Cracking the Code: Learning to Collaborate and Collaborating to Learn in a Networked Environment

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ABSTRACT

This paper is based on the central idea that networked teaching may best be improved by those engaged in it. Systematic enquiry into educational interactions can yield understandings and insights about one of the fundamental relationships of all educational endeavours: between teaching and learning. The paper explores this relationship through analyses of teaching and learning in a networked collaborative learning environment using two new content analysis schemas. The first of these probes the social co-construction of knowledge in a collaborative online event by analysing the social, cognitive and metacognitive contributions to an online learning event. In the second schema the presence of teacher processes is investigated. Computer assisted qualitative data analysis is used for this. In conclusion, consideration is given to the prospects for this type of approach as a means of enriching understandings of the complexity of the relationship between teaching and learning in networked collaborative learning environments.

Keywords
Social constructivism, content analysis, collaborative teaching and learning, on-line tutoring

INTRODUCTION

The central idea in this paper is that networked teaching may best be improved by those engaged in it. This is based upon the premise that systematic enquiry into educational interactions can yield understandings and insights about one of the central relationships of all educational endeavours: between teaching and learning. Unless teachers make rich links between their teaching 'acts' and students' learning it is difficult for them to improve their own teaching in order to improve learning. This is not a new idea. It is self-evident in some senses: teachers will naturally claim responsibility if their students are successful in examinations. In their attribution, their teaching acts have brought about learning in their students - as measured by the output, examination performance. This may be a rather bold and unhelpful assertion. Firstly it is a very general one; 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 teaching. Nor does it provide any systematic basis for communicating the effective and efficient aspects of practice to others. Secondly it takes no pro-active account of the different needs of students; it gives no insight into what it was about the teaching that produced 'good' measurable learning outcomes in some of the students, nor what happened to students who didn't demonstrate these outcomes. Thirdly it equates learning with assessable outcomes, in a way that limits the understanding of learning to the data provided by the output measurement instrument. Learning as an ongoing set of processes, happening in time and space, within an individual and groups, does not feature in detail in this general analysis. Fourthly it makes no connection with learning theories or, if it does it, it is with personal and usually tacit understandings about learning held by the individual teacher. In summary, the main problem with this self evident linking of teaching and learning is that it is un-evidenced, overlooks the diversity of students' learning needs and processes, and generates relatively little localised insight into what works and what doesn't. Sotto (Sotto, 1996) has argued this point very cogently: that good teaching in higher education is far from self-evident, and that its connection to students' learning is complex, both in terms of learning outcomes at the end of a teaching and learning event (lecture seminar or whatever) and learning processes occurring during that event.

ANALYSING NETWORKED TEACHING AND LEARNING

The networked environment provides the teacher with some new opportunities to understand the nature of teaching and its many and complex links with learning. As the text remains available to the teacher and the students, after the primary interactions between them have moved on, it is a resource that can be used as part of an attempt by the teacher or the students to understand the nature of the teaching and learning that have taken place. The challenge, when looking back at messages exchanged between students and teachers in a networked collaborative learning environment, is to understand what Popping (Popping, 2000) has called the world of 'meanings, values and norms' which are 'invisible' to a casual observer. In a teaching and learning context, then, it's more than trying to understand what was said about whatever subject was under discussion between the learners and the teacher. It is about trying to understand the social and cognitive processes of knowledge and meaning construction occurring between and within individuals and the group. An important educational aim of attempting content analysis in order to develop these understandings is broadly the same as for Action Research in any context: to help improve the quality of the situation, in this case the learners' learning and the teacher's teaching. In the case of this type of content analysis, the understandings created about the social and cognitive processes

occurring can be used: for the immediate benefit of present learners in the context, that is, to use specific understandings to make immediate (and probably relatively small scale) improvements to some aspects of the situation; for the benefit of future learners in the context, by making more general improvements to aspects of the situation (perhaps structural).

