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Support for Asynchronous Interaction in Group Experiential Learning

Abstract

To be relevant to the constantly changing work patterns of the real world, effective learning in universities often occurs in small groups facilitated by collaborative environments where participants are dynamically involved in purposeful activities. The research described in this paper is an investigation of purposeful group work devised for experiential learning where a variety of socio-technical tools were used to support asynchronous tasks and communication among the learners. In order to explore the complexity of this collaborative activity a distinctive inductive research approach has been adopted using reflective developmental methods. The data collection and the analysis part of the research involved the reflection of participants on their activity being requested as reports within their course work. Student reports were subject to content analysis using a computer-based tool that creates a conceptual map of collections of documents comparing the ratings and relationships of concepts among different sets of participants. The study was enhanced by the use of Q-methodology that allows the participants to outline their views and to make individual decisions on the relative importance that they place upon the available views of the larger group. Concepts from Activity Theory allowed the researchers to take a holistic contextual approach both to the design of the research and the interpretation of the findings to make some sense of the complexity of the dynamic work-learning dialectic in a socio-technical collaborative setting.

Introduction

The research described in this paper is concerned with group learning facilitated by collaborative environments where participants are dynamically involved in purposeful activities. The research is motivated by the belief that collective purposeful activity in small groups is frequently the site for emergent learning, creativity and innovation (Hasan & Crawford 2003). Moreover, such groups are most effective when they are given the opportunity to be self-directed, flexible and adaptive, enabled by suitable collaborative tools and a supportive environment (Warne et al 2002). There is growing recognition that a better understanding of this phenomenon has the potential to improve the performance of business and government organisations facing the challenges of constant and dynamic change in an increasingly networked world.

This is however a complex, multifaceted phenomenon incorporating social and technical factors that are context dependent and therefore difficult to study in isolation. In order to explore the complexity of collaborative activity, in a modern technologically-supported setting, a distinctive inductive research ap-

proach has been adopted, consistent with the principles of the Cultural Historical Activity Theory, which involves reflective developmental methods that will be described and justified as appropriate for this type of investigation.

Background to the Study

The explosive development of the World Wide Web and electronic networks over the past decade has seen corresponding growth in the use and study of web based collaborative activity systems, often generically referred to as web based groupware or Computer Supported Cooperative Work (CSCW) applications. The main purpose of these systems is to allow people with shared interests, tasks or purpose to co-operate towards shared objectives across dimensions such as time and space (Mueller-Prothmann & Siendentopf, 2003).

Just as the object of collaborative activity within groups varies so to does the functionality that such systems provide to support these efforts. Education is seen as one key activity in which web-based groupware can provide both educators and learners with collaborative activity environments that can potentially stimulate and enhance active learning processes through the provision of

- Support for the delivery, sharing and manipulation of information
- Communication facilities (email, real time chat, electronic bulletin boards etc) to encourage and support communication and collaboration between participants regardless of constraints such as time and space
- Tools that enhance and support student creativity and initiative

The potential benefits are not only limited to distance-education context but can also extend traditional classroom based learning environments by providing alternative communication, collaboration and co-ordination channels for participants (McClelland, 2001). The use of such groupware applications has been shown to be especially beneficial in courses where a high degree of collaborative activity is required between both instructors and students and especially among students themselves (Parikh & Verma, 2002).

There are a substantial number of studies into the characteristics and viability of online communities. These studies typically focus on sustainability as well as on comparisons between the ability of members to accomplish tasks online, as opposed to offline. The issues that are of significance in these types of studies are various aspects of technical facilities and capabilities, the differences between the effectiveness of synchronous versus asynchronous communication, as well as social attributes such as identity, trust and awareness in the online environment. Research into online learning has recognised how the frustration of students with the technology inhibits the learning process (Renzi & Klobas 2002). On a more positive note current work on the use of asynchronous learning networks, has shown the value of threaded online discussion where students have time to consider their responses to the conversation which encourages them to collect and evaluate knowledge and create their own learning strategies (Caverly & Macdonald 2002). These authors describe how online asynchronous threaded discussions, create a group orientation where individuals help each other reach goals, are productive because of the think-time students are given and the inherent cooperative grouping, encourage students to invest energy to support each other and have a high value to achieve and create positive interpersonal relationships as group members engage each other for assistance. This also has an advantage for the researchers in that their discussion is visible to them.

