concerns, adding another layer to the complexity of the theory-praxis conversation. To develop the metaphor a little further, one might say that the language of this conversation is partly determined by the *syntax* of methodology. One requirement of the power of theory is that it should contribute to the conversation by indicating what we might focus on in real learning situations. But theory does not necessarily indicate by what means we should focus. Experience of praxis, for those engaged as learners or tutors in any NL context, leaves us with an awareness of the complexity of processes occurring between participants. What methods are best suited to systematic and rigorous analysis? How might these methods complement one another? Methodology assists the conversation between theory and praxis by providing the rules for their interaction. However, as a community of researchers, we are still confronted with the methodological challenge of agreeing the rules.

At the Fifth International Conference on Computer Support for Collaborative Learning, in Boulder, Colorado (Stahl, 2002), one of the stated aims was to articulate a new paradigm for "a distinctive form of learning research". However, a browse through the conference proceedings (CSCL, 2002) soon reveals that, despite this, only a small minority of the 50 long papers focused on the methodological issues and practicalities of researching learning in networked environments. In some ways this was disappointing and perplexing, given the stated aim. At the same time it is understandable. The challenges to be faced in researching learning are at once attractive, but also formidable.

The analysis of the content of discourse within online communities provides a useful example of these methodological challenges. Here the processes of praxis are mediated by a virtual learning environment (VLE). This can create the comforting feeling, for unwary researchers interested in analysing educational praxis, that the transcripts of discussions taking place in the VLE contain easily accessible and potentially significant evidence of learning, tutoring, or research processes among the participants. There is no manual transcription to undertake, and it is clear who said what, and when. Initially then, the methodological challenge might, apparently,

be easily resolved in terms of analytical tools through the employment of content analysis of the written messages (see Popping (2000) for an extensive account of these procedures). However, content analysis is cumbersome and time consuming. The choice of coding categories is a complex issue in itself, and the application of complex coding schemas by co-workers may lead to further problems in resolving issues of validity and reliability, arising from subjectivity in the application of the schemas. More fundamentally, the available theoretical frameworks may not be sufficiently robust to enable valid inferences to be made about any of these processes from the textual traces. Furthermore, what does one do about those aspects of learning that are not expressed in, and therefore not amenable to, content analysis? This difficulty has been acknowledged and articulated by a few workers in the field (notably, for example, Jones & Cawood, 1998). However, there are very few studies that attempt to triangulate content analysis with other robust qualitative approaches that might offer access to evidence of the processes under discussion (see, for example, Hara, Bonk and Angeli (2000) for one of the few studies in the field to articulate these methodological difficulties).

The emerging reality of our own recent work in this area, is that the nature of interactions among participants in online educational communities is sometimes very complex and multi-dimensional. It is not easy to research the processes of these interactions using any single method. This has been a stimulus to us to explore a multi-method approach to understanding interactions among members of these communities and, in so doing, attempt to reveal and understand the richness of processes beyond the capability of any one of the methods, when used by itself.

In this paper we share some of our findings from the application of computer assisted content analysis (Popping, 2000) to asynchronous discussion transcripts of the E-Learning MEd at the University of Sheffield (formerly the M.Ed. in Networked Collaborative Learning). Specifically, the empirical findings in this paper arise from our focus on the content analysis of individual contributions and differences in learning and tutoring processes. This is integrated with the use of Critical Event Recall (CER) to probe learning and tutoring processes that may not be expressed in the actual text records used as data for the content analysis. Elsewhere (see, for example, De Laat, 2002) we are exploring a combined approach using social network analysis and content analysis to relate patterns of group interaction to learning and tutoring processes. In future reports we will explore the dynamics of group learning and tutoring processes over time, and relate these to the individual patterns described in this paper. In methodological terms we aim to move towards a more coherent synthesis of content analysis, critical event

recall and social network analysis. However, this is a longer-term aim of our research programme.

Theoretical complexity as a basis for understanding learning and tutoring processes

Arising from our earlier argument about the complexity of the theory-praxis conversation, we contest that there is a need to draw on a plurality of theoretical perspectives in order to develop both theory and praxis through a conversation between them, mediated by multi-method analysis. In this section we outline briefly some of the key theoretical ideas upon which our recent work, and the present paper, are based. We also indicate how the overall direction of the work draws upon each of these ideas, and the kinds of analysis to which each perspective has led us. In this work (for example Barrett & Lally, 1999; De Laat, De Jong & Simons, 2001; De Laat, De Jong & Ter Huurne, 2000; Lally & De Laat 2002; Lally & Barrett, 1999) we have attempted to explore a range of aspects of collaborative learning and begun to develop analytical frameworks in order to understand the complex tutoring and learning processes that are occurring in learning communities. We contend that the interaction between tutoring and learning processes is of central importance in all educational endeavours. Therefore, one of our central aims is to enquire systematically into this key educational interaction. Unless we make rich links between tutoring processes and students' learning processes it is difficult to fully understand or improve these processes. This is not a new idea in some senses: teachers will naturally claim responsibility if their students are successful in examinations. In their attribution, their tutoring acts have brought about learning in their students – as measured by the output, usually examination performance. But it may be a rather bold and unhelpful assertion. It offers no detailed insight into what 'worked' and what 'didn't'. Therefore, it provides no local evidence base on which the individual teacher can act about the details of her tutoring. Nor does it provide any systematic basis for communicating the effective and efficient aspects of praxis to others. Learning and tutoring, as ongoing sets of processes, happening in time and space, within an individual or a group, do not feature in detail in this general analysis. Sotto (1996) has argued this point very cogently: that good tutoring in higher education is far from self-evident, and that its connection to learning is complex, both in terms of learning outcomes at the end of an event, and learning processes occurring during that event.

Constructivism, situativity, and group learning

We have premised the analysis and theorising in the present paper by drawing on several theoretical perspectives about learning. One of these is a social-constructivist view of learning that also considers the situativity of learning processes. This leads us to focus on a search for evidence, in the online discussions, of cognitive processes in which participants link new knowledge to their prior knowledge, and actively construct new internal representations of the ideas being presented (Boekaerts & Simons, 1995). We also draw on ideas about the meaningfulness and situativity of learning. That is, we view learning as a set of processes by which the learner personalises new ideas by giving meaning to them, based upon earlier experiences. However, meaning is also rooted in, and indexed by experience (Brown, Collins & Duguid, 1989). Therefore, each experience with an idea, and the environment of which that idea is part, becomes part of the meaning of that idea (Duffy & Jonassen, 1992). Learning is therefore understood and viewed by us as situated by the activity in which it takes place (Brown et al., 1989; Lave & Wenger, 1991). This view has led us to also seek evidence, in the online texts, for the cognitive, social and affective processes in which participants engage in trying to make meaning of the ideas presented to them by the tasks they are undertaking. We have also used Critical Event Recall (CER) to try to access the meaning making, and awareness of context, that participants use to make judgements and engage in activities in their course of study.

In our thinking we have also drawn on a wide body of work that has focused more explicitly on the social or group dimensions of learning. Influenced principally by the work of Vygotsky (1962, 1978) many authors (Dillenbourg, 1999; Goldstein, 1999; Lave, 1988; Lave, 1996; Lave & Wenger, 1991; Levine, Resnick & Higgins, 1996; Moll, Tapia & Whitmore, 1993; Resnick, 1991; Salomon & Perkins, 1998; Smith, 1994; Wegerif, Mercer & Dawes, 1999; Wertsch, 1991), have focused on the role of the group in shaping and driving individual cognitive (i.e. learning and tutoring) processes (group-mediated cognition or gmc). Key aspects of this view include the suggestion that, in a group meeting, the situation itself may exert a strong mediating effect on individual cognitive and conceptual processes: the thinking of individuals is influenced by the group in which they are working. Furthermore, the merger of intellectual and social processes may be another fundamental feature of group-mediated cognition. A third key feature is the tension between the conceptual structure or understanding (of the problem or ideas under discussion) of the group and that of the individuals within it. These individual understandings may vary from each other as well as from the group. This tension may be the driving force for the collective processing of the group. So, for example, when an individual member of the group

expresses his or her opinion in relation to the shared public understanding of the group, this may be based on an attempt to synthesise this understanding with the public (that is group or shared) one. The other members of the group might compare this new synthesis with their own understandings of the group-accepted version and their own disagreements with it. Depending on the outcome of this process there may be further interaction and negotiation until a new meaning or understanding is accepted by the group. In this way interaction between individuals, as well as their shared and individual cognitions, can be viewed as key aspects of the co-construction of knowledge, meaning and understanding. Our interest in the cogency of these ideas has led us towards a parallel focus on individual processes and group processes, as well as the interactions between them, in the group activities that are the focus of our empirical work. However, in this study we report on our work with individual processes within the group. Our work on group processes and interactions will be reported later, and synthesised with the present study.