The major challenge facing the teacher is how to attempt an analysis of messages, to understand the implications of this analysis for teaching and learning, and then to act upon the situation in order to improve it for the learners, as well as for her or himself. Tools for analysing communication patterns have been developed in several disciplines, (for example applied linguistics), but are generally based upon analysis of large bodies of text (corpora) and involve relatively cumbersome methods. They are not designed for Action Research use in the immediacy of particular teaching and learning situations. Furthermore, they are not designed to analyse dynamic, ongoing social situations where knowledge is actively being co-constructed by the participants. In the next section we will describe our coding schemas and the rationale for our choice. This is followed by a description of the educational context on which we have drawn for the analyses presented here.

THEORETICAL BASIS OF LEARNING, TEACHING AND CONTENT ANALYSIS

In previous work (Barrett and Lally, 1999; De Laat, De Jong and Ter Huurne, 2000; De Laat, De Jong and Simons, 2001; Lally, 2001; Lally and Barrett, 1999) we have explored a range of aspects of collaborative learning and begun to develop analytical frameworks in order to understand the complex teaching and learning processes that are occurring. In the analysis presented in this paper we are interested in gaining insight into collaborative knowledge construction and teacher presence in a collaborative learning environment through the use of two compatible coding schemas. The students featured here were following a Master's Programme in Networked Collaborative Learning (see below for details). Our analysis is based upon work conducted by students and a tutor in the first workshop of this programme. Here we were particularly interested to explore the relationship between knowledge construction and teacher presence as these evolved over time within the workshop. Previously we have used Henri's approach to content analysis (Henri, 1989; 1992) using categories that focus on the social activity and the interactivity of individuals in a group at the same time as giving a picture of the cognitive and meta-cognitive processes of those individuals. However, one of its major limitations is that it gives us no impression of the social co-construction of knowledge by the group of individuals as a group, in a discussion or a seminar. We have also attempted to address this limitation using a schema proposed by Gunawardena et al. (1997), with some success. Influenced principally by the work of Vygotsky (1962; 1978) (although see Gillen, 2000 for a critique of the fashionableness of this process) many authors (for example: Goldstein, 1999; Lave, 1988; Lave, 1996; Lave & Wenger, 1991; Salomon & Perkins, 1998), in attempting to define cognition in groups (group mediated cognition or gmc), have suggested 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. The merger of intellectual and social processes may be a fundamental feature of group mediated cognition. A second 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 the group. This tension is the driving force for the collective processing of the group. So, for example, when an individual member of the group expresses her opinion in relation to the shared public understanding of the group, this will be based on an attempt to synthesise her own understanding with the public one. The other members of the group will 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 process interaction between individuals, as well as their shared and individual cognitions, are the key aspects of co-construction of knowledge, meaning and understanding.

We have premised our present analysis on this 'social-constructivist' view of learning: learners linking new knowledge to their prior knowledge- i.e. learning as a cumulative process: learners constructing new internal representations of the information being presented (Boekaerts & Simons, 1995). Learning is a process by which the learner personalizes new information by giving meaning to it, based upon earlier experiences. Meaning is seen as rooted in, and indexed by experience (Brown, et al., 1989). 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 as situated in the activity in which it takes place (Brown, et al. 1989; Lave & Wenger, 1991). 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. They point out that learning cannot be understood as a process that is solely in the mind of the learner (Van Boxtel, 2000). Knowledge is constructed in settings of joint activity (Koschmann, 2000). 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 emphasizes 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 Networked Collaborative Learning featured in this paper (see McConnell, 2000 for a much more detailed exploration of collaborative learning). In addition, Lethinen et al. (1999) argues 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 & Biemans, 2000). In a setting of collaborative learning, students can criticize 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. Social-constructivist collaborative learning is a powerful educational method to realise academic goals. In the MEd programme the tutor acts as in three important ways: to design the curriculum and the environment, in outline; to facilitate discourse among participants, and to provide some direct instruction related to the topics under discussion. However, it is important to acknowledge that these roles may also be undertaken by the students in this course environment. In networked learning settings we see that learners become tutors and that tutors become learners (Gartner & Riessman, 2000). Their roles interact and change over time. The original role of the teacher moves from a central position towards a guide on the side, fostering an online learning culture in which participants take charge of their own learning (Collison, 2000).