Other research into groupware has had as its primary focus the issue of usability, with

evaluation of the success of an application, in terms of its acceptance and use, defined in terms of 'ease of use' (navigation etc) (eg Brown, 2002, Mueller-Prothmann & Siedentopf, 2003). The 'tightness of fit' between type and level of activity and the environment provided, however, is at least, equally important in terms of technology acceptance.

Collaborative activity systems in a learning environment, or any other context, is not limited to the technologies that mediate this process, but also incorporate the individuals that use them and the social context in which they operate. As has been widely documented, collaborative experiences are heavily affected by the individual socialisation of its participants and the organisational cultures in which it takes place. Gender, ethnicity, class and education are just a few of the variables that impact on the collaborative experience (Rogers & Belloti, 1997: Venkatesh & Morris, 2000).

In order to extend this body of research, this paper will focus on what constitutes the most appropriate mix of elements, and forms of environment, the nature of tools and functionality for web based educational groupware that are valued in the activity of learning in group space. In this study the participants undertook purposeful collective activities and were exposed to several collaborative environments (applications). As part of this developmental activity they were asked to critically reflect on their experience from an informed perspective. They were also allowed to identify what they found to be the 'best features' of collaborative activity systems in an educational environment based on their experience.

Research Method and Approach

In order to conduct this research, a multidisciplinary, holistic approach is adopted using a developmental work research (DWR) approach (Engestrom 1987), where communities of learning and practice are viewed as activity systems (Virkkunen & Kuutti 2000). DWR provides a dynamic framework that can accommodate a multifaceted analysis of the community members, their motives and purpose for belonging, their relationships within the community and the tools that mediate collective activity. Development research is disciplined investigation conducted in the context of the development of a product or program for the purpose of improving either the thing being developed or the developer. It is therefore ideal for this investigation as it is both contextual and evolutionary, where a prototype model is constructed, used with the target group, which is observed and questioned before the prototype is revised. The developmental approach implies that the modelling aspect of the research will be evolutionary, incorporating a growing understanding of the concepts of the cases. In our research, the focus of study incorporates technology together with social and learning processes and discipline is imposed on our investigation by the analysis of each case as an activity system, undergoing expansive learning cycles, in the manner of Engestrom (1987).

In an activity system the unit of analysis is the work activity itself, which is culturally and historically located. Engestrom (1987), who first applied the theory to workplace learning, shows that the work activity system is comprised of the following components:

- the purpose to which members of the community direct their activity
- individual workers/learners, their colleagues and co-workers/learners
- the conceptual models, tools and equipment they use, and
- the rules, culture and context that govern how they work, and learn through their work

In DWR/Activity Theory, all of these elements are analysed together as a unified and dynamic whole. A key feature of the DWR approach is that activity is mediated both by tools from the particular culture and setting and by the less visible social mediators of work activity. The holistic nature of Cultural-Historical Activity Theory allows us to consider learning and doing as an integrated whole.

Research into collaborative activity has been undertaken in a variety of settings ranging from the artificial laboratory situations examined by social psychologists and the real world studies by sociologists and anthropologists to the theoretical approach taken by game theory economists (Rumage 1998). While the findings have been as diverse as their approaches, they tend to converge in identifying a number of common requirements for collaboration to take place. As summarised by Rumage (ibid), these include the need for

- Communication between those co-operating
- The establishment of shared understanding and goals between those co-operating
- A benefit (material or otherwise) that is likely to be gained by the participants
- Awareness by participants of others' actions, thoughts, and feelings

Laboratory based research into groupware has traditionally faced a series of difficult problems due to the many social factors that impact on its use and acceptance. Organisational culture, differences in the personalities of participants, and group dynamics, are just some factors that combine to make the understanding of group interaction a 'wicked problem' and one not easily simulated nor assessed in a laboratory environment (Fitzpatrick 1997). In addition, the use of artificial scenarios employed in the evaluation of such systems typically fail to secure the effective commitment of participants. Beyond feelings of altruism towards the testers, participants have no real incentive to fully explore the potential of the system (Rumage 1998). Finally, the snapshot exposure of participants to the applications do not provide participants with sufficient experience to make adequate assessment of what tools and functions are available to them, and how they may be used in an active collaborative process. As a result traditional experimental and laboratory methods that remove software from its context result in simplistic findings that do not generalise well to real world situations.