Socio-cultural theory

The other perspective that we have drawn upon is socio-cultural theory. Whereas the social-constructivist perspectives makes a distinction between the individual cognitive activities and the environment in which the individual is present, the socio-cultural perspective regards the individual as being part of that environment. Accordingly, learning cannot be understood as a process that is solely in the mind of the learner (Van Boxtel, Van der Linden & Kanselaar, 2000). Knowledge, according to this perspective, is constructed in settings of joint activity (Koschmann, 1999). Learning is a process of participating in cultural practices, a process that structures and shapes cognitive activity (Lave & Wenger, 1991). The socio-cultural perspective gives prominence to the aspect of mutuality of the relations between members and emphasises the dialectic nature of the learning interaction (Sfard, 1998). Construction of knowledge takes place in a social context, such as might be found in collaborative activities of the MEd in E-Learning featured in this paper (see McConnell (2000) for a much more detailed exploration of collaborative learning). In addition, Lehtinen et al. (1999) argue that conceptual understanding is fostered through explaining a problem to other students. Therefore, in collaborative learning it is necessary to formulate learning objectives, to make learning plans, to share information, to negotiate about knowledge and to take decisions (Veldhuis-Diermanse, 2002). In a setting of collaborative learning, students can criticise their own and other students' contributions, they can ask for explanations, they can give counter arguments and, in this way, they will stimulate themselves and the other students. Additionally, they can motivate and help each other to finish the task. Arising from

our interest in these ideas is a need to focus on tutoring processes, that is the processes of interaction by which participants guide, facilitate and structure the contributions of others, and in so doing modify and develop their own learning processes. To probe the online texts for evidence of these processes we have employed a second coding schema for content analysis, which we will describe below. In conclusion, we contend that this complex collection of theoretical ideas, drawing on social-constructivist and socio-cultural theory, and ideas about situativity, is necessary to take account of the real complexities of individual and group processes in the networked learning context that is the focus of our study. Furthermore, we have tried to indicate how, together, they direct us towards a focus on individual and group processes, towards the interactions between these, and towards learning and tutoring. They also suggest the kinds of methodological tools that might help us understand and investigate collaborative learning in our networked community.

Analysing individual learning and tutoring processes in a Master's programme

The students featured in this analysis are undertaking a Master's Programme in E-Learning that is based upon an action research approach to professional development. It is an advanced part-time programme designed to provide participants with opportunities to engage with theory and praxis of collaborative networked tutoring and learning. The programme is based upon the establishment of a 'research learning community' among the participants and tutors. In this community activities are undertaken around five workshops over a two-year period. The programme is hosted in the electronic learning environment WebCT. Some course resources are provided to participants in printed format. Students also communicate with each other, and the designated university tutor, informally and outside the course environment. The students are a sophisticated group of professionals, in several senses. Many are mature learners who bring more than one established and relevant body of expertise to the course with them. They often already have extensive postgraduate experience of higher education, are themselves professionally engaged with teaching responsibilities within their organisations, and are charged with developing e-learning within that organisation. Some also have research experience in the natural or social sciences. In the course they become engaged in collaborative learning and tutoring processes (McConnell, 2000) as they support each other and the group as a whole in a range of structured activities. Tutoring processes in this course are not the exclusive domain of the designated tutors. They may be undertaken by any of the participants in this course environment. This kind of

integration of learning and tutoring processes has been documented in other networked learning settings (Gartner & Riessman, 2000). The more traditional role of the 'teacher', with its central position, may be transformed within such collaborative structures, towards fostering an online learning culture in which participants take charge of their own learning and tutoring (Collinson, Elbaum, Haavind & Tinker, 2000).

Methods

Our analysis is based upon work conducted by 7 students and a tutor in the first workshop of this programme (approximately 10 weeks' duration). We were particularly interested to explore the relationship between knowledge construction (learning) and tutoring processes as these evolved over time within the workshop.

Content analysis

In the process of analysing tutoring and learning processes of the participants in our group, messages from the workshop had to be coded and analysed. The central purpose of coding, for us, was to extract, generalise and abstract from the complexity of the original messages in order to look for evidence of these processes, and use this to interrogate the theories about the situation that we had used to direct our investigation. This is a balance between oversimplification, resulting in the loss of subtlety and insight into complex processes, and over-coding where the themes and trends are still obscured by too many sub-categories. We used computer assisted data analysis software (CAQDAS) to achieve this. The main advantages of such an approach include: partial automation of the coding process, with increased speed of coding, and a wider range of ways to search, re-code and interrogate the coded data (in this case messages), including visual coding. We used NVivo 1.1-3 (Qualitative Solutions and Research, 1999) for this work, and set up the categories in our two schemas as 'nodes' within the NVivo system. Each message was imported as a text file and given a 'time-stamp' to indicate when it was posted in the original discussions in WebCT. It was also given other 'descriptors' including who authored the message, and the gender of the author. Once all the messages had been coded and described we used the search facility in NVivo to carry out two analyses. The results in this paper are based on one of these analyses: a search, by individual participant, for his or her contributions within each category of the learning and tutoring coding schemas. In a second analysis, reported elsewhere (Lally & De Laat, 2002), we looked at tutoring and learning processes for the whole group over time,

in order to try to understand how the relative proportions of learning and tutoring processes changed over the lifetime of the group's work.

In order to probe collaborative knowledge construction and tutoring in this learning environment we 'coded' the contributions made to a 10 week discussion using two coding schemas. The coding process consisted of two steps: (1) dividing the messages into meaningful units (Creswell, 1998; Henri, 1992) and (2) assigning a code to each unit. We decided to segment messages into units of meaning by using semantic features such as ideas, argument chains, topics of discussion (for further details of this approach to the definition of units of meaning see Chi, 1997; Ericsson & Simon, 1984) or by regulative activities such as making a plan or explaining unclear information. Thus, the content of the messages had to be read for meaning to determine segment boundaries. Although it may be considerably easier to use syntactic boundaries to segment messages (such as sentences), we followed the semantic boundary approach to attempt to obtain a more finely grained analysis that more closely reflected the meaning of the phrase or paragraph.