In order to probe collaborative knowledge construction and teacher presence in this learning environment we used two new coding schemas. The first, modified from Veldhuis-Diermanse and Biemans (2000) was used to investigate group knowledge construction. This included four main categories. The first is cognitive activities (thinking activities) students use to process the learning content and to attain their learning goals. The category 'cognitive activities' consists of three subcategories: (1) debating, (2) using external information and experiences and (3) linking or repeating internal information. The second category is metacognitive activities: metacognition refers to metacognitive knowledge as well as to metacognitive skills. Metacognitive knowledge can be defined as knowledge concerning one's own cognitive processes and products or anything related to them. Metacognitive skills concern the extent to which students can regulate their cognitive activities and, therefore, their own learning process. These skills are essential to successful learning because they enable individuals to manage their cognitive skills, and to determine problems that can be solved by applying other cognitive skills. The third category is affective activities. These are used to cope with feelings occurring during learning and can lead to a state of mind influencing the learning process positively, negatively or neutrally (Vermunt, 1992). The final category, miscellaneous, was used to score all other units. This category includes social talk as well as units that can not be coded according to one of the other categories. The second schema, adapted from Anderson and Rourke et al. (2000), is used to probe teacher presence. This includes three main sub-categories. The first, design and organization, refers to the construction of the processes, structures, evaluation and interaction components of the course. The second, facilitating discourse, refers to the maintenance of interest, motivation and engagement of students in active learning. The term discourse is used, rather than discussion, to highlight the focused and sustained deliberation that marks learning in a community of inquiry (Lipman, 1991) or as Scardamalia and Bereiter (1994) refer to it, the knowledge-building community. The third sub-category is direct instruction. This refers to the teacher's provision of intellectual and scholarly leadership and the sharing of subject matter knowledge with students. Davie (1989) describes this as the ability to set and communicate the intellectual climate of the course or seminar, and model the qualities of a scholar. The teacher communicates content knowledge that is enhanced by the teacher's personal interest, excitement and in-depth understanding of the content. The cognitive apprenticeship model espoused by Collins & Brown (1991), Rogoff's (1995) model of apprenticeship in thinking or Vygotsky's (1978) scaffolding analogies illustrate an assistive role for teachers in providing instructional support to students from their position of greater content knowledge.

COMPUTER ASSISTANCE FOR CONTENT ANALYSIS

In the process of analysing teaching and learning situations in a networked collaborative learning environment, messages from a learning event need to be coded and analysed. The central purpose of coding is to extract, generalise and abstract from the complexity of the original data in order to find significant themes and develop theories about the situation that illuminate it. This is a delicate 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. Bearing these dangers in mind, we decided to use computer assisted data analysis software (CAQDAS). The main advantages of such an approach include: partial automation of the coding process, with increased speed of coding; a wider range of ways to search, recode and interrogate the coded data (in this case messages), including visual coding and more sophisticated coding at 'nodes' - this allows instantaneous access to all the text coded for a particular category; the possibility to code creatively, that is, to develop new codes, and re-code, in response to the patterns in the coded data as they emerge (a grounded approach). A helpful account of some of the issues around the use of CAQDAS have been provided by Barry (Barry, 1998). One powerful package which we have found suitable for coding networked collaborative learning interactions is QSR NUD*IST Vivo (NVivo) (Qualitative Solutions and Research, 1999). This package offers powerful tools for coding and interpretation of coded conferences and events from on-line situations. The messages can easily be imported directly into NVivo for coding, and nodes created from any categories used for coding. A very useful overview of the use of NVivo in this type of work is provided by Richards (Richards, 1999).