For these reasons we have deliberately chosen a more ethnographical approach to the study's design which allowed for the organic formation of groups, placing the participants in a real-world situation in which they had an actual incentive to collaborate, allowing them a reasonable period of time in which to both familiarise themselves with the applications and develop their own co-operative structures and conventions. How work was divided and how the applications were to be used was left to the discretion of the participants themselves.

The Design of the Collaborative Learning Study

The Participants and their Activities

The participants in the study were 34 post-graduate students enrolled in an Information Systems course unit entitled "Critical Issues in Information Systems", comprised of an ethically heterogeneous mix of 19 males and 15 females. As post-graduate information system students, all participants had a high level of experience, in using a range of computer software and familiarity with a range of web applications, although only a few had had direct experience in using groupware applications. The study commenced during the second week of the unit and lasted for its duration (a total of 13 weeks).

The course unit included as assessable material four assignments, of which three were

group work and the fourth was an individual assignment reflecting on their experience to be submitted using the designated application. In total these assignments would constitute 50% of their final mark, providing a real incentive for all participants to fully and creatively use the system. The first three assignments were identical to those used in the unit in previous years (avoiding the possibility of leading the participants in any particular direction). These were three phases of a task where students had to find, summarise and visualise trends in the Information Systems literature over the past five years. These assignments were ideally suited to the study, requiring students to negotiate the division of labour within assignments (necessitating communication and co-ordination of activities), and the generation of artefacts (documents and a database) over a period of time through the participation of the entire group (co-operation). The final grade for each student included a substantial emphasis on the quality of the reports of their experience and their insights into the way the groupware tool had influenced the outcome of their work activity.

Students were encouraged to use their groupware application in their collaborative effort as they deemed fit towards the completion of these assignments though no formal directives were issued in this regard. It was explained to the participants that in order to document their experience in using the system, the researcher team would periodically inspect their groupware workspaces. Participants were also encouraged to keep a diary detailing their personal collaborative experience.

In the introductory group meeting the class was instructed to organise themselves into groups of no more than 4 people, which resulted in the formation of 9 groups, 7 with 4 members each and 2 with 3 members. Each group was then allocated an application and a two-hour introductory tutorial was provided to each group on its structure and functionality. From this point forward, although their use of the system was periodically audited by the research group, students co-ordinated their work for the period of the study without the intervention from the research team.

The Applications

The four applications used in the study were WebCT, Yahoo Groups, Groove, and Unilinks. In selecting the applications, the researchers were faced with two sets of constraints. The first was financial (ie the absences of funds) limiting the project to applications that were either already available within the University (WebCT), freely available (Yahoo and the preview edition of Groove), or whose use was possible with the agreement of the developers (Unilinks).

Some of the services provided by each groupware application supporting both the task and teamwork functions of the collaboration process are listed in Table 1. There were significant differences between the functionality, usability and sophistication of each tool as well as the experience of the students in using the tool. However the students all had a bachelor's degree in Information Systems and were deemed to have the skills to quickly appropriate each tool to a reasonable level of use.

Secondly, each application had to support at least in some way both the taskwork (creation, modification or management of artefacts) and teamwork activities that comprise the 'mechanism of collaboration' (Gutwin & Greenberg, 2000). These include

- Communication (e.g,. email, chat, audio, forums)
- Co-ordination (e.g., organisation of actions and resources)
- Planning (e.g. division of tasks, division of workspace for those tasks)
- Monitoring (e.g., capacity to gather/monitor information about those that use the space)

Table 1 Services Provided by each Application

	Unilinks	Yahoo	Groove	WebCT
Non real time discussion	~	~	~	~
Email	~	~	~	~
Email notification		~		
Online messaging	~	~	~	
Chat		~	~	~
Whiteboard			~	
Audio/Video conferencing		~	~	
Task List			~	
Contact management	~	~	~	
Polling	~	~		
Meeting minute/ records			~	
Scheduling tool		~	~	
Presentation			~	
File share	~	~	~	~
File Manage	~	~	~	~
Real time document sharing			~	

- Assistance (e.g., formal and informal channels via which users and the system itself provide assistance to users.)
- Protection – from inadvertent or malicious destruction of group resources/works and the ability of the group to define different levels of users.