The first coding schema (developed by Veldhuis-Diermanse, 2002) was used to investigate knowledge construction processes (see Appendix 1 for details and examples of indicator phrases). This included four main categories: cognitive activities used to process the learning content and to attain learning goals; metacognitive knowledge and metacognitive skills used to regulate the cognitive activities; affective activities (used to cope with feelings occurring during learning), and miscellaneous (used to score all other units). Our intention was to try to reveal something of the participants' thinking, as expressed in their message contributions, while they were undertaking the collaborative task. This coding schema was used to code units of meaning that we regarded as 'on the task', focusing on the learning processes used to carry out the course assignment. Although some codes of this schema are designed to identify cognitive expressions of the learning processes of individuals, some of the codes are targeted on processes that are social, and occur between individuals. Examples of these types of code include the metacognitive codes used to mark expressive, questioning, explaining, and sharing of ideas. The second schema focuses on units of meaning that are 'around the task'. We have called these tutoring processes and to probe them we adapted another published coding schema (Anderson, Rourke, Garrison & Archer, 2000). This includes three main sub-categories: design and organisation, facilitation of discourse (Lipman, 1991; Scardamalia & Bereiter, 1994) and direct instruction. The work on cognitive apprenticeship by Collins and Brown (1991), Rogoff's (1995) model of apprenticeship in thinking, and Vygotsky's (1978) scaffolding analogies provide some of the theoretical basis for these categories. The intention here was to reveal something of the ways

in which the participants were supporting each other's learning, and learning together, while undertaking the task. The choice of coding schemas is an important one for this type of work. It could be argued that a more 'grounded' approach, using categories that emerge from a reading of the messages, would provide a more 'authentic' summary of the intentions of the participants. In our view this is a valid and important way of approaching the analysis. However, we wanted to connect with some of the conceptual and theoretical ideas about learning and tutoring in the literature using schemas that were already in use, rather than create *de novo* categories. At the same time we hope to be able to share our analyses with colleagues in other contexts by supporting the use of publicly available schemas as a basis for comparison within the research community. Both of these schemas have been used extensively by their originators, and we shall address the comparative aim of our work in future studies.

Critical Event Recall (CER)

This method is a form of 'stimulated' event recall (Interpersonal Process Recall – IPR) to which one of the authors (Lally) was introduced by Jon Scaife at the University of Sheffield (UK). IPR is a process developed by Norman Kagan, commencing at Michigan State University in the early 1960s (Kagan, 1984; Kagan & Kagan, 1991). A broader theoretical and practical overview has been provided by Tuckwell (1980). The basis of IPR, as it was developed by Kagan and others, is the realisation that humans store vast amounts of information, feeling, impressions and ideas about the events, or 'interpersonal processes', in which they have participated. Because of the speed at which human interactions occur much of the detail of these processes is soon 'forgotten', and not available for subsequent reflection. One of the present authors has used IPR extensively to help schoolteachers to analyse the teaching and learning processes occurring among the pupils in their classrooms (Lally & Scaife, 1995). When groups of participants engage in mutual or shared recall of events in which they have been present together they can gain insight into their behaviour and learning processes. In a sensitively guided recall this can be of benefit for the future learning of the group, as well as the individuals within it. The recall enables the articulation of many previously unexpressed aspects of learning.

In networked collaborative learning environments such as the Sheffield E-Learning M.Ed. Programme (University of Sheffield, 2001), students and tutors are working in learning communities with many complex learning interactions occurring simultaneously. The use of the records of these interactions as a stimulus to recall of critical learning events occurring during the programme workshops suggests itself as a way of investigating those aspects

of these processes not actively expressed during the events. We have termed this critical event recall, and adopted two approaches to undertaking it. In the first approach the participant is presented with summary analyses of the group and individual learning events. These give an overview of the patterns of learning and tutoring within the event (as presented in Tables 1–6 of this paper). In the second approach we use the full text of learning events. In both approaches the participant was presented with these items in advance of the recall sessions so that they might familiarise themselves with the summary analyses and full text of the events. In this paper we include the recall event of one participant (the university tutor) using summary analyses and full texts from which he was able to choose what, for him, were the *critical events* of the workshop. In future studies we will present the results for all of the participants.

Results and discussion

Content analysis

The following tables (1–6) give the results of our analyses of individual and group (i.e. total) contributions to the workshop, using the two coding schemas. In the first analysis we coded learning processes, on the basis that we considered these to be the primary processes of the workshop activity. Tables one to three show the units of meaning coded for learning processes for eight individuals, including the tutor (Brian, denoted by * in the tables). This coding represents a sample from three phases of the activity. The total number of messages from the workshop was approximately 1000. Our sample consisted of 10 percent of these messages, spread equally between the beginning, middle and end phases of on-line activity (each phase was a time sample of ten days duration). In a second coding analysis we coded for tutoring processes in the message sample. Tables four to six show the units of meaning coded for tutoring processes for the same individuals during the same time samples.

In this section we would like to offer some analysis of the results of the coding of learning processes (Tables 1–3). Firstly, however, it is important to add a general note of caution about this analysis. Clearly, learning processes are occurring within and between individuals in the group. However, all coding techniques are based on indicator phrases for each of the processes that are coded. We are assuming that the (internal) learning processes are actually represented by the expressions we are coding. This may not always be the case. The problem arises because linguistic expression of thinking is a conscious process in which a person is making active choices based upon

Table 1. Units of meaning coded for learning processes during the beginning phase (note: pseudonyms are used here and in the rest of this paper)

Beginning phase									
Type of learning process	Learning processes of individual community members								
	Bill	Katie	Brian*	Pauline	Andrea	Felicity	Charles	Margaret	Total
Cognitive	0	2	4	1	17	5	11	6	46
Affective	0	2	1	0	4	1	3	0	11
Metacognitive	0	1	1	1	4	3	4	1	15
Miscellaneous	1	0	1	0	2	0	1	0	5
Total	1	5	7	2	27	9	19	7	77

Table 2. Units of meaning coded for learning processes during the middle phase

Middle phase									
Type of learning process	Learning processes of individual community members								
	Bill	Katie	Brian*	Pauline	Andrea	Felicity	Charles	Margaret	Total
Cognitive	5	1	0	7	8	9	14	18	62
Affective	2	0	0	0	0	0	0	1	3
Metacognitive	0	0	0	1	1	2	5	2	11
Miscellaneous	0	0	0	0	0	0	0	1	1
Total	7	1	0	8	9	11	19	22	77

his or her intentions and motivation. What he or she chooses to say may be a more or less accurate account of his or her thinking. This is a limitation of the coding process that must be borne in mind when evaluating the results of coding. Having said this, the codings do seem to suggest some clear patterns,

Table 3. Units of meaning coded for learning processes in the ending phase

Ending phase									
Type of learning process	Learning processes of individual community members								
	Bill	Katie	Brian*	Pauline	Andrea	Felicity	Charles	Margaret	Total
Cognitive	4	0	2	0	6	2	2	3	19
Affective	0	0	1	1	2	0	0	0	4
Metacognitive	2	0	0	0	1	2	2	2	9
Miscellaneous	5	0	1	1	3	2	0	1	13
Total	11	0	4	2	12	6	4	6	45

over the three phases of the activity. In the beginning phase, we coded 42 units of meaning (60 percent of the total), from the expressions of learning processes in the text, as cognitive, and 15 units (20 percent of the total) as metacognitive (Table 1). This is the phase of activity when the task of carrying through a collaborative project, on an aspect of networked learning, is being conceptualised for the first time by the group. Also the coding of affective activity produced highest number of units of meaning in this phase (11 units, or 14 percent of the total). In the middle phase, however, this relationship changes. Units of meaning coded for cognitive activity rise to 62 (81 percent of the total) while units coded for metacognitive and affective processes drop to 11 (14 percent of the total) and 3 (4 percent of the total) respectively. At this point in the workshop, participants are often thinking, and discussing the concepts of the task itself (Table 2). In our sample, this is the phase in which Charles and Margaret were most involved. By the ending phase (Table 3) the units of meaning coding for cognitive processes have dropped back to 19 (42 percent of all units). The affective activity, as indicated by coded units, remains low (4 units or 8.9 percent of the total), but units coding metacognitive processes have risen; in this case to 9 (20 percent of all coded units). Also, coding for miscellaneous discussion has increased considerably, from 1 unit (1.3 percent) in the middle phase, to 13 units (28.8 percent) in this concluding phase. This suggests to us that as the group members complete their project they may be moving away from thinking 'on the task' and starting to discuss other matters that are not directly related to it. At the same time, individual profiles are discernible in these coding values. For example, Andrea is a student participant who makes extensive contributions to learning processes (as represented by the number of coded units) throughout the activity, although at lower levels in the middle phase. Katie, on the other hand, makes very few explicit contributions to any learning process. Charles has been active in both beginning and middle phases but is much less so at the end. Margaret (and Pauline to some extent) make extensive contributions during the middle phase, but much less at other times. Bill, on the other hand, seems to grow in confidence during the learning event, with few explicit contributions in the beginning phase rising to almost 25 percent of all contributions by the ending phase. During this activity the university tutor (Brian) contributes at a low level in the beginning phase; makes no expressed contribution at all in the middle phase, and a low level of contribution at the end of the activity.

