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Investigating processes of social knowledge construction in online environments

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Abstract: On-line forums provide opportunity and potential for collaborative work, dialogue and study that can increase the flexibility of learning while motivating participants. By enabling teacher-learner and learner-learner interaction online systems can support the essential elements of a learning conversation by providing scope for discussion, dialogue and interaction. It is argued that this medium presents a socio-cognitive educational domain, unique in its potential for dialogue, participation and collaboration and a departure from face-to-face didactic paradigms of learning. Often, the types of verbal interactions and the means by which new knowledge is created on-line are not well understood. The paper provides frameworks for tertiary teachers and moderators of computer conferences that can be applied to the analysis of processes and activities that occur in text-based conferencing.

Learning on-line: Social aspects of knowledge construction

Theories of social learning emphasise that learning involves social processes and the use of tools. There is much common ground between sociocultural theory (Vygotsky), situated learning theory and cognitive apprenticeship theories (Brown, Collins & Duguid, 1989). All theories emphasise that use of tools, both tangible and intangible including language and technologies shape thought and action. Research on computer conferencing has been positive about its potential and outcomes, promoting its advantages and merits as a form of socio-cognitive experience. However, it may be best to adopt a more skeptical and critical view and to question whether the advantages of computer conferencing may be exaggerated. While online forums claim to enrich student learning and collaboration, many researchers have dedicated their effort to ascertaining whether in fact text-based interaction leads to learning outcomes (Hammond, 1999; McConnell & Banck, 1998; Hara, Bonk & Angeli, 2000; McKinnon & Aylward, 2000). Recently, online forums have been lauded because of their capacity to sustain collaborative learning by enabling sharing of views, resources and ideas through peer support. It is claimed that the social, interpersonal and interactive features of online forums are most supportive of collaborative dialogue, as they reduce isolation and increase group participation in learning.

From the perspective of assessing student learning, it is important to establish how knowledge construction is achieved within a computer conference, and how text-based interaction achieves learning outcomes. By conducting an analysis of the dynamics of on-line forum discussion, it is possible to understand the depth of inquiry, the quality of dialogue and outcomes of interactions and to build on these aspects in order to improve the design of conferencing activity.

Context of the study

The final year students in the Interactive Multimedia course at Edith Cowan University are required to develop skills and expertise in project management. A unit of study on project management is delivered on-line using WebCT software, and is available on-campus and in the distance mode of study. Students learn about project management methods (such as needs analysis, design specifications, storyboards, concept maps, evaluation, legal issues, quality auditing, scheduling and costing) and put them to practice by creating a web site in project teams. The objective of the team project is to promote team and client collaboration skills by focussing on a common task.

Students are continuously assessed throughout the duration of the one semester unit. The assessment consists of project team-based work, task-team work, peer assessment, individual reflective reports, a client mark and individual postings to a weekly forum. Participation in the conferencing task is continuously assessed throughout the semester. The task team assessment requires the team to publish a short summary paper on the bulletin boards at the beginning of the week on an aspect of project management such as team dynamics, legal issues, scheduling etc. and to raise issues for discussion. The task team is also responsible for moderating the discussion during the week and then providing a synopsis at the end of the week. Usually students assume roles within the forum so that each team member participates in a task such as production of a short outline/issues paper discussion moderation or synopsis and summary.

Students are assessed on bulletin board contributions which account for 30% of their total mark. Participation in the forum is compulsory. There is little intervention by tutors in the discussion forum except to provide explanations and procedural information when required. Students are left to develop a discussion which is relevant to the assigned topic and the forum is therefore truly "student centred". The structure of the weekly contributions and roles of team members do not vary, and each week there is a forum leader, questioner and summariser of information.

Investigative Questions

The focus of the research was to evaluate the educational potential of the forum by investigating the quality of interactions that occurred. Specifically, the aim was to investigate:

- the nature of the text-based interactions and whether the contributions were educationally valid and led to
- knowledge-construction processes or merely social interchanges;
- the nature of group information processing and group dynamics
- whether students regarded the discussion forum as a serious learning tool.

The primary objective of the research was therefore to analyse the value of the discussion forum for knowledge construction, to refine the assessment instrument used by tutors, and to assess the activities planned for the forum. A further goal was to go beyond the superficial counting of utterances and quantitative analysis of messages to a deeper understanding of communication and learning processes on-line. The need for more research in this area is becoming more urgent as off-campus modes of delivery utilise computer conferencing and several Web-based course support systems provide functionalities that enable discussion between learners. Up to now the adoption of computer conferencing has flourished despite the paucity of research and theory on which to base its contribution to knowledge development in learners.

Linking on-line discussion to learning

The on-line forum developed for Project Management is an asynchronous learning environment in which group collaboration takes place through the mediation of technology. The participants in the on-line forum in the first semester 1999 could be regarded as a community of adult learners. Some learners had extensive practical experience in project management for interactive multimedia. Others were relative novices. The aim of the forum was to provide a constructivist learning environment where participants could share knowledge, discuss ideas and contribute to each other's understandings of important issues in the management of multimedia development.