Data collection and method of analysis

Content Analysis of self-reflections using Leximancer

The data collection and the analysis part of the research involved the reflection of participants on their activity being requested as part of their course work. These reports were subject to content analysis using a computer-based tool, Leximancer, a data-mining application that creates a conceptual map of collections of documents comparing the ratings and relationships of concepts among different sets of participants, for example those who used different groupware applications. Leximancer performs the two major categories of content analysis: conceptual analysis and relational analysis, measuring the presence of defined concepts in the text as well as how they are interrelated. On a concept map (see examples in Figures 2,3 and 4):

- The brightness of a concept is related to its frequency (i.e. the brighter the concept, the more often it appears in the text).
- The brightness of links relate to how often the two connected concepts co-occur closely within the text.
- Nearness in the map indicates that two concepts appear in similar conceptual contexts (i.e. they co-occur with similar other concepts).

Participant Perspective Gathering using Q-Methodology

The study was enhanced by the use of Q-methodology that allows the participants to outline their views and to make individual decisions on the relative importance that they place upon the available views of the larger group. This method captures the views that the participants gained from their "real world" experience and refines this with Q factor analysis to arrive at three perspectives on what elements would be desirable and not so desirable in an online collaborative environment. In the penultimate week of the semester, with their experiences still (hopefully) vivid in recollection the participants (and the research team) were asked to take part in a concourse, the first step in a Q Study. A Q-concourse is a group discussion where participants, in this case the student and staff, contribute statements about a topic, in this case desirable features for an online group learning application. The following week each participant was given a numbered list of statements and asked to sort them, one to a square on a sheet as shown in Figure 1. The type of sort that was conducted in this study was a "fixed" or forced sort where every item was placed into one of 9 piles with each pile having the following places: 3 5 6 8 10 8 6 5 3. Figure 1 is a schematic of the scoring sheet where each of the numbered statements (54 in this case) were placed.

In placing the items the participants are deciding which ones that they agree with most, in this case those statements that they felt were most important or "best feature" for the application to have on the right and on the left those that they thought were least important to the application. Thus the result of the sorting process is a "forced" decision making process where the participants must decide among the statements to produce a result that reflects their decisions. The resulting data in the sheets for all participants is then entered into the Q-Sort software where the final part of the process is carried out. This is the factor analysis where the sorts are compared with each other in light of the positioning of the statements and a number of factors are developed reflecting the grouping of views of the participants.

Q Methodology was selected as it allows for the free expression initially, and later for the precise act of deciding for oneself what is deemed important or not from the expressed ideas of all the subjects. It is not unusual for participants in a Q study to learn from the exposure to the other participant's ideas and to and to take their ideas on board when doing the sorting.

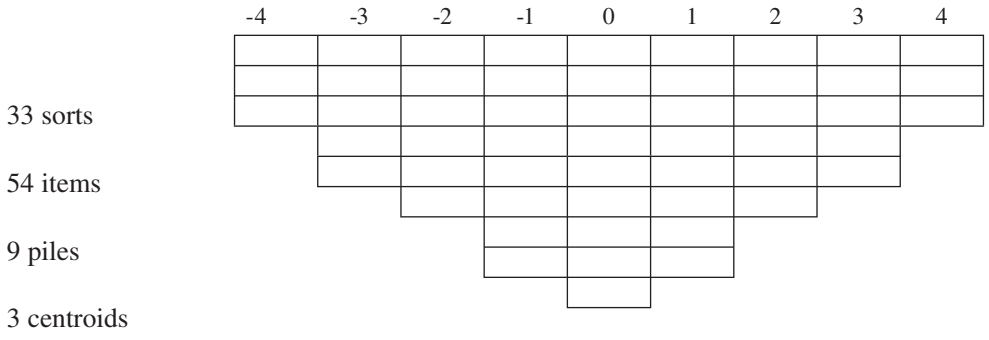

Figure 1: *Sample of Schematic of the scoring sheet*

The Findings

Initial Content Analysis using Leximancer

The student reports on their experiences were the grouped in folders according to the groupware application used and Leximancer was run to mine the concepts from each group. This did not reveal any meaningful difference between the groups. This probably indicates that all students had sufficient level of computer literacy to overcome any differences in functionality or usability of the tool. For example it was observed that one group developed procedural protocols to overcome the limited discussion facilities in WebCT. All students were reasonably confident using each of the tools to support their work and had some appreciation of the benefits of online collaboration for such group activities.