THE MASTER'S PROGRAMME IN NETWORKED COLLABORATIVE LEARNING

The MEd in Networked Collaborative Learning by action research is an advanced part-time programme designed to provide participants with a comprehensive grounding in the theory and application of networked teaching and learning. The programme focuses on learning about information and communication technologies; designing online learning; developing learning communities; and working with online groups of collaborative learners. The MEd programme is suitable for a wide variety of professional people who wish to develop their understanding of, and expertise in, this form of learning. Current participants include: professional trainers and developers, self employed or in public and private sector organizations; teachers and lecturers in Further, Higher and Open Education; adult continuing educators; people working in libraries and resource centers; open and distance learning educators and developers. 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. In brief, the workshop structure is:

Year One

Workshop One (4 months online): An Introduction to Online Learning

Workshop Two (4 months online): Networked Learning and Computer Supported Cooperative Work

Workshop Three (4 months on-line): The Internet as a Learning Environment

Year Two

Workshop Four (3 months on-line): Designing for Research and Evaluation

*Workshop Five (9 months online): Research Dissertation*

RESULTS

Figures 1 to 4 show the results of coding three samples from one learning set of workshop one of the MEd. In this analysis we have attempted to reveal the social co-construction of knowledge in a set of threaded discussions undertaken by a sophisticated group of adult learners. At the same time, we have also tried to reveal the teaching processes that may be supporting this co-construction. In attempting to make sense of this analysis it is important to understand the pedagogical context of their work. The participants collaborated for approximately 10 weeks in order to construct a group project around an aspect of networked learning. It is this collaboration that forms the focus of the analysis presented here. The overall structure of the activity was predetermined by the course tutor team, and published in the WebCT group space well in advance of the commencement of the activity. The group had previously spent approximately one month together in the online space, engaged in a set of activities designed to support the establishment and development of the research learning community. The project work followed on from this process. Each learning 'set' or sub-community was assigned a tutor. The three tutors shared a common approach, with an agreement to some variation according to the tutor's own views and style of working. The approach consisted of supporting and facilitating the group's work, and providing some knowledge input when appropriate, according to the tutor's own expertise and interests. In many respects the tutor undertook to behave as a participant in the group, rather than as a leader or more traditional instructor. Therefore, there is little evidence of direct instruction by either the tutor, or other participants, in any of the discussions featured in this analysis. This is typical of the 'style' of teaching espoused by the course tutor team for the course as a whole. In all cases we coded units of meaning with either the appropriate subcategory of the learning schema or the teaching schema. These were used exclusively. The collaborative project of this set consisted of approximately 1000 messages. Our sample, at the beginning, middle and end of this discussion consists of approximately 10 per cent of that total.

Figure One. Early Phase of Discussions (x axis = days; y axis = percentage of all coded units of meaning)