In our second coding analysis we focused on attempting to code the text for tutoring processes occurring in the discussions (Tables 4, 5 and 6). In this programme, based upon a learning community of professionals, the activities that we have described as tutoring include: direct instruction, facilitation,

Table 4. Units of meaning coded for tutoring processes in the beginning phase

Beginning phase									
Type of tutoring process	Tutoring processes of individual community members								
	Bill	Katie	Brian*	Pauline	Andrea	Felicity	Charles	Margaret	Total
Direct instruction	0	0	2	2	0	0	0	0	4
Facilitation	1	3	8	1	5	0	5	2	25
Instructional design	2	1	8	4	4	3	8	1	31
Total	3	4	18	7	9	3	13	3	60

Table 5. Units of meaning coded for tutoring processes in the middle phase

Middle phase									
Type of tutoring process	Tutoring processes of individual community members								
	Bill	Katie	Brian*	Pauline	Andrea	Felicity	Charles	Margaret	Total
Direct instruction	0	0	0	0	2	0	0	0	2
Facilitation	3	3	2	4	24	5	6	7	54
Instructional design	2	1	3	2	5	0	1	2	16
Total	5	4	5	6	31	5	7	9	72

and curriculum organisation (see Appendix 2 for details of the schema and examples of indicator phrases). It is important to note that these are not the exclusive domain of the designated (*) university tutor. They are activities used and employed by all members of the group at different times. Our decision to try to probe these processes using a second coding schema was based on our own awareness of the strong interrelationship between 'tutoring' and 'learning' that may occur in such groups, arising from the socio-cultural framework outlined above. It is an important feature of this kind of collaborative on-line work on the E-Learning programme. The results of these tutoring codings are shown in Tables 4–6.

Once again, and within the limitations outlined above, some patterns are discernible. In terms of group totals firstly, the level of units of meaning coded for direct instruction remains at a low level throughout the entire activity. This is not surprising given that the group was engaged in a collaborative activity that drew on members' own professional resources and other material to which they were directed before the activity commenced. Therefore, there was little need for anyone to provide this during the period of work that we analysed. On the other hand, the level of units coded for instructional design in the beginning phase is high, at 31 (51 percent of the total) (Table

Table 6. Units of meaning coded for tutoring processes in the ending phase

Ending phase									
Type of tutoring process	Tutoring processes of individual community members								
	Bill	Katie	Brian*	Pauline	Andrea	Felicity	Charles	Margaret	Total
Direct instruction	0	0	1	0	0	0	0	0	1
Facilitation	4	0	9	1	9	3	2	1	29
Instructional design	3	0	8	1	1	1	1	0	15
Total	7	0	18	2	10	4	3	1	45

4). One interpretation of this is that it may arise from the group's need to help each other to get organised for the activity to come. In the middle phase (Table 5) coding for instructional design decreases to 16 units (22 percent) as coding for facilitation by group members increases from 25 to 54 units (41 percent in the beginning phase to 75 percent in this phase). Coding of units for facilitation continues at a high level into the ending phase, with 29 (64 percent), where instructional design units increases again, with 15 units (33 percent) as the group members plan and prepare to review their work. Brian's contributions (the tutor, denoted by * in the tables) are coded at high levels for tutor processes in the early and ending phases (Table 6), but less so in the middle phase. Some of the students, for example Andrea, make contributions that are coded at high levels for tutor processes. Indeed, Andrea sustains these units in the middle phase when Brian's contributions are relatively low. Margaret shows the same pattern to a lesser extent. The role undertaken by Charles is interesting because his coded tutor contributions are highest in the beginning phase and then decline in the middle phase and remain low in the ending phase. During this change evidence from coded units of his engagement in learning processes remains steady in the beginning and middle phase and decreases at the end. Bill again shows a growth in engagement, whereas Felicity seems to be a stable participant in the workshop as a whole.

Critical event recall interview

The learning and tutoring patterns that have emerged from this coding analysis provide some insights into the dynamics of individual and group behaviour in a virtual professional development environment. Group learning is dependent on the individual contributions. These individuals have different interests, agendas, and abilities in regulating the individual as well the group learning processes. The critical event recall interview with the tutor involved with the guidance of this group may help us understand some of these differ-

ences. The interview with Brian, using all six tables of summary analyses, occupied approximately 45 minutes. Time was spent at the beginning helping Brian to clarify the meaning of the numbers in the tables and the way in which they had been calculated from the coding. The interview was loosely structured, and tended to follow a natural pattern arising from the structure of the six tables we were using. After articulating patterns of individual behaviour, gleaned from the summary tables, he began to recall his impressions, at the time of the event, of the learning and tutoring behaviours of the participants.

Starting with himself, Brian commented that the tables showed him to be much more active at the start and end of the workshop, and much less so in the middle phase:

> That was certainly an active conscious decision. Because I knew that throughout, I had that as a sort of personal policy, to be there at the start and give them the space in the middle, and to come back in the end.
>
> I am not surprised with that because I not only had that personal policy of starting with the profile and ending with a higher profile, but I also had a personal policy of explaining that policy to them as part of my personal philosophy. So I said to them that I'd try to be there at the start to clarify the task and everything, left it to them in the middle and then be here again at the end, talking about 'how was it for you' kind of thing.

These excerpts illustrate the decision he made to be much more visible to the other participants at both the beginning and ending phase of the event, but to withdraw to a large extent in the middle phase of work. He went on to explain his thinking behind this strategy, and how it related to the way in which he wanted to give space to participants to work together and express their own ideas, not dominated by him. This revealed strategic pedagogic thinking about his role as a tutor and facilitator with special responsibilities (he represented the university in the group). It was clearly intended to support the learning processes of other group members, but was not expressed in the discussions of this particular group.

Brian expressed his role as a tutor and facilitator during this recall in two ways. In one way Brian was concerned with the learning process of the group and how to facilitate or mediate that. On the other hand he was constantly aware of the dynamics of the group.

> Of the things I remember, looking back at this, are two things really. One is Charles' role, his sort of 'if you like' behaviour, and the other is trying to contain Charles, from my own perspective, while others had a chance to come in and have their say. Because Charles came forward, he was very strong really, very clear. And I remember thinking 'well it's really

> valuable to have that early sense of direction', but the concern was that the rest of the people would not have a voice.
>
> Now the other strong figure, and possible counter-figure, to it was Andrea; the great thing about her was that she was not only participating, but she was offering help as well, still being supportive and considerate of Charles' view, but offering a wider possibility.
>
> So I remember being particularly grateful that Andrea was there, and feeling at that point that there were two key figures in the group, and that it was these two figures I was (if you like) containing, or just working with and trying to hold and trying to avoid them making any decisions until the rest of the group appeared, because the rest of the group was slower in appearing.

Meanwhile Brian was not contributing much himself, but trying to keep a feeling of where the discussion was going to, ready to facilitate whenever he thought necessary. This is illustrated through the following excerpts:

> The other thing was that I felt that Charles was concerned to get the task done, to get the group on board, and to get everybody active. And as the project went on I was conscious that we weren't really thinking about the processes but acting on completing the thing. Rather than making decisions about a project topic.
>
> I really felt like Andrea was almost doing a holding thing on Charles as well. Saying that, there are other possibilities. With my own message here I was trying to comfort and support Andrea a bit, as she was trying to hold back Charles eagerness and enthusiasm. Partly as a slight counter against Charles strong direction, and again just to buy time for the others to come in.
>
> And although I have had put message in, I was staying as neutral as I could and trying to keep a small footprint on the thing.