As mentioned previously student grades for the whole course unit (entitled "Critical Issues in Information Systems") were determined by the assignments 50% and a final written examination 50%. The reports of the students were divided into two groups based on their final grade and analysed separately using Leximancer. The outstanding difference between the concepts detected from these two groups was that the top group, based on final grade, rated "team" and "teamwork" highly whereas these were missing from the bottom group.

Table 2: Highest and Lowest Statements for Factor 1

Highest statements for Factor 1		*Z Scores*
6	It should be secure	2.820
12	It should be reliable	1.956
31	It should be easy to navigate	1.586
23	It should have a management set of tools	1.551
46	Have an alert system	1.269
42	Be able to share files	1.251
44	Have an administration system	1.234
35	It should be able to insure that no local software comes to your machine	1.057
27	It should provide a search engine	1.004
38	It should be able to expand its features	0.987

Lowest statements for factor 1		*Z Scores*
21	It should provide a voice activation system	-1.956
17	It should have a skins or / theme set	-1.921
19	It should be able to read (speak) the text	-1.762
53	It should be able to let icons show emoticons	-1.692
30	It should be able to make a message sticky	-1.375
10	It should have a good outlook	-1.234
40	It should allow guest members	-1.075
7	It should have a rating feature for messages	-0.987
24	It should support different languages	-0.952
3	It should provide feedback hints	-0.934

This indicates that an enhanced awareness of the need for social skills is present in better-performed Information Systems students.

The Factors found from the Q-Analysis

As mentioned previously a Q-analysis allows the participants to outline their views and to make individual decisions on the relative importance that they place upon the available views of the larger group. At the Q concourse students were encouraged to produce as many statements as they could that expressed what they would view as desirable features in an online group learning application and the group came up with 54 statements. The features expressed in the statements were not limited to their recent experience but would certainly be influenced by it. The aim was to capture their ideas while their experience of using existing online group learning applications was still fresh. In this case a three-factors solution was established. This solution resulted in a situation where 22 sorts have been accounted for in the 3 factors which are now examined.

The "top ten" for each factor one followed by the "bottom ten" are listed in the corresponding Table and the participants populating each factor. A more detailed report of the Q-analysis is reported elsewhere (Meloche & Papakosmas 2004).

Table 3: Highest and Lowest Statements for Factor 2

Highest statements for Factor 2		*Z Scores*
19	It should be able to read (speak) the text	1.872
29	It should be able to set a time period for each login and logout	1.596
47	It should be able to log all actions	1.550
52	Limit access to parts of the system	1.434
45	It should be able to enforce a code of conduct	1.233
34	It should be able to view messages by month / years	1.089
37	It should have cross – group communication	1.014
51	It should be able to output to other media	0.945
50	Have set procedures	0.922
36	It should be able to categorize discussion	0.870

Lowest statements for factor 2		*Z Scores*
8	It should be user friendly	-2.252
4	It should be simple	-1.889
6	It should be secure	-1.866
12	It should be reliable	-1.855
2	It should respond quickly	-1.573
24	It should support different languages	-1.215
27	It should provide a search engine	-1.141
31	It should be easy to navigate	-1.100
41	It should be able to support real audio	-0.939
9	It should provide online help	-0.916

Factor 1, shown in Table 2, is populated by four males and three females. One of the participants in this sort is a Lecturer in Information Systems and a user of the groupware.

Factor 2, shown in Table 3, is populated by two males and four females. One of the participants in this Factor is an Associate Professor in Information Systems.

Factor 3, shown in Table 4, is populated by seven males and two females, all students.