*Learning (After Veldhuis-Diermanse & Biemans, 2000)*
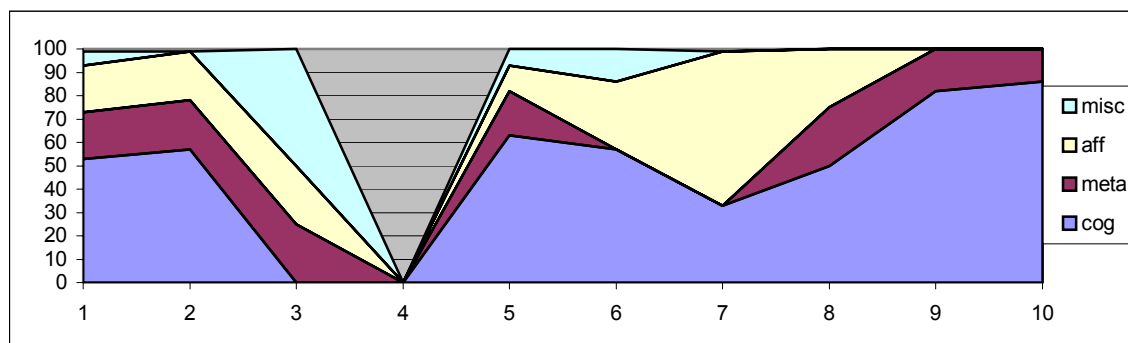
Teaching (After Anderson, et al.,2000)
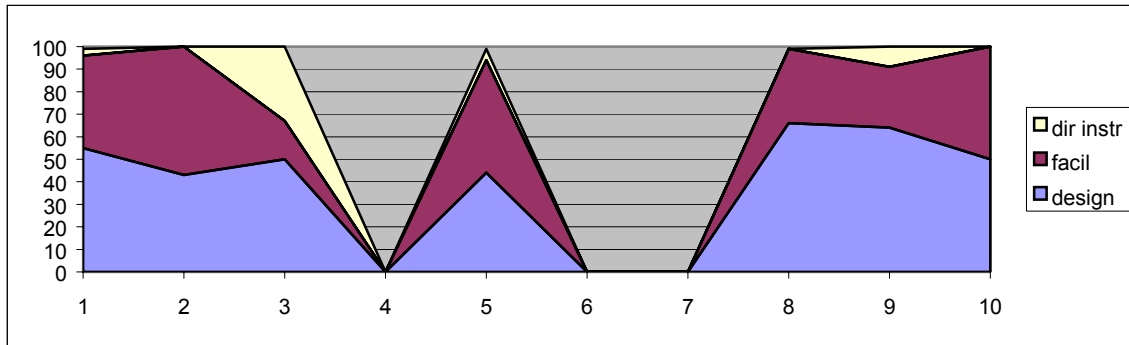
The first sample of discussion threads occurs in the early phase of the group collaborative project (figure 1 and 30-10 to 9-11 in figure 4). At this point the students were formulating their project, with the aid of the tutor, and agreeing procedures to facilitate their work together. The main features of this phase of group activities include a high level of cognitive activity, as indicated using the learning schema to code the interactions. This activity is in a ratio of approximately 3.3:1 with metacognitive activity. There are two discernible peaks in learning activity. These coincide with peaks in teaching activity. Much of the teaching has been coded as design and organization discussion, together with facilitation. The simultaneous peaking of the teaching and learning discussion within the group indicates a strong linkage between these two types of processes. There is little direct instruction taking place in the group's deliberations.

Figure Two. Middle Phase of Discussions (x axis = days; y axis = percentage of all coded units of meaning)

Learning (After Veldhuis-Diermanse &Biemans, 2000)
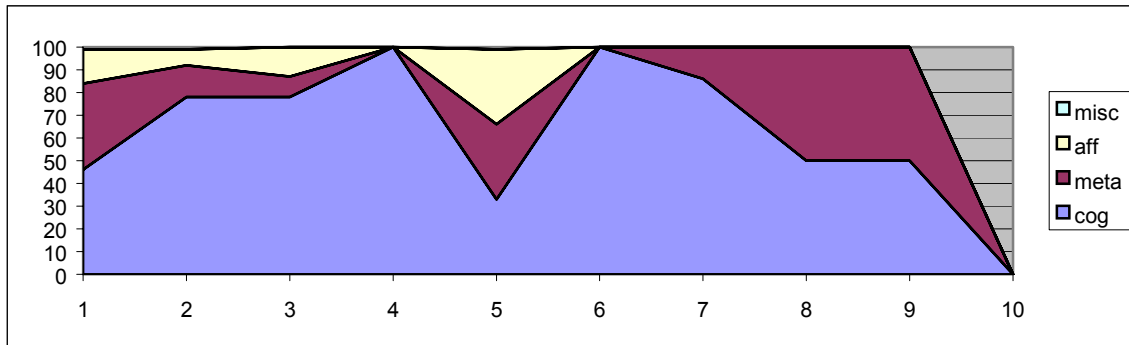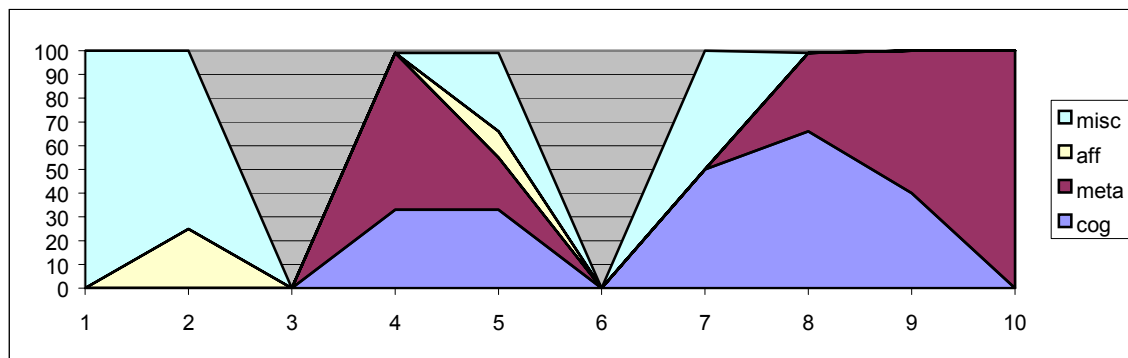