As the discussion proceeded Brian felt he needed to act more directly to give the group some more support to help them to learn in this context.

> I was just concerned that we did not have a lot of ideas for the project and that the whole thing might take a lot of time if they were going to succeed in completing it.
>
> I did two things in this thread, if you like. One was to offer a model of how to organize as a group, and the other was to try and summarize all

> that had been said. This one was definitely an attempt to facilitate some progression.

Later on in the project when the group's thoughts and aims were more or less crystallised, Brian decided to withdraw.

> I did not make many comments here compared to the starting phase, because the first phase was the preparatory thing and I was conscious of 'its got to happen and I have to get them there'. By the time it got to this [middle phase] they have taken over, so I was conscious of sitting back.
>
> There were not many things that really caused thought in my mind, as it were. But I was tracking it, like a hawk really, but I was in a more relaxed mode.

This is the point where Brian started to focus more on the dynamics within the group.

> I was beginning to have a slight sense of two groups forming, one was Andrea and Charles, as they were working quite closely together, and the other was Katie and Pauline, in the background, and Bill as well. Bill was trying to attach himself to Charles, I felt. Bill was struggling to find a place where he could contribute and talk.
>
> I was conscious of Pauline supporting Katie at that time. Katie seemed to be someone who was struggling to hang on. They also seemed to become some sort of a subgroup and I was aware of that at the time, maybe Felicity was a member of it. Katie, I felt, was struggling to engage; the others seemed to be talking over her head. So there was a group – Andrea and Charles – who were really cracking on. They talked in models. Margaret also was able to join in that, although she wasn't very 'present'. But Pauline, Katie and Felicity seemed to be more shadowy figures, and Bill too.
>
> Bill approached Charles to say: 'Is this something we could collaborate on?'; Katie expressed, instead, a problem that she was having. This struck me as a similar problem but obtained different responses. Bill was looking for somewhere to make an input. He found a niche in which he could do that, whereas the opposite happened for Katie. She did not try to establish a niche. She just simply said 'I am really struggling', and the response came from Pauline to say 'don't worry'. Andrea gave a more academic response whereas Pauline gave a more emotional response, I felt. It just seemed to be a different level of response, even though Andrea's was

> more comprehensive, Pauline's tone and style seemed to be more useful. Andrea was saying 'I will help you but I am up here doing this clever stuff', (not expressed like that, but sort of the summary of it). Whereas Pauline spoke to her as a person.

After recalling his own behaviour in the group Brian started to elaborate on the behaviours of others. According to Brian, Andrea was a significant participant in the event.

> She was an ever-present person, she had quite a high profile because of her personality, she was generally present in the social area.
>
> And she also discussed her personal on-line tutoring practice. She was already familiar with such a role. So it is not surprising that she took on that role. [In the middle phase, when the tutor withdrew.]
>
> She is very facilitative in all her communications.
>
> She already had a strong model of how these things would play out and so she engaged in it, whereas Bill was struggling to understand it.

Brian realised at the time of the event that Andrea had considerable experience of working in the medium, and was able to recall this from seeing the summaries. He observed her facilitating others in the group, and her relatively high presence in the summaries caused him to comment that this was his strong recollection of the way she worked for much of the time in the 10 week event. She was the biggest contributor of learning-coded messages at the beginning and end of the event, and replaced Brian as the biggest contributor of tutoring-coded messages in the middle phase, when Brian had deliberately withdrawn.

Charles was also very active (especially in the beginning) but seemed to have a strong personal idea about the task.

> Yeah, well, Charles seemed to me very task-oriented. He seemed to be a do-er. He seemed really like he didn't want to think about it or talk about it: 'I have got this idea and I really want to try and implement it together'. And he really struck me as that; he was very active but as soon as it came to the discursive side of it he disappeared.
>
> He is a very procedural person, and he had lots of clear ideas and experiences but he did not want to get into the dialogue overtly, apart from 'how do we get this done?'.

This matches the individual coding patterns for Charles: high involvement in the beginning, to start up the project. Later on, when the community was in 'motion' and started to reflect more on their task, as Brian recalls it, Charles became less involved.

Bill was another participant in the group. According to Brian this way of learning was quite new to Bill.

> My idea is that he was a sort of local person sent to do the course on behalf of the university or whatever; I thought it was a business school. So it would not surprise me that he did not have a clear idea about what to do and how to do it. But he was motivated and interested and talking about it locally. At the end he came in to say: 'right, well, based on that I think this it how it could be used for us locally'. So he was ready to contribute, but did not know how to, in the task.
>
> [In the beginning] Bill was struggling to understand it.

For this reason, according to Brian's recall, Bill's level of participation, as reflected in coding for both learning and tutoring processes, was low. However, as he clarified his own purposes for being involved, Bill's participation increased. He was the second highest participant (by learning units) by the end [having been the lowest at the beginning], and third highest for tutoring units [having been equal lowest at the beginning].

Brian also recalled some of his thinking about the low level of participation of Katie.

> It doesn't surprise me in some time senses, because she had difficult personal circumstances. So that could have contributed to it.
>
> Her model of the experience to come was possibly of a more directive nature, so it was a struggle then to accept a new mind-set, of knowledge being distributed amongst themselves.

Brian also commented on Felicity, another active participant, as measured by units coded for learning processes. He thought she felt more comfortable thinking about the task than providing tutoring support for others. This is also supported by the coding analyses in Tables 1–6.

> It will be interesting to be thinking about her because she was very communicative, good sense of humour and a very willing person.
>
> She seems initially more a little bit like a procedural person. But later on she was ready to engage the reflective activity.
>
> She was quite a strong person but did not dominate.

The recollections presented here indicate that the tutor engaged in many reflective and analytical observations about his own facilitation of the group and the behaviours of individuals within it, yet much of this thinking was not directly observable in the transcripts of the group's work. The teacher was making careful judgements about when and how to intervene based upon his interpretations of the needs and behaviours of individuals, the needs of the group, and his own largely unarticulated (in the group forum) values about the nature and purposes of collaborative learning. In summary, Brian was, as Jones and Asensio have articulated in detail elsewhere (Jones & Asensio, 2002), engaged in a social *process* of actively designing his involvement through his interaction, with a view to enhancing the learning of the group members. He was concerned, it would seem, to maintain balance and integration within the group, assist socially oriented processes of learning and tutoring, and foster collaboration among group members.

Conclusions

This paper has attempted to address some of the complexities of researching networked learning (NL) in a higher education context on both theoretical and empirical levels by linking a theoretical discussion with an example of our recent work. Specifically, we are concerned to illuminate how theory and praxis interact in a range of networked learning environments with a view to enriching both. We describe this interaction as a kind of exploratory conversation between theory and praxis that may be mediated by methodology. We argue that there are several complexities in this endeavour. Firstly, while acknowledging the power of theory as a framework for both pedagogy and research, we suggest that the complexity of praxis in networked collaborative learning environments is such that the models of social-constructivism, situated learning and socio-cultural theory are not, separately, capable of providing an account of the role of meaning making, the function of context or the power of the interaction between tutoring processes and learning processes. We have therefore drawn on all of these frameworks in this account of individual learning and tutoring, that is, we have used them as a means of thinking about the kinds of processes that might form a meaningful focus for our enquiry. Secondly, we acknowledge that the complexity of praxis is such that the empirical work reported here can focus only on a sub-set of the aspects of human agency that are pertinent to a holistic understanding of collaborative educational contexts. In this study we have chosen learning and tutoring processes as the focus of our research because we think that they are central to the pedagogical endeavour (a view informed by the theoretical perspectives upon which we have drawn in this study). However, it is also

clear that richer theoretical descriptions than those we have employed may be required to take account simultaneously of more aspects of agency. For example, we have taken little account of individual and group motivation, although some features of the tutor's motivations are apparent in the CER interview. Thirdly, we argue that the complexity of the tutoring and learning processes that we encountered in the E-Learning MEd are such that a multi-method approach is required to mediate the conversation between theory and praxis. This complexity has been reported in other online programmes (for example Hara et al., 2000). We note that our use of content analysis and CER (using summary analyses as a stimulus), is only one step in the development of a more sophisticated approach to the researching of this complexity across these contexts.