Interpreting the Factors with Content Analysis

From the results of the Q-analysis, interpretations of the 3 Factors were made and compared. To augment this interpretation the written reports of participants on their experiences were grouped by those students identified with each of the 3 factors. A concept map from each Factor was generated from a straight run of Leximancer on each group of reports and the three resulting maps are shown below. Inspection of these was used to confirm the interpre-

Table 4: Highest and Lowest Statements for Factor 3

Highest statements for Factor 3		*Z Scores*
8	It should be user friendly	0.709
6	It should be secure	0.650
42	Be able to share files	0.612
16	It should be server based	0.548
18	It should have a discussion – point by point date or event to keep a history	0.542
2	It should respond quickly	0.521
4	It should be simple	0.510
31	It should be easy to navigate	0.462
14	It should have a chat tool	0.446
28	It should sort by date or type	0.424

Lowest statements for factor 3		*Z Scores*
39	It should be able to support live images	-0.666
41	It should be able to support real audio	-0.580
53	It should be able to let icons show emoticons	-0.564
17	It should have skins or / a theme set	-0.564
19	It should be able to read (speak) the text	-0.542
21	It should provide a voice activation system	-0.532
24	It should support different languages	-0.462
38	It should be able to expand its features	-0.451
45	It should be able to enforce a code of conduct	-0.403
30	It should be able to make a message sticky	-0.338

tation of each Factor from the Q-analysis and also to extend this interpretation as follows:

Factor One

Factor one represents a group that put priority on having a secure reliable easy-to-use system with an emphasis on functionality over personalisation. The design for this group would not include add on features such as voice activation, or various interfaces, as the "look" of the system is not seen as important. They would desire the ability to expand the systems, to have an administration system control over the development of the system, to adapt a system to their needs. Thus this group would seek to have an adaptable system that can be tailored to suit the requirements of the particular activity being undertaken. The ability of the system to have a search engine for information retrieval was also desired.

The concept map for Factor one (Figure 2) gives the impression of being matter of fact, concentrating on concepts of "online", "work" and "users". The concepts of "experience", "discussion", "communication" and "teamwork" are missing. The names of the groupware applications are prominent but with different strength relationship to other concepts.

Factor Two

Factor two also represents a group that would seek a high level of control over the group environment and the activity occurring within it. They are seeking, more precise administrative control, of users, time and various elements of the system, (enforce code of conduct, log all actions, set procedures, and establish the roles and behaviour of group members). They want control of procedures and the ability to organise or categorise discussions.

