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Project-Based Collaborative Learning: Negotiating Leadership and Commitment in Virtual Teams

Pernille Bjørn
Computer Science
Roskilde University
4000 Roskilde, Denmark
+45 4674 3841
pbr@ruc.dk

Morten Hertzum
Computer Science
Roskilde University
4000 Roskilde, Denmark
+45 4674 3077
mhz@ruc.dk

ABSTRACT
Identifying, formulating, and maintaining a shared focus in a project group is a difficult and complex negotiation process. We investigate this negotiation process in an educational setting with students collaborating in virtual project teams. We examine the asynchronous online negotiations of three project groups during one semester of project-based studies. The students are geographically dispersed and engaged in tightly coupled collaboration mediated by a text-only groupware system. The analysis leads to the identification of two issues that may jeopardize virtual negotiations: a risk of individualistic proactive behaviour that constrains consensus building and prevents progress and a risk of one student taking the lead while the other students assume subordinate roles and learn less. The study shows how the groupware system that mediated the students' negotiations about their project also entered into their handling of these two risks.

Keywords
Virtual teams, negotiation, project work, commitment, collaborative learning.

INTRODUCTION

Cooperative work is ubiquitous and increasingly involves people who are occasionally, periodically, or permanently cooperating at a distance [1, 4, 8, 13, 17, 18, 20]. This physical distribution has partly been made possible by standardization and division of labour and partly by the introduction of computer support in terms of information and communication technology (ICT). People's ways of working must, however, be adjusted to accommodate remote co-workers, and some types of cooperative tasks have proven detrimental to virtual cooperation – distance matters [5, 24]. This study investigates one such task, namely the process of identifying and formulating a shared focus in projects where the interaction among participants is primarily by means of technology. Whereas several studies have investigated this process of negotiating a shared project focus for virtual teams in industry [e.g., 9, 22, 29], this study takes place in an educational setting of project-based collaborative learning.

A crucial element of project-based collaborative learning as discussed in this study is that the students define their own project – including the problem with which they will be working, the methods they will apply, and the literature they will draw upon in the process. The students work with real or at least realistic problems and are consequently confronted with ambiguous and chaotic situations, rather than simplified, decontextualized problems [33]. This makes the process of identifying and formulating the problem, or project focus, the students' main activity during the initial stage of a project [11]. Further, the students work in groups throughout the process and produce a project report for which they are jointly responsible. Thus, 'open skills' [6, 30] such as argumentation and negotiation are indispensable. Identifying and formulating a shared project focus is a complex activity, which is often slow and punctuated by mistakes and redirections even when performed by experienced professionals in co-located settings [25, 26]. When teams and thereby negotiations become virtual, complexity is further increased and Olson and Olson [24] provide the broadly scoped warning that firm common ground is essential for virtual cooperation to succeed. To sort out this complexity we need a detailed understanding of how virtual negotiations evolve in real-life settings such as project-based collaborative learning.

This paper concerns the process of negotiation in student groups that communicate by means of electronically mediated textual messages for extended periods of time. Like Lave and Wenger [16] we use negotiation in a broad sense, referring to actors' continued negotiation of situated meaning and shared focus. Our empirical data comprise the complete online written interaction of three virtual teams

during one semester of project work on the two-year, part-time master education of *ICT and Learning* in Denmark. The education is for people who have full-time jobs and need to study in the evening and during weekends. This makes it difficult for students to meet, a difficulty further aggravated by considerable geographical dispersion among the students. Consequently, students predominantly study remotely via a Web-based groupware system: Virtual University (VU).

The next section covers previous work on virtual teams, followed by a description of our research method. Then, we analyse the students' virtual negotiations and the strategies they employ in reaching closure on the focus of their projects. This results in the identification of two risks to successful negotiations and an understanding of how VU contributes to and otherwise affects the students' handling of these risks.

VIRTUAL TEAMS

Townsend et al. [31, p. 18] define virtual teams as "groups of geographically and/or organizationally dispersed co-workers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task". A distinctive feature of this definition is that virtual teams are, partly, defined by their reliance on certain technologies. This is rarely meant to imply that teams never meet face to face, and illustrates that the difference between virtual and co-located teams is one of degrees. Further, virtual teams are often composed of dispersed sub teams of co-located people [9, 10, 19].