Teaching *(After Anderson, et al.,2000)*
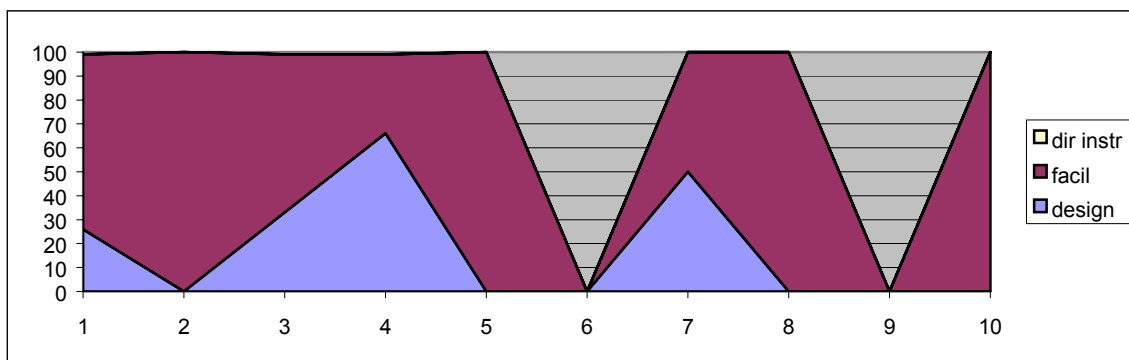
In the second sample of threads (figure 2 and 5-12 to 11-12 in figure 4) the students were well advanced with the development and compilation of their collaborative project. The level of cognitive activity is raised further as a proportion of all learning sub-categories, compared to the early threads (70 per cent compared to 60 per cent in the early threads). This corresponds to a relative reduction in affective activity from 16 per cent to 10 per cent, suggesting that social and motivational comments offered to one another by group members have reduced as their working relationship becomes established and they focus more on the task in hand. Metacognitive activity shows little change overall (18 per cent in the early phase and 20 per cent in the middle phase) and its ratio to cognitive activity stays quite constant at 3.5:1. It is interesting to note that within teaching activity there has been a major shift of emphasis. In the early phase 50 per cent of

the teaching activity was coded as design and organization, and 35 per cent was facilitation. In the middle phase the design and organisation has decreased to 25 per cent and facilitation to 75 per cent. This is compatible with the notion that much of the organizational arrangements have been made for the project, and the students and tutor are now helping each other to discuss and explore the project as they work. There is one large peak of learning activity, occurring early in this phase (around 6-12). Once again we see this peak at the same time as the peak in teaching activity, as with the early phase thread sample. This underscores the linkage in time already identified between learning and teaching aspects of the discussions observed in the early phase.

Figure Three. Concluding Phase of Discussions (x axis = days; y axis = percentage of all coded units of meaning)

Learning (After Veldhuise-Diermanse & Biemans, 2000)