Empirically, this paper reports part of an attempt to study both learning processes and tutoring processes within a group of collaborating professionals in an on-line learning community. We have presented the results of an approach to content analysis of messages exchanged during a single professional development activity of approximately ten weeks duration. This analysis has enabled the tentative identification of patterns of individual and group learning during the activity. It has also allowed us to discern different individual roles in tutoring processes among these professionals (as revealed through coding of units of meaning and a CER interview). We have tentatively attempted to relate these to learning processes. We suggest that these analyses have added to our understanding of tutoring and learning processes by professionals in a learning community within an on-line Master's Programme. They show, for example, how participants may operate quite differently, and yet within discernible patterns, some being strong facilitators, while others offer little support to their collaborators. There are many other implications in terms of differentiated patterns of working that we hope to articulate in future work. Through this approach we contend that it may be possible to gain deeper insights into how professionals collaborate successfully to develop their own practice, and into the complexity of the interactions between individual and group processes during these collaborations.

At the same time, we have indicated that the analysis of such complex interactions in learning communities presents a strong methodological challenge for researchers. The use of coding schemas, for example, is beset with difficulties. Their use to 'code' the messages is an attempt to 'categorise', and to some extent quantify the meanings embedded in the exchanges between participants. However, this is a considerable task. Because the total number of messages was around 1000 we had to 'sample' these in order to make the coding manageable. Hence the exchanges were sampled during the first ten days of the group's work, during the middle

ten days and for a further ten days at the end (the three phases in Tables 1–6). This sampling approach was used in an attempt to retain meaning and coherence over time in the sampled episodes of work. We analysed all the messages in selected threads rather than sampling across all threads. This was important to us because we wanted to look at the development of tutoring and learning processes in the group, over time, as well as at individual totals. We are aware that this approach still fragments the contextual meaning of the coded content to some extent, and further work is required to refine this methodology so that the relations of the coded units to its neighbours in the text can be seen. Furthermore, the coding schemas required to capture the complexity of the activities were necessarily complex in themselves. There was a total of 42 categories and sub-categories. Some passages of text could have been coded using more than one category, because of the multiplicity of meanings that could be inferred from the text. At these points we had to make judgements about this and agree them in 'coding conversations' between the two researchers. Given these difficulties, the use of coding in this way is still only a partial solution to the methodological challenges we identified at the beginning of this paper. Furthermore, coding of discussions in the social space that was created in WebCT, for use during the workshop, was not undertaken. Yet this space was a place where ideas were discussed, and relationships built that supported the group's work in the more formal group space (or forum).

Of course coding provides little insight into a key aspect of the individual and group processes: those that were not expressed in text messages. We have argued for the need to complement coding analyses with several complementary forms of analysis in order to understand more fully the richness of these learning interactions. In this study we have combined coding analysis with critical event recall which is based upon the research of Kagan and others into the stimulation of recall of learning events using video records of those events. The recall episode used here is based on a single recall interview with the tutor in the featured group. Summary content analyses of the texts of the learning event were used a basis for the stimulation of recall of critical events in the work of the group. This was then followed by recall based on the full transcripts of the workshop in which the tutor selected critical episodes upon which to focus his recollections. A significant finding of this study is that recall of important details of the tutor's thinking *at the time* of the original event is possible using summary analyses of this kind. This is enhanced further by the selection of critical events from the full transcripts. The recollections presented here suggest that the tutor engaged in many reflective and analytical observations about his own facilitation of the group and the behaviours of individuals within it, yet much of this thinking was not directly observable in the transcripts of the group's work. The tutor

was making careful judgements about when and how to intervene based upon his interpretations of the needs and behaviours of individuals, the needs of the group, and his own largely unarticulated (in the group forum) values about the nature and purposes of collaborative learning. However these were not all tacit understandings of the processes, as he articulated his design processes to himself, both at the time and subsequently. Critical event recall has the potential to access aspects of learning and tutoring processes that are not directly available in discussion transcripts. Furthermore, this tool can complement content analysis in an important way by using its results to probe 'the thinking behind the text' in collaborative work within learning communities in networked environments. In future studies we will report on the use of critical event recall among all the participants in an online workshop, and on the combination of content analysis, critical event recall and social network analysis (not used in the present study) to the same workshop. The aim of this work is to move towards a more complete understanding of the complexities of praxis in on-line learning communities through a conversation with theory. It is our hope, in this task, to contribute to the development of praxis, and to the enriching of our theoretical and methodological tools. This paper does not report a theoretical synthesis of the frameworks upon which we have drawn. This is a communal endeavour that will require many more conversations.

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Note

1. Actions that result from the deliberate application of theory or are entailed by a particular theoretical structure.

Appendix 1. Veldhuis-Diermanse schema for learning processes coding

Code	Cognitive learning activities
	Debating
CDPF	• A problem, solution or idea is presented. This contribution is followed by an illustration or argumentation "These crops are very suitable for the field. One restriction is that these crops (certainly potatoes) can be grown only once every 4 or more years, because of diseases. It is not good to grow potatoes and sugarbeets in a sequence, either. So they should be separated by another crop."
CDPNF	• A problem, solution or idea is presented. This contribution is *not* followed by an illustration or argumentation "The best research procedure would be watershed level (i + 3) with the use of simple comprehensive methods."
CDAF	• A student does or does not agree with the opinion or idea contributed by another student or author. This viewpoint is followed by a backing, refutation or restriction "I agree that Income Optimization is not an easy term, though I think it's quite right here. A cognitive map only gives an overview of the problems to make things clearer. All influences concerning agriculture will affect the income of the farmers".
CDANF	• A student does or does not agree with the opinion or idea contributed by another student or author. This viewpoint is *not* followed by a backing, refutation or restriction "I like the idea!"
CDAQ	• Asking a content-directed question "In that school the aim is diagnostic testing. What does that mean to the students? Is it not necessary for them to be coached? And what sort of coaching? Are these tests serious?"
	Using external information and experiences
CCEI	• Contributing new information found in other information sources (mentioned or not) than the discourse "Yields according to Wofost when using sowing dates as mentioned in the CIM: potatoes – very high (15,847 kg/acre), winter wheat – low (7,653 kg/acre), sugar beets – very high (14,293 kg/acre)."
CREI	• Referring to information found in other information sources (mentioned or not) than the discourse "I found an interesting site: http://www.sainsbury.co.uk/gm/."
CSEI	• Summarizing or evaluating the information found in other information sources (mentioned or not) than the discourse "Summarizing: A LUT is sustainable if it is ecologically possible, economically viable and socially acceptable. The three characteristics of a LUT distinguished in the article are . . ."
CREE	• Referring to earlier experiences (scholastic or daily)/Referring to outcomes of running a model "In Germany farmers told me that rape seed is grown on fallow fields. The legislation (15% fallow) allows rape seed."
	Linking or repeating internal information
CIL	• Linking facts, ideas or remarks presented in the discourse/Referring explicitly to a contribution in the discourse "I found results similar to those of Eesge and Ries."
CIR	• Repeating information without drawing a conclusion or interpreting that information "In approach 1 land units are derived from extensive soil sampling and Remote Sensing. Four functional layers are distinguished and combined to soil profiles. Two land units are distinguished: one with a mainly sandy texture, one more clayey" (= note 34).