A core result of previous studies of distributed collaboration is that articulation [27] is crucial to closing the gaps between collaborating actors. Recent studies find that major aspects of this articulation work concern trust, commitment, task complexity, and appropriation of technology. These four aspects all relate to the process of negotiating the focus and common ground of a project.

Trust. Virtual teams often include people who have not previously worked together and therefore have little or no basis for forming an initial perception of their remote colleagues' ability, benevolence, and integrity [12]. Thus, the physical distance between actors may develop into a psychological distance characterized by uncertainty and absence of trust. Jarvenpaa and Leidner [13] find that trust is facilitated by different types of behaviour at different stages of a project. Early on, the primary facilitators of trust are social communication, communication of enthusiasm, and individual initiative. Several studies propose initial face-to-face activities as an effective – or even necessary – means of creating social relationships, building trust, and thereby jumpstarting virtual collaboration [e.g., 12, 35]. Later in the lifecycle of a virtual team Jarvenpaa and Leidner [13] find that trust is mainly facilitated by predictable communication, substantial and timely responses, and a successful transition from social through procedural to task focus.

Commitment. There is a distinct difference between agreeing about what to do and agreeing about who will do it. Jarvenpaa et al. [12] find that in effective virtual teams members volunteer for explicit roles and engage in independent activities, whereas in ineffective teams members are reluctant to take on individual responsibilities. Commitment to future action is to a considerable extent negotiated indirectly, and this often leads to differences between the requester and the other team members in their perception of the salience of requests and, in turn, to differences in team members' perception of their individual commitments [7]. At the utterance level Searle's [28] taxonomy of illocutionary acts provides a means of analysing how commitment is negotiated. As email and other asynchronous messages typically contain multiple utterances, turns in these forms of communication may involve negotiation of multiple intertwined commitments. The taxonomy of illocutionary acts helps identify requests and clarify whether they lead to commitments or go unnoticed. In a study with designated leaders in virtual teams of students, Kayworth and Leidner [14] report that the subordinate students experienced a lack of information from their leader to clarify their commitments and motivate them. At the same time the leaders felt powerless and experienced considerable difficulty asserting their authority. This testifies, we believe, not to a need for more clarity about commitments than in face-to-face interactions but to an increased need for communication in order to achieve clarity about commitments.

Task complexity. Maznevski and Chudoba [22] propose that in effective virtual teams more complex tasks and higher interdependence of sub tasks instigate richer and more frequent communications. Conversely, ineffective teams tend to either assign less importance to rich and frequent communication or fail to get the majority of team members involved in such communication. A specific aspect of complexity concerns the initial level of goal agreement. Whereas virtual teams have successfully handled tasks for which goal agreement has been achieved prior to virtual collaboration [e.g., 1], the prospects of virtual collaboration are much more uncertain when goal agreement is to be reached through virtual negotiation [24].

Appropriation of technology. In synchronous communication mutual understanding is typically assumed if the other party continues relevantly [2]. This implicit assessment of mutual understanding breaks down in asynchronous communication, such as the email-like messages exchanged in VU, because feedback cannot be obtained instantly and continuously but only after a distinct delay and normally at a more coarse-grained level. Media richness is, however, not simply a feature of the technologies [23]. Markus [21] finds that lean media, such as email, can be rich in situations where people know each other, but that people expect their relationships to degrade if they are confined to textual media for extended periods of time. Further, different technologies affect people's

negotiation behaviour in different ways. Valley et al. [34] find that people are less trustworthy in telephone negotiations than face-to-face, and that written negotiations tend to result in less information being exchanged and more negotiations reaching an impasse.

In *project-based collaborative learning* [3, 11, 33] all of the above aspects of articulation are important. In addition, the process of reaching and preserving goal agreement is a major aspect of the collaboration and cannot be confined to an initial pre-virtual stage. The transition from an overall choice of topic, through a delimitation of a problem area, to the formulation of a specific problem is thus a pivotal element of problem-oriented learning. The educational setting implies that the formulation of a problem is not just a decision process for the group, but a learning process for each individual student [3]. Starting from vague, individual notions about the focus of their project students must continually negotiate a shared agreement. This involves a balancing of individual interests and group consensus and it is a complex, time-consuming activity.