In reviewing literature relevant to this unique community of on-line learners, a socio-constructivist perspective seemed most appropriate. The socio-cultural approach to learning requires close examination of the contexts in which the learning occurs, and is illustrated in the work of a number of practitioners and researchers (Aviv & Gola, 1997; Bonk & Sugar, 1998; Gunawardena, Lowe & Anderson, 1997; Laurillard 1995). A social-constructivist approach to learning is also reflected in the words of Säljö (1994: 91) who states that '... it is important to consider seriously the role of communication and interaction for learning, and to employ analytical perspectives in which the natural habitat for individual action is shared human activity'. Analytic approaches consistent with this focus on communication and interaction are linked to socio-cultural theory.

Approaches to the analysis of on-line talk

Recently, there have been several attempts made to provide an analysis of 'cybertalk', though examination of the transcripts of text-based discussions (Eastmond, 1995; Gudzial, 1998; Jarvela et al, 1999; Salmon, 2000). At the same time there is well-documented evidence of strongly opposing views as to how talk should be treated as evidence of learning and of thought (Edwards & Westgate, 1994). Among the approaches to talk-analysis which have contributed to our understanding of classrooms there are several: sociolinguistic, ethnographic, conversation analysis, systematic observation, and interaction analysis, each with a distinctive array of analytic procedures and conventions for setting out transcripts of data, drawing inferences and analysing cognitive processes.

Originating with Flanders (1970), interaction analysis describes and categorises various forms of instructional practice that take place between teachers and students where there is a teaching-learning speech transaction. Such categories tend to be prescriptive and narrowly defined, reflecting static rather than dynamic patterns of interaction. All categories are *a priori*, and assigned to the talk by observers who systematically record occurrences. As the categories are predetermined, this seriously restricts observation of behaviours, as only those categories defined in the observation schedule are recorded. Other studies have used variations of the coding process. A recent study of peer interaction during collaborative writing with computers (Kumpulainen, 1996) used a system of analysis which classified linguistic utterances according to the functions displayed. In a study of the development of scientific reasoning, Azmitia & Montgomery (1993) used a coding scheme to quantify features of scientific reasoning which included justifying solutions, evaluating, clarifying, questioning and explaining. This research, like that of Nastasi & Clements (1992) was based on the Piagetian concept of cognitive conflict, which related success in problem solving to the degree of conflict or verbal disagreement that arises among peers. The data analysis procedures were nevertheless of interest to the present study as they highlighted the role that dialogue and transaction played in supporting reasoning and testing of ideas which are outcomes expected of tertiary students. A related approach to data analysis is content analysis (Henri, 1992), which highlights critical dimensions of the learning process and conducts an analysis on a multilevel basis, assigning behaviours to different features of the learning process. Henri developed a content analysis model based on four dimensions, relating to the educational quality of messages. Four dimensions were proposed for transactions: social, interactive, metacognitive, cognitive. A further dimension relating to the analysis was a quantitative dimension, to reflect the total number of messages posted by one person, as an indicator of the level of participation. Henri's method of analysis has been elaborated and transformed by Gunawardena, Lowe and Anderson, (1997) who propose a social constructivist approach to knowledge building in on-line environments. Their analytic model proposes that knowledge construction moves through five phases (1) sharing ideas (2) discovering different perspectives (3) Co-construction of knowledge (4) Testing and revision of ideas (5) metacognitive awareness of newly constructed knowledge.

Methodology

The study used a combination of research instruments and approaches. The researchers conducted a transcript analysis using the text-based interactions of the weekly forum and created a survey instrument which elicited students' views. This approach enabled triangulation of data sources and provided multifaceted analytic tools with which to analyse the dynamics and processes of on-line discussion.

Survey

The survey instrument consisted of two sections each with a number of Likert scale questions. Part one focussed on the knowledge creation aspects of the forum (Table 2) and asked students to rate the value of the forum in terms of its relevance, opportunities for collaboration, reflection, discussion, exposure to new ideas and understanding. Part two of the survey asked students whether the forum supported group work, collaboration, feedback and collective goals.

Table 2: Summary of survey instrument dimensions

Knowledge building questions Group work questions

• Topics discussed were relevant	• The forum assists group work skills
• There were opportunities to deal with original topics	• There is commitment to group discussion
• WE can develop novel views and ideas	• There is a need for the forum
• There is opportunity to consider many perspectives	• There is scope for in depth discussion
• The forum fosters reflection	• The forum supports sharing of ideas
• There is opportunity for integration of new knowledge	• The forum gives opportunities for team work
• The forum increases my understanding	• The group acknowledges contributions

Transcript analysis

The analysis of the forum transcripts consisted of a number of procedures. In the first stage of analysis, the overall pattern of talk was reconstructed by means of a concept map showing the flow of interactions, and the number of postings that each thread attracted from students. This visual approach enabled the researchers to make sense of the data. The second stage of analysis involved assigning each message to one of the phases of the model. Discrepancies were discussed and an agreement on coding was concluded from these discussions.