*Teaching* (After Anderson, et al., 2000)
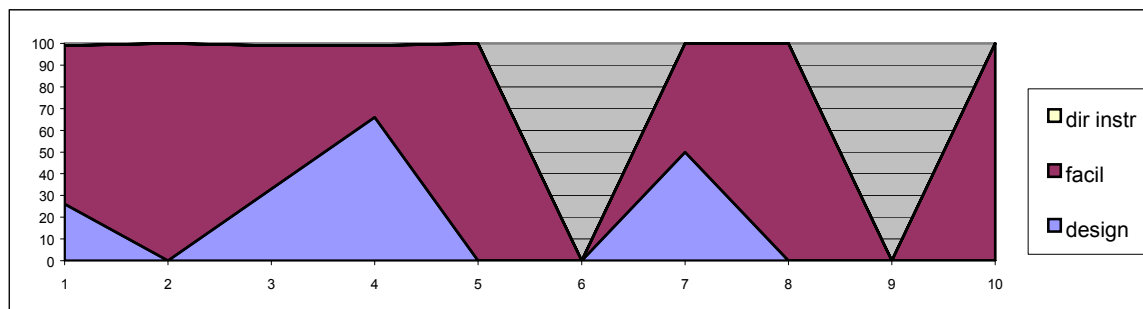
In the third (concluding) sample of threads (figure 3 and 29-12 to 14-1 of figure 4) the project work is drawing to a close and students, together with their tutor, are reflecting on the process and discussing their preparations for the presentation of their work to the other groups. Within the learning discussions, the balance between cognitive and metacognitive activity has shifted to a ratio of 1.9:1 (42 per cent of cognitive activity and 22 percent of metacognitive activity), as a result of an overall decrease in cognitive discussion. At the same time, the level of metacognitive discussion has stayed almost constant. Affective discussion is at a similar level to the middle phase (10 per cent), with miscellaneous discussion activity appearing in this phase to replace, to some extent, the cognitive discussions. Within the teaching activity there is still a strong emphasis on facilitation (65 per cent). However, this has reduced from the middle phase, with a concomitant small increase in design and organization as the students think about their presentation to the other groups. Once again we see an alignment, in time, between the learning and teaching activity within the group, but with some notable differences. There are three peaks of activity (3-1, 9-1 and 13-1). All of the learning peaks are aligned, in time, with peaks for teaching. One noticeable difference in the learning peaks, when compared to earlier patterns, is that in the first peak the maximum cognitive and metacognitive levels coincide. However, in the second smaller peak the raised level of metacognitive activity precedes the cognitive activity. In the third learning peak there is raised cognitive activity, but this is not associated with a rise in metacognitive discussion.

In our view, some clear patterns have emerged from our analysis. Using two coding schemas, for teaching and learning, and coding contributions to the discussion over time, has enabled us to interrogate the complex relationship between these processes within a group. The most striking feature of the discussions in the group is that, within the discernible peaks of discussion activity, high levels of learning and teaching are co-incident in time. This is a clear pattern that can be seen throughout the samples of the three phases of activity. While it is not possible to describe this relationship as causal, the analysis does indicate a strong linkage of these two types of activity within the group as a whole. At this level the analysis does not enable us to identify whether some individuals are acting in a teacherly way while others are learning. This will be probed in future analyses. However, the pattern is consistent and deserves further attention to attempt to understand the

nature and significance of the interaction in more detail. Further patterns are identifiable. The levels of cognitive activity throughout the discussions are in the order of two to three times higher than for metacognitive activity.

Figure Four. Learning and teaching interaction (x axis = days; y axis = percentage of all coded units of meaning)
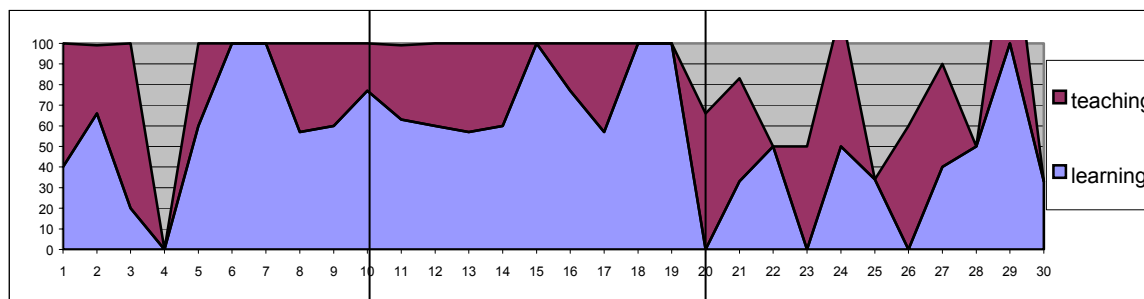
Yet peaks in both types of activity occur together. This suggests to us that regulative activities, of the types indicated by the metacognitive learning categories we have used, are associated with discussions about the topic, and may be a necessary part of increased levels of cognitive activity associated with this. Once again, it is not possible to see the partitioning of these functions between group members at the level of analysis we have employed. We shall undertake this as part of further work. In one case, in the concluding phase, the metacognitive peak precedes the cognitive one, rather than being co-incident with it in time. This suggests that metacognitive 'regulatory' processes may play a different role in relation to the more 'subject-focused' cognitive discussions, depending on the overall stage or context of the work being undertaken. Furthermore, the nature of teaching activity changes within the group over time. In the early phase of discussions there is a relatively high level of design and organisation as the group prepares for the task. As the task proceeds this is replaced by facilitation of discussion that continues for the remainder of the work. At the same time, as the task is concluded the levels of cognitive activity decrease, while the level of metacognitive discsussion remains constant.