RESEARCH METHOD

The data analysed in this paper are the complete written online communications of three project groups during their second semester of a two-year master education in ICT and learning. The three groups that allowed us access to their communications consisted of a total of 12 students (7 female, 5 male), all with full-time jobs. Apart from two weekend seminars, the groups were virtual throughout the six-month project period and communication was mediated by VU, which was known to the students because they had used it during their first semester. VU provided the students with facilities for writing textual messages to their group and made these messages available as threaded discussions. Students could further create folders, so-called conferences, to help structure their negotiations. This study is based on an analysis of the 1833 messages exchanged in VU by the three groups of students. The messages were supplemented with observation at the two weekend seminars, an interview with each group, and four interviews with the groups' supervisor.

We analysed the structure and contents of the groups' communications in VU. The structural analysis involved calculations of the number and length of messages and quantitative differences in how individual students contributed to the negotiations. The contents analysis involved coding the messages according to two sets of categories. These categories were developed by exploring and annotating about a third of the messages, and inspired by the literature.

First, we coded the messages with respect to their main contents. We distinguish three categories of contents, which can be simultaneously present: (1) *Social*, which is messages about the students' interests, activities, and lives beyond their studies. (2) *Process*, which is messages about how the students plan and coordinate their collaboration. (3) *Subject matter*, which is messages about the topic, line of argumentation, results, and other elements that form the contents of the project report.

Second, we coded the messages with respect to Searle's [28] taxonomy of illocutionary acts. The purpose of this coding was to investigate how commitment was negotiated and, thereby, how the groups orchestrated the individual efforts that constituted their collective project. The taxonomy of illocutionary acts has five categories: (1) *Assertives*, which are utterances committing the sender, in varying degrees, to something being the case, to the truth of the expressed proposition. Example: 'There is something inconvenient in the way we go about our discussions'. (2) *Directives*, which are utterances in which the sender attempts, to varying degrees, to get the receivers to do something, ranging from questions to commands. A directive can address a specific person, such as 'Nicolas, could you make the interview guide for tomorrow?', or be addressed to nobody in particular: 'We need to email the agenda to our supervisor'. (3) *Commissives*, which are utterances in which the sender commits, in varying degrees, to a future course of action. As a special subcategory we include utterances in which the commitment is expressed post hoc through the sender's provision of the outcome of a self-initiated course of action. Examples of the two types include 'I will do the review for tomorrow' and 'I have read this book and here is a summary'. (4) *Expressives*, which are utterances expressing the sender's psychological state about a state of affairs, including such acts as apologizing and praising. Example: 'SORRY ABOUT MY IMPATIENCE' (capitals in original). (5) *Declarations*, which are utterances that bring about a state or condition by virtue of the sender declaring the new state or condition. Example: a student becomes a candidate by virtue of the examiners at the final exam declaring that the student has passed.

A subset of 198 messages (11% of the data) was coded by both authors. Inter-coder agreement was assessed by Cohen's kappa. Landis and Koch's [15] interpretation of the strength of agreement is given in parentheses. Kappa yielded values of 0.82 ("almost perfect agreement") for the coding of main contents and 0.67 ("substantial agreement") for the coding of illocutionary acts. Consequently, the codings of contents and illocutionary acts were retained (while a third coding of the depth to which participants argued about each others' ideas was skipped due to insufficient inter-coder agreement). Disagreements among the coders were discussed and a consensus reached. Then, the first author coded the remaining messages.

ANALYSIS

The analysis starts with a short description of the groups. Then, we identify overall patterns with respect to message content. On this basis, the remainder of the analysis looks into the negotiation process of each group in turn.

The Three Groups

Groups were formed at the weekend seminar in January. Here the 45 students taking part in the master education met face to face, discussed their interests with respect to the projects they would be doing until June, and engaged in a group-formation process.

Group 1 consisted of five motivated and self-reliant students. During and immediately after the weekend seminar they created 13 conferences in VU to structure their negotiations. The intensity of these negotiations is evident in the explosive number of messages written by the five group members from the first week onward, see Figure 1. During the first month they wrote more messages than Groups 2 and 3 did during the entire semester. However, while Group 1 started out enthusiastically they dissolved into three subgroups after about a month. These three subgroups – Groups 1A, 1B, and 1C – all completed their projects with above average grades.