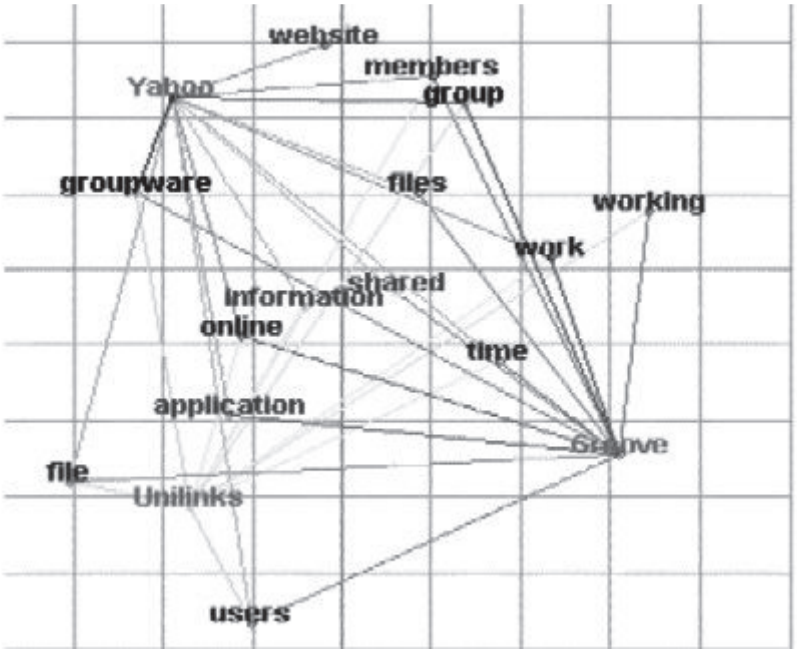

Figure 2 *The Concept Map for Factor One*

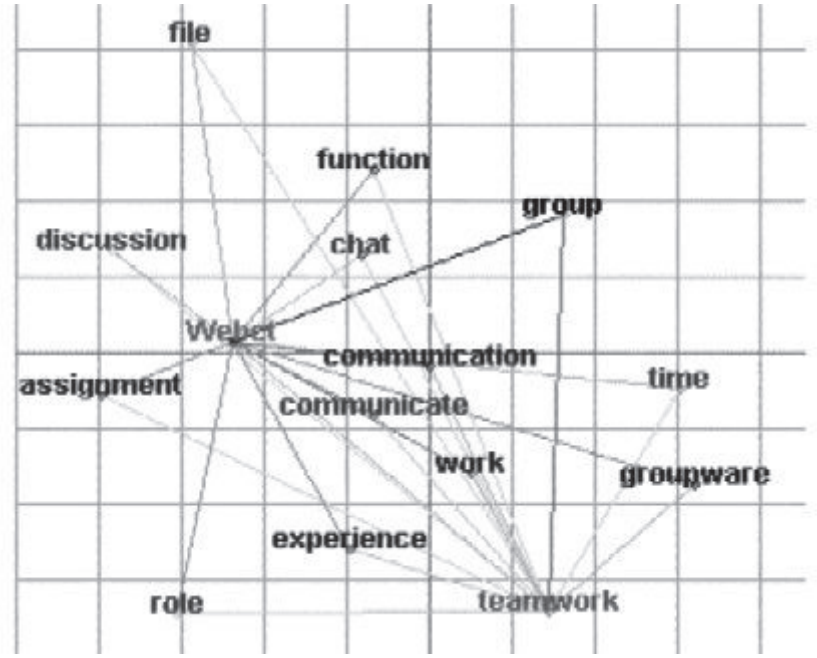

Figure 3 *The Concept Map for Factor Two*

They are also concerned with communication between groups and out to other media, (Information/artefact manipulation). Factor two is the most unique factor having a low correlation with the other two factors and the greatest number of distinguishing statements.

The concept map for Factor two (Figure 3) shows strong emphasis on the concepts of "function", "experience", "discussion", "communication" and a very weak reference to "teamwork". Only one groupware application WebCT is mentioned and then only weakly.

Factor Three

Factor three contains individuals who care about usability comprising the tools and software and hardware stating that it should be server based and also have a chat facility, be easy to navigate, share files, respond quickly and be friendly and secure. They are not concerned with live video or audio or other "high end" functions or administrative matters such as a code of conduct. They also are alone in not asking for the system to be able to expand. They seem to be most concerned with being a group and having easy, flexible communication among members, being able to chat, to share files, and have a quick and friendly system.

The concept map for Factor three (Figure 4) places strong emphasis on the concept of "teamwork", with some weak emphasis on concepts of "productivity" and "effectiveness" that are not apparent elsewhere.

Discussion

This research contributes at three levels: the findings, the methodology and the theoretical underpinnings. These will be discussed here.