DISCUSSION AND CONCLUSIONS

The aim of this paper is to explore the relationship between teaching and learning in a networked collaborative learning environment. For this purpose we used two new content analysis schemas. The first of these probes the social co-construction of knowledge (learning) in a collaborative online event by analysing the affective, cognitive and metacognitive contributions to the event. In the second schema, the presence of teacher processes (teaching) is revealed and discriminated using sub-categories for design and organisation, facilitation of discussion, and direct instruction (after Anderson et. al., 2000). In each of these analyses we employed a range of linguistic indicators for the types of activity we were coding. These have not been presented in this paper for reasons of space, but are available in Anderson et. al. (2000), and Veldhuis-Diermanse and Biemans (2000).

These analyses begin to reveal the detail of the processes occurring as a group works to construct new knowledge and understanding over time. Furthermore they indicate that high levels of teacher functions are occurring as this construction proceeds, and seem to be interacting with it in regular, discernible but complex ways. Regulation of cognitive activity is revealed to be an ongoing process, often but not always co-incident with it, indicating the possibility of more than one mode of interaction between cognitive and metacognitive processes. All of these functions are undertaken by many of the participants in the group. There is no strong indication that the tutor is initiating these processes within this discussion. However, further and more detailed analysis will be required to explore the precise nature of the tutor's role as a participant within the group. The triggering mechanisms for peaks of activity remain to be identified, as does the process by which these become magnified within the group into high levels of learning and teaching.

These analyses, using two compatible coding schemas and allied to a computer assisted approach to coding, have enabled us to characterise a substantial collaborative learning and teaching event within the MEd. in Networked Collaborative Learning. However, many questions still remain to be answered. We have not looked in detail at the correlations between learning and teaching processes and learning outcomes. The group featured in this analysis was a high functioning group that created a substantial report of high quality. There was good participation by all members of the group. In this sense the processes illuminated in this paper represent those of a high achieving group collaborating on an extended project. The group members were contributing both learning and teaching activity to the group processes. Our analysis does not feature the nature of individual processes within the group. It is not possible, therefore, to elucidate the interactions between the individual as a learning entity and the group as another learning entity. This will have to wait for future analysis, and is part of our ongoing project to fully analyse the nature of all of the learning and teaching interactions occurring within a collaborating group. A further limitation of our analysis is that it is based only on those processes that are articulated by group members. Processes that are not articulated may be having an effect on the explicit processes, but they are hidden from direct analysis. In order to understand these processes we shall, in future investigations, use stimulated recall by

participants at significant points in the development of the expressed processes. With this data it may then be possible to relate the hidden processes in the event to those that we can see expressed on the screen.

The title of this paper reflects our concern to 'crack the code' of learning and teaching processes occurring in real, complex events in collaborative online education. Our analysis reveals a complexity and time-related development of these processes that can be correlated with the structure of the educational task and the skills required by group members to address it successfully. We are optimistic that the approach we have described and used here will enable us to probe a range of different events and understand the processes revealed in ways that can yield insights that may be of value to online educators in many contexts. We shall report this work in further papers in due course.

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