Group 2 consisted of three students. Once the group was formed they experienced few problems reaching agreement about the focus of their project, partly because Liza immediately emerged as the leader, and partly because they quickly got access to an empirical case and made it the pivotal element of their project. Group 2 received an above average grade for their project.

Group 3 consisted of four students. While they were enthusiastic about their project, their collaboration in VU was very limited during the first month, see Figure 1. After that they got more focussed and productive. Group 3 succeeded in negotiating a problem statement and made a project receiving an above average grade.

Message Contents

The tripartition of message contents into social, process, and subject matter shows essentially the same pattern for Groups 1, 2, and 3, see Table 1. As much as 76-81% of the messages had process contents and about half as many, 36-40%, contained information about the subject matter of the projects. This suggests that VU played a considerable role in procedural and coordinative negotiations whereas detailed negotiation of the subject matter probably was divided between VU and the text processing system used for writing draft documents. Only 3-8% of the messages had social contents and few messages were exclusively social. Although we were unable to detect much social interaction in VU we did find traces of social activities in VU mediated by other technologies such as phone, email, and instant messaging. The subgroups of Group 1 had a higher percentage of messages with social contents. In Group 1A these messages occurred mainly during the first half of the project; in Group 1B mainly during the last half.

Table 1. Distribution of messages with respect to main contents. A message can be in multiple categories.

Group	Messages	Social	Process	Subject matter
1	599	49 (8%)	485 (81%)	239 (40%)
1A	133	31 (23%)	118 (89%)	54 (41%)
1B	342	43 (13%)	318 (93%)	170 (50%)
1C	28	3 (11%)	25 (89%)	20 (71%)
2	501	31 (6%)	383 (76%)	180 (36%)
3	230	8 (3%)	176 (77%)	92 (40%)

Jarvenpaa and Leidner [13] find that successful virtual collaboration is facilitated by an initial focus on social communication and a subsequent transition through a procedural focus to a focus on the subject matter. In contrast to Jarvenpaa and Leidner [13] we find that apart from the initial social communication at the first weekend seminar the relative prominence of social, process, and subject-matter contents was rather stable over time. Figure 2 illustrates this for Group 2.

Group 1: Insisting on Individual Views

Table 2 summarizes how the individual students contributed to the negotiations of their group. In Group 1 all five students were very active during the short period the group existed. The least active group member wrote

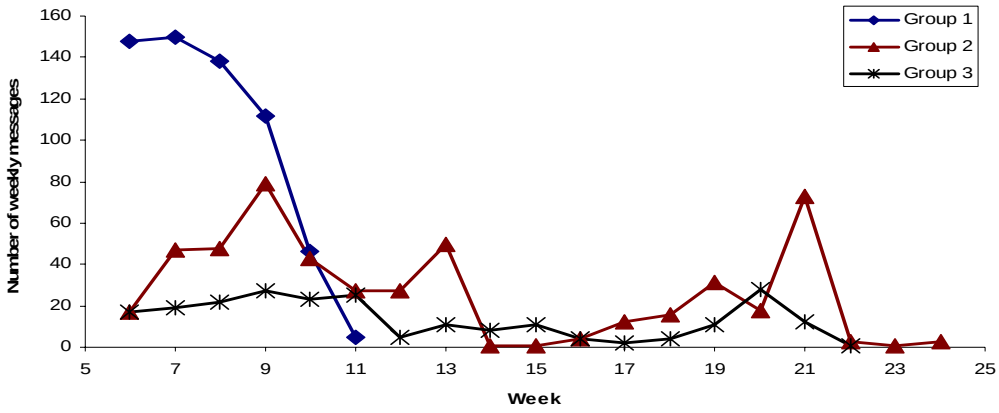

Figure 1. Number of messages produced by the groups during each week of the project period. To avoid clutter, Groups 1A, 1B, and 1C have not been included.

more messages a week than any member of Groups 2 and 3. Although they exchanged an average of 120 messages a week, the students in Group 1 did not reach a mutually acceptable agreement about the focus of their project. To understand the apparent discrepancy between an active and enthusiastic group and their failure to complete their project we turn to Table 3, which shows the distribution of the messages onto illocutionary acts.