Appendix 1. Continued

Code	Affective learning activities
AM	• General: reacting emotionally to notes of fellow-students, without directly reacting to the content of that note. This reaction can be *positive*, *negative* or *neutral* "It is a very interesting and mainly correct map. . . ."
AA	• Asking for (general) feedback, responses or opinions by fellow-students "What is your opinion about my minor case?"
AC	• 'Chatting' or 'social talks'; contributions that are not relevant to solve the case/task "Anton, Happy birthday!"
	Metacognitive learning activities
	Planning
MPA	• Presenting an approach or procedure to carry out the task "I think we can take the report as point of departure to write our policy note."
MAA	• Asking for an approach or procedure to carry out the task "I read a lot of articles, but I do not know if it was useful. Summarized: it is non-organic and better to the milieu. It is possible to acquire it synthetically, but it can also be found in nature. Is this wasting time or shall I search for more information?"
MEA	• Explaining or summarizing the approach already adopted "After reading the article 'Dewey's Problem' I went back to my notes on the online document given above. There are several comments that Dewey makes there that bear on CSILE, and I thought that I would share them. I'll post my thoughts on the article separately."
	Keeping clarity
MSD	• Structuring the contributions in the database "I think note 45 is related strongly to note 67 and 89. So, I replaced the note."
MAC	• Asking for an explanation, clarification or illustration as a reaction to a certain note "I don't understand how you are able to discriminate sandy and clayey soil from the CESAR image. Can you explain how to do that?"
MGE	• Explaining unclear information in notes; answering a question asked by another participant "Legislation and the farming policy have a positive influence on the problem of leaching. That is what is meant with the +."
	Monitoring
MKW	• Monitoring the original planning, aim etc. "It is very unclear to me. What is the aim of this course? What do have we to do?"
MRP	• Reflecting on one' s own actions or on certain contributions to the database "I notice some confusion about the meaning of + and – in the cognitive map."
	Rest activities
RNE	• Units that cannot be decoded by using the categories above "*$#@%#&#@. My computer crashed again and I was just going to save my note! I will stop, tomorrow try again . . ."

Source: Veldhuis-Diermanse (2002)

Appendix 2. Anderson Schema for tutoring processes coding

Instructional design and organization	
Indicators	*Examples*
• Setting curriculum	• "This week we will be discussing . . ."
• Designing methods	• "I am going to divide you into groups, and you will debate . . ."
• Establishing time parameters	• "Please post a message by Friday . . ."
• Utilizing medium effectively	• "Try to address issues that others have raised when you post"
• Establishing netiquette	• "Keep your messages short"
• Making macro-level comments about course content	• "This discussion is intended to give you a broad set of tools/skills which you will be able to use in deciding when and how to use different research techniques"
Facilitating discourse	
Indicators	*Examples*
• Identifying areas of agreement/ disagreement	• "Joe, Mary has provided a compelling counter-example to your hypothesis. Would you care to respond?"
• Seeking to reach consensus/ understanding	• "I think Joe and Mary are saying essentially the same thing"
• Encouraging, acknowledging, or reinforcing student contributions	• "Thank you for your insightful comments"
• Setting climate for learning	• "Don't feel self-conscious about thinking out loud on the forum. This is a place to try out ideas after all
• Drawing in participants, prompting discussion	• "Any thoughts on this issue?"
• Assess the efficacy of the process	• "I think we're getting a little of track here"
Direct instruction	
Indicators	*Examples*
• Present content/questions	• "Bates says . . . what do you think"
• Focus the discussion on specific issues	• "I think that's a dead end. I would ask you to consider . . ."
• Summarize the discussion	• "The original question was . . . Joe said . . . Mary said . . . We concluded that. . . . We still haven't addressed"
• Confirm understanding through assessment and explanatory feedback	• "You're close, but you didn't account for . . . this is important because"
• Diagnose misconceptions	• "Remember, Bates is speaking from an administrative perspective, so be careful when you say . . ."
• Inject knowledge from diverse sources, e.g., textbook, articles, internet, personal experiences	• "I was at a conference with Bates once, and he said . . . You can find the proceedings from the conference at http://www . . ."
• Responding to technical concerns	• "If you want to include a hyperlink in your message, you have to . . ."

Source: Anderson et al. (2000)

References

Anderson, T., Rourke, L., Garrison, D.R., & Archer, W. (2000). *Assessing Teaching Presence in a Computer Conference Context*. Retrieved 27/3/01, 2001, from the World Wide Web: http://www.atl.ualberta.ca/cmc/publications.html

Barrett, E. & Lally, V. (1999). Gender differences in an on-line learning environment. *Journal of Computer Assisted Learning* 15: 48–60.

Boekaerts, M. & Simons, P.R.J. (1995). *Leren en instructie: Psychologie van de leerling en het leerproces* [*Learning and Instruction: Psychology of the Learner and His Learning Process*]. Assen: Dekker & Van de Vegt.

Brown, J.S., Collins, A. & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher* 18(1): 32–42.

Chi, M.T.H. (1997). Quantifying qualitative analyses of verbal data: A practical guide. *Journal of the Learning Sciences* 6: 271–313.

Collins, A. & Brown, J.S. (1991). Cognitive apprenticeship: Making things visible. *American Educator* 15(3): 38–46.

Collinson, G., Elbaum, B., Haavind, S. & Tinker, R. (2000). *Facilitating Online Learning: Effective Strategies for Moderators*. Madison: Atwood.

Creswell, J. (1998). *Qualitative Inquiry and Research Design: Choosing Among Five Traditions*. London: Sage.

CSCL (2002). *Computer Support for Collaborative Learning: Foundations for a CSCL Community*. Retrieved 27/2/02, 2002, from the World Wide Web: http://newmedia.colorado.edu/cscl/

De Laat, M. (2002). Network and Content Analysis in an Online Community Discourse. In S. Banks, P. Goodyear, V. Hodgson & D. McConnell, eds, *Networked Learning 2002: A Research Based Conference on E-Learning in Higher Education and Lifelong Learning*, pp. 218–226. Sheffield: Lancaster University and University of Sheffield.

De Laat, M., De Jong, F. & Simons, R.-J. (2001). *Supporting Self Regulation of Learning Activities in Online Communities of Practice (poster paper)*. Paper presented at the First European Conference on Computer Supported Collaborative Learning, Maastricht, Netherlands.

De Laat, M., De Jong, F. & Ter Huurne, J. (2000, June 26). *Supporting a Community of Practice: The Role of Workers as Learners*. Paper presented at the Ed-Media, Montreal, Canada.

Dillenbourg, P., ed. (1999). *Collaborative Learning: Cognitive and Computational Approaches*. Amsterdam: Pergamon.

Duffy, T.M. & Jonassen, D.H. (1992). Constructivism: New implications for instructional technology. In T.M. Duffy & D.H. Jonassen, eds, *Constructivism and the Technology of Instruction: A Conversation*. New Jersey: Lawrence Erlbaum Associates.

Elliott, J. (2001). Making evidence-based practice educational. *British Educational Research Journal* 27(5): 555–574.

Ericsson, K.A. & Simon, H.A. (1984). *Protocol Analyses: Verbal Reports as Data*. Cambridge MA: The MIT Press.

Gartner, A. & Riessman, F. (2000). *Peer-Tutoring: Toward a New Model*. Retrieved, 2000, from the World Wide Web: http://www.educationplanet.com.

Goldstein, L.S. (1999). The relational zone: The role of caring relationships in the co-construction of mind. *American Educational Research Journal* 36(3): 647–673.

Goodyear, P. (1999). Pedagogical frameworks and action research in open and distance learning. *European Journal of Open and Distance Learning*. Retrieved 01/09, 2002, from the World Wide Web: http://www1.nks.no/eurodl/shoen/goodyear/index.html

Goodyear, G. (2001). *Online Learning and Teaching in the Arts and Humanities: Reflecting on Purposes and Design*. 2001 HAN Conference: Online Conferencing in the Arts and Humanities. Retrieved 01/09, 2002, from the World Wide Web: http://iet.open.ac.uk/research/herg/han/2001conf.htm

Halverson, C.A. (2002). Activity theory and distributed cognition: Or what does CSCW need to DO with theories? *Computer Supported Cooperative Work* 11: 243–267.