Table 4: Summary of content of the messages in weeks 4, 5 and 6

Categories for data analysis	week 4 *n=94	week 5 n=97	week 6 n=56
Phase 1: Sharing & Comparing • statements of observation, examples and descriptions	68	63	37
Phase 2: Discovery and exploration of difference • Questions, clarifying statements, identifying different views	18	22	12
Phase 3: Negotiation of meaning and co-construction of knowledge • Negotiation, identification of common ground, joint meaning making, statements of compromise	6	9	5
Phase 4: Testing and revision of ideas • Testing of ideas, hypotheses etc against personal knowledge	3	3	2
Phase 5: Awareness of newly constructed knowledge • Metacognitive statements, reflection, summarisation of agreement	0	0	1

*n= number of statements in this category

Results

Because of the amount and complexity of data in each of the weekly discussions, it was decided to investigate only a portion of the whole corpus and to analyse three consecutive weeks of the forum discussions. Weeks 3, 4 and 5 were selected for content analysis, and the researchers assigned each message in one of five categories. Table 4 shows the total number of messages posted for each of these weeks and the number of messages in each phase. The results indicate that most of the forum messages were in the first category of *comparing* and *sharing information*. These interactions were forms of social interchange between group participants. There was little evidence of construction of new knowledge, critical analysis of ideas or instances of negotiation. Instead, it could be concluded that the majority of on-line interactions were related to the elaboration of existing beliefs and knowledge (Table 4). This exchange of information consolidated participants' existing knowledge schemata and therefore performed an important aspect of the learning experience. However, while this kind of activity added little to the knowledge base, it nevertheless offered a forum for display of existing knowledge. The forum did not appear to foster testing and revision of ideas and negotiation of meaning. Table 4 shows that only 1%-3% of contributions could be categorised as knowledge testing and awareness of knowledge building.

Student perceptions of the discussion forum

The responses to the survey instrument were tabulated and displayed using descriptive statistics. The survey instrument provided insight into learners' perceptions of the knowledge construction opportunities and group work processes. The survey instrument was designed to determine learner perceptions of the conferencing experience, and to explore student attitudes to the dimensions of knowledge building and support for group work in the forum. The results of the questionnaire were every positive, showing that students found the discussions relevant, engaging, a source of new ideas and capable of increasing understanding. However, the quality of the on-line interactions showed that the majority of exchanges did not contribute to new understandings or to revision, challenging of ideas and reflection. With respect to group work, students perceived the forum as affording opportunities for group discussion, clarifying ideas, team work and group feedback. The open-ended questions showed that students considered the process very time-consuming, but appreciated its capacity as a communication tool.

Discussion

The analysis of data gathered from the transcripts showed that participants engaged in display of knowledge, comparison of ideas and elaboration of personal knowledge. The processes underlying these exchanges were social and participatory, and did not involve learners in conflict, challenging or revision of ideas. According to constructivist theory, knowledge building involves learners in negotiation of meaning, reasoning and reflection on authentic tasks and engagement in conversation where knowledge is revised (Luarillard, 1995). These processes were not evident in the dialogue, although student perceptions of the discussion forum showed that they were positive and committed to group processes. The forum was supportive of group dialogue, social cohesion and sharing of ideas, and for many learners these aspects of on-line dialogue consolidated their understanding and were regarded positively. The fact that this pattern of interaction characterised the discussion forum for the entire duration of the course may have conditioned participants to engage in surface level processing and display of knowledge. The dominant social transactions and protocols that occurred can be classified as communication, negotiation and consolidation. This findings concur with those of Jehng, (1997), who emphasises that psycho-social messages tend to dominate in online forums and that virtual groups tend towards social and collaborative interactions.

Implications for practice

The study provides evidence that if forum discussions are to become knowledge construction events, we need to provide orientation and support to learners to help them engage in critical analysis of their own views and revision of concepts in the light of multiple viewpoints and disconfirming evidence. This can be achieved by the tutor modeling the kinds of processes that aim at inquiry into concepts, rather than display and comparison of existing ideas. It would also require students to learn how to articulate their current understandings and misconceptions. However, this process is constrained by the need to socially edit one's contribution in order to appear 'correct' and to maintain the illusion of being knowledgeable. Affective concerns in relation to computer conferencing should also be considered, as social constraints operate to constrain open inquiry and construction of new ideas, particularly if all contributions are being assessed. Group moderation, task design and the scaffolding of dialogue towards refining, defending and elaborating ideas is essential if participants are to move beyond display of ideas.

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