A total of 51% of the messages exchanged by Group 1 were commissives but they were very unevenly distributed between the two subcategories of commissives. Whereas commissives to future actions tend to occur in reply to directives from other group members, post-hoc commissives indicate proactive behaviour. For Group 1, 40% of the messages were post-hoc commissives through which the students volunteered the outcome of self-initiated activities, whereas only 11% of the messages were commissives toward future actions. Furthermore, all students in Group 1 displayed this pattern (post-hoc commissives were in the range 28-51%; commissives to future action were in the range 8-15%). For Groups 2 and 3 the two subcategories of commissives were more evenly balanced and at least some group members displayed the opposite pattern; that is, they committed to future actions more often than they engaged in proactive behaviour.

Investigating this aspect further, the messages exchanged by Group 1 include numerous incidents where one of the students promotes his or her own interest without making an attempt to integrate this individual interest with the other students' views. The large number of such messages was, to some extent, recognized by the group and experienced as a problem, for example in relation to the explosive number of summaries. The below quotations illustrate how they articulated the problem:

> "Our positive problem [concerning self initiative and high engagement] can in the future become a negative one as we may loose our overview [...]" [Sascha, #13, 6th of February, 10:51, Group 1 conference]

> "Maybe it is a good idea that we decide which books/articles each of us will read and make summaries of. I will however make a lot of summaries myself, no matter whether others have made them too." [Thomas, #18, 6th of February, 13:33, Group 1 conference]

> "I have now provided comments on messages from Mary, Ellen, and Jane. It took a long time (read: inordinately long time) [...]. Also, Thomas has provided an annotated summary of the article, which I will start commenting on now... But there is something awkward in the way we conduct these discussions." [Sascha, #59, 10th of February, 16:53, Group 1 conference]

The quotations show that the students were highly committed, that each of them produced summaries of the same books and articles to verbalize their individual perspective, and that the resulting masses of material made the process confusing and complicated collaboration. The large number of post-hoc commissives reflects the students' individualistic attitude, implying that their summaries pointed in different directions rather than supported the group in converging toward a shared focus. Underneath the socially supportive tone of the messages a more manipulative practice emerged, in which the students in Group 1 used strategies such as simply ignoring other group members' ideas and repeating their own points:

> "Hi all, I have started to read all the good and inspiring messages posted here in this conference [...] and I would like to repeat my suggestion from #36 [...]" [Sascha, #39, 20th of February, 13:15, Problem statement conference]

> "Referring to the dialogues we have had on the problem statement so far, I want to make the below suggestion [...]. I have mostly adjusted my previous proposal [...]" [Thomas, #35, 20th of February, 00:02, Problem statement conference]

The students in Group 1 were not able to change their unconstructive ways of working toward a more collaborative process and after about a month Sascha decided to leave the group, creating Group 1C. Soon after Ellen and Jane also left and created Group 1A, leaving Mary and Thomas as Group 1B.

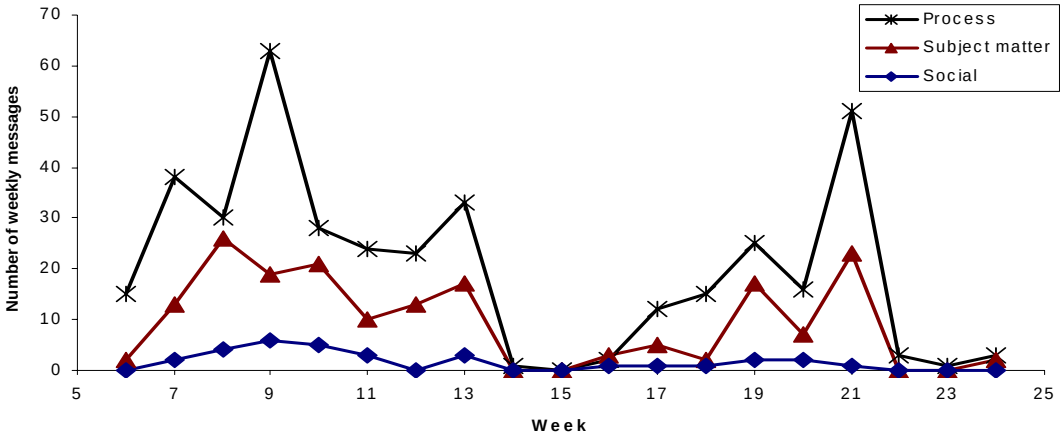

Figure 2. Contents of the messages produced by Group 2 during each week of the project period. A message can be in multiple categories.