Hara, N., Bonk, C.J. & Angeli, C. (2000). Content analysis of online discussion in an applied educational psychology course. *Instructional Science* 28(2): 115–152.

Hartley, K. & Bendixen, L.D. (2001). Educational research in the Internet age: Examining the role of individual characteristics. *Educational Researcher* 30(9): 22–26.

Henri, F. (1992). Computer conferencing and content analysis. In A.R. Kaye, ed., *Collaborative Learning Through Computer Conferencing: The Najaden Papers*, pp. 117–136. London: Springer Verlag.

Jones, C. & Asensio, M. (2002). Designs for Networked learning: A phenomenographic investigation of practitioners' accounts of design. In C. Steeples & C. Jones, eds, *Networked Learning: Perspectives and Issues*, pp. 253–278. London: Springer Verlag.

Jones, C. & Cawood, J. (1998). *The Unreliable Transcript, Contingent Technology and Informal Practice in Asynchronous Learning Networks*. Paper presented at the Networked Lifelong Learning Conference: innovative approaches to education and training through the Internet, Sheffield, U.K.

Kagan, N. (1984). Interpersonal process recall: basic methods and recent research. In D. Larsen, ed., *Teaching Psychological Skills*, pp. 229–244. Monterey, California: Brooks Cole.

Kagan, N. & Kagan, H. (1991). IPR – a research/training model. In P.N. Dewrick, ed., *Practical Guide to Using Video in the Behavioural Sciences*. Canada: Wiley.

Koschmann, T. (1999). *Toward a Dialogic Theory of Learning: Bakhtin's Contribution to Understanding Learning in Settings of Collaboration*. Paper presented at the CSCL1999, Palo Alto.

Lally, V. & De Laat, M. (2002). Cracking the code: Learning to collaborate and collaborating to learn in a networked environment. In G. Stahl, ed., *Computer Support for Collaborative Learning*, pp. 160–168. Hillsdale, New Jersey: Lawrence Elrbaum.

Lally, V. & Scaife, J.A. (1995). Towards a collaborative approach to teacher empowerment. *British Educational Research Journal* 21(3): 323–338.

Lally, V.E. & Barrett, E. (1999). Building a learning community on-line: Towards socio-academic interaction. *Research Papers in Education* 14(2): 147–163.

Lave, J. (1988). *Cognition in Practice*. Cambridge: Cambridge University Press.

Lave, J. (1996). Teaching, as learning, in practice. *Mind, Culture, and Activity* 3(3): 149–164.

Lave, J. & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.

Lehtinen, E., Hakkarainen, K., Lipponen, L., Rahikainen, M. & Muukkonen, H. (1999). *Computer Supported Collaborative Learning: A Review*. CL-Net Project. Retrieved August 17, 1999, from the World Wide Web: http://www.kas.utu.fi/clnet/clnetreport.html

Levine, J.M., Resnick, L.B. & Higgins, E.T. (1996). Social foundations of cognition. *Annual Review of Psychology* 44: 585–612.

Lipman, M. (1991). *Thinking in Education*. Cambridge: Cambridge University Press.

Mann, S.J. (2003). A personal inquiry into an experience of adult learning on-line. *Instructional Science* 31(1–2): 111–125 (this volume).

McConnell, D. (2000). *Implementing Computer Supported Cooperative Learning* (2nd edn.). London: Kogan Page.

Moll, L.C., Tapia, J. & Whitmore, K.P. (1993). Living Knowledge: The social distribution of cultural resources for thinking. In G. Salomon, ed., *Distributed Cognitions: Psychological and Educational Considerations*, pp. 139–163. Cambridge: Cambridge University Press.

Niven, J., Harris, R.A. & Williams, D. (2002). Motivation to use online learning communities: A methodological outline. In S. Banks, P. Goodyear, V. Hodgson & D. McConnell, eds, *Networked Learning 2002: A Research Based Conference on E-Learning in Higher Education and Lifelong Learning*, pp. 474–480. Lancaster and Sheffield: Lancaster University and University of Sheffield UK.

Paavola, S., Lipponen, L. & Hakkarainen, K. (2002). Epistemological foundations for CSCL: A comparison of three models of innovative knowledge communities. In G. Stahl, ed., *Computer Support for Collaborative Learning: Foundations for a CSCL Community*, pp. 24–32. New Jersey, USA: Lawrence Erlbaum Associates.

Popping, R. (2000). *Computer Assisted Text Analysis*. London: Sage.

Qualitative Solutions and Research (1999). *QSR NUD∗IST Vivo (NVivo)* (Version 1.1). London: Sage.

Resnick, L.B. (1991). Shared cognition: Thinking as social practice. In L.B. Resnick, J.M. Levine & S.D. Teasley, eds, *Perspectives on Socially Shared Cognition*, pp. 1–20. Arlington VA: American Psychological Association.

Rogoff, B. (1995). *Apprenticeship in Thinking*. New York: Cambridge University Press.

Salomon, G. & Perkins, D.N. (1998). Individual and social aspects of learning. *Review of Research in Education* 23: 1–24.

Scardamalia, M. & Bereiter, C. (1994). Computer support for knowledge building communities. *Journal of the Learning Sciences* 3(3): 265–283.

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher* 27(2): 4–13.

Smith, J.B. (1994). *Collective Intelligence in Computer-Based Collaboration*. New Jersey: Lawrence Erlbaum Associates.

Sotto, E. (1996). The self-evident nature of teaching. *Innovations in Education and Training International* 33(3): 203–209.

Stahl, G., ed. (2002). *Computer Support for Collaborative Learning: Foundations for a CSCL Community*. Hillsdale New Jersey: Lawrence Erlbaum.

Stenhouse, L. (1983). *Authority, Education and Emancipation*. London: Heinemann.

Taylor, C. (1992). *Sources of the Self: The Making of the Modern Identity*. Cambridge: Cambridge University Press.

Tuckwell, N.B. (1980). *Stimulated Recall: Theoretical Perspectives and Practical and Technical Considerations* (Occasional Paper Series 8-2-3). Alberta, Canada: Centre for Research in Teaching.

University of Sheffield (2001). *MEd in E-Learning (formerly Networked Collaborative Learning)* [Web Site]. School of Education. Retrieved 31/07/01, from the World Wide Web: http://www.shef.ac.uk/uni/projects/csnl/medindex.htm

Van Boxtel, C., Van der Linden, J. & Kanselaar, G. (2000). Collaborative learning tasks and the elaboration of conceptual knowledge. *Learning and Instruction* 10(4): 311–330.

Veldhuis-Diermanse, A.E. (2002). *CSCLearning? Participation, Learning Activities and Knowledge Construction in Computer-Supported Collaborative Learning in Higher*

Education. Unpublished Ph.D. thesis, Wageningen, Netherlands: University of Wageningen.

Vygotsky, L.S. (1962). *Thought and Language* (E.H.a.G. Vakar, trans.). Cambridge, MA: MIT Press.

Vygotsky, L.S. (1978). *Mind in Society: The Development of Higher Psychological Processes* (V.J.-S.M. Cole, S. Scribner & E. Souberman, trans.). Cambridge MA: Harvard University Press.

Wegerif, R., Mercer, N. & Dawes, L. (1999). From social interaction to individual reasoning: An empirical investigation of a possible socio-cultural model of cognitive development. *Learning and Instruction* 9(6): 493–516.

Wertsch, J.V. (1991). A sociocultural approach to socially shared cognition. In L.B. Resnick, J.M. Levine & S.D. Teasley, eds, *Perspectives on Socially Shared Cognition*, pp. 85–100. Arlington VA: American Psychological Association.

Young, M.F., Depalma, A. & Garrett, S. (2002). Situations, interaction, process and affordances: An ecological psychology perspective. *Instructional Science* 30(1): 47–63.