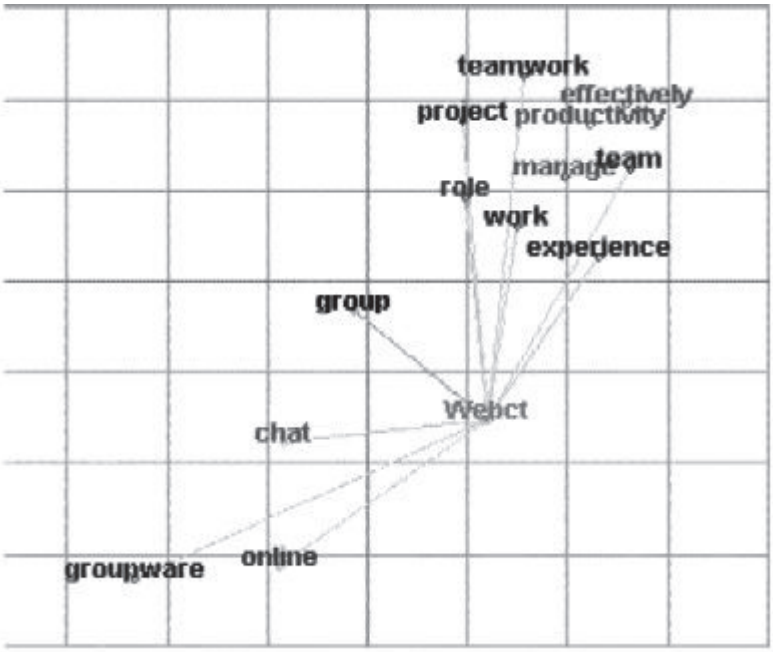

Figure 4 *The Concept Map for Factor Three*

1. The most direct outcome of the research is its contribution to the understanding of group learning processes in modern technology-supported settings. It was anticipated that there would be extensive mediation of the activity by the different groupware tools used. However the concepts emerging from the participant reports, aligned with the statements associated with the factors, suggest that the attitudes and capabilities of the participants had more influence on their learning than their direct experience with the applications. It was observed that each of the groupware applications was readily adapted for effective use by the more capable students. It appeared more important to have a realistic task, be personally motivated to achieve, to have a good mix of skills in each team, and to expend as much effort on team-building as goal achievement. This was supported by the finding that the students achieving high grades in the course placed more emphasis on concepts associated with teamwork than those with lower grades. The distinctive divergence between the preferred modes of working and learning of participants in the three predominant Q-factors, is a sign that computer-based tools, designed to support this type of collective activity should have the facility to match the flexibility and adaptability of human workers and learners. The results, while not conclusive, raise questions, suggestions and directions that are likely to facilitate the development of effective group learning environments and further study to advance their development. The research did verify that effective learning can occur through suitably planned, purposeful activity in small

groups enabled by collaborative tools and a supportive environment. The results of the study also support the view that such groups are most effective when they are given the opportunity to be self-directed and flexible.

2. In respect of methodology, this work substantiates the inductive developmental research approach involving reflective methods of data analysis. This approach is seen as appropriate for this type of investigation, which explores the complexity of collaborative activity supported by sophisticated groupware tools. This is a complex, multifaceted phenomenon incorporating social and technical aspects that are context dependent and therefore difficult to study by traditional reductionist scientific methods. For this study existing purposeful activities, for which participants were highly motivated (advance student assignments), were set up in such a way that these were undertaken in self-organising groups using a variety of novel groupware tools for group organisation and communication. Using the participants themselves as insightful observers, the dynamic interaction between the activity and the tools could be captured by their embedded reflection. The researchers then reliably analysed the contents of the students' reports using Leximancer and the results compared with participant perceptions by means of the Q-method. The results of the analysis were then interpreted in terms of the research objectives guided by principles of the Cultural-Historical Activity Theory as will now be described.
3. This research is a demonstration of the applicability of Activity Theory/DWR to contemporary situations where participants are dynamically involved in purposeful activities facilitated by collaborative tools in networked environments. A holistic contextual approach is taken both to the design of the research and the interpretation of the findings. This allows the researchers to make sense of the complexity of the dynamic work-learning dialectic in a socio-technical collaborative setting. With "activity" as the unity of analysis the student groups were seen as "subjects" of an extended collective activity of which the "object" was their assignment work. This activity was highly aligned with the aims of the course so that the "object" of the activity was "real" and the highly self-motived students would have "only understandable motives" (Verenikina 1998).

Activity theory provides both a holistic view of a complex, dynamic world and a language for describing the activities of all participants: both students and researchers. The students were engaged in complex activities that involved learning by doing. Their assignments were not only exercises for learning about information systems but also ones where the students were engaged in meaningful work of locating, summarising and presenting information in a team situation. The tools that mediated this experiential learning activity were both social (planning, coordinating) and technical (the groupware system). Rather than limit the number of variables or narrow the scope of the investigation, this approach ensures that the whole dynamic activity, subject, object and mediating tools, is the focus of study.

The activity of the researchers then becomes one of sense making of the students' collective activities. The researchers followed an inductive approach where no hypotheses are formed but findings allowed to emerge from the data analysis and interpretation. The data collection and analysis tools, Leximancer and Q-method gave substance to the conduct of the study and provided support for the human subjects of the research activity.

Conclusion

In achieving the "object" of an activity, it is important to note the mediation of tools, which in this case includes the computer-based groupware application and the social and functional protocols it affords. The perceptions and preferences of the participants within this environment may vary placing different emphases on different aspects of the affordance. For example some may focus on security, while others focus on ease of use, where others will focus on precise control, yet if asked they might all articulate the same object of the activity. The reason for this may relate to previous experience, for example, many people on factor two of the Q-study came with experience with IT and an expectation for a "quality" output and mentioned this in their reports.

The process of exposing a group of participants to an actual working experience, having them self report their experience, and later participate in a Q Methodology study has proven to be a alternate way to develop and refine systems. It will have more rigor than "artificial" laboratory designs and more flexibility than "pure" real world observation.

The language and concepts of Activity Theory further allows us to usefully frame such studies and to more closely examine the relationships that exist between elements such as culture and experience, motivation, object and the environmental setting.

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