In Group 1 activities were mainly triggered by the students' pursuit of their individual interests, and group consensus remained a secondary issue to which none of the students felt genuinely committed. VU provided an explicit record of their previous messages and this made it easy to include or refer to old statements in a new message. In advocating their ideas, the students mainly used the presence of previous messages to refer to their own former messages. Other students' messages were referred to if they provided supporting arguments but were otherwise largely ignored.

Asynchronous, text-based systems such as VU provide users with plenty of opportunity for carefully selecting and deselecting the messages to which they respond and refer. Thus, for a group to benefit from the availability of previous messages the group members must be open toward other group members' views and seek to establish common ground. Previous work on virtual teams has emphasized proactive behaviour and individual initiative as indicators of success [e.g., 12, 13]. However, Group 1 exemplifies that proactive behaviour may also be an indication of group members with strong individual views and a limited disposition to accept a compromise.

Group 2: Creating Subordinate Members

Contrary to Group 1 there was only one student in Group 2 who maintained a strong individual position and she quickly attained a leading role. Table 2 shows that Liza wrote more and longer messages than the other group members, reflecting her leading role. Conversely, the two other students in the group assumed subordinate roles and followed Liza's lead. On several occasions Nicolas was inactive for four or five days without warning and apparently with no need for ensuring that important decisions were not made in his absence. Peter was more vocal than Nicolas but did not challenge Liza's position.

It was settled early on that the group would make a case study. A major reason for this decision was that Liza knew about and could provide access to an empirical case. By introducing the case Liza got an advantage due to her prior knowledge of the case, and she single-handedly settled the key question about which stakeholder group to prioritize. The negotiation of the problem statement ended without explicit closure when Liza stated:

> "I think we will eventually come up with the right formulation [of the problem statement]. With respect to the contents I don't see any disagreements." [Liza, #22, 21st of February, 14:17, Problem

Table 2. The students' negotiation behaviour (all names are pseudonyms). Self transitions are the number of times a message is followed by another message by the same person without in-between messages by other people, including the supervisor.

Group	Person	Messages	Words/message	Messages/week	Self transitions
1	Ellen	111	123.75	22.20	54 (49%)
	Mary	110	157.19	22.00	37 (34%)
	Jane	113	132.97	22.60	46 (41%)
	Sascha	159	120.96	31.80	56 (35%)
	Thomas	106	193.54	21.20	51 (48%)
	Total	599	143.24	119.80	244 (41%)
1A	Ellen	57	219.82	4.75	25 (44%)
	Jane	76	265.03	6.33	43 (57%)
	Total	133	245.65	11.08	68 (51%)
1B	Mary	152	179.70	12.67	84 (55%)
	Thomas	190	143.43	15.83	124 (65%)
	Total	342	159.55	28.50	208 (61%)
1C	Sascha	28	158.46	2.33	21 (75%)
	Total	28	158.46	2.33	21 (75%)
2	Liza	217	135.25	12.76	87 (40%)
	Peter	175	96.99	10.29	66 (38%)
	Nicolas	109	49.62	6.41	40 (37%)
	Total	501	103.26	29.47	193 (39%)
3	Emma	50	94.82	2.94	15 (30%)
	Michael	44	88.32	2.59	25 (57%)
	Juliette	83	168.55	4.88	31 (37%)
	John	53	309.81	3.12	17 (32%)
	Total	230	169.73	13.53	88 (38%)

statement conference]

Here Liza stated that they agreed although they did not yet have a clear formulation of the problem statement. In effect she said that she could not see any objection to her approach, but at the same time she acknowledged that it had not yet been properly formulated. This left the other group members in limbo and made Liza the only person who fully knew what they had agreed to do. While nobody challenged her at this point in the process, the proposed agreement might have collapsed later when Peter and Nicolas gradually learned the contents of their agreement. This was, however, not the case since both Peter and Nicolas accepted the situation. When Liza subsequently adjusted the formulation no objections were raised.

Liza was an active and engaged leader, but she could only attain her leading role because Peter and Nicolas adapted to the situation and assumed subordinate roles. The majority of Liza's commissives were post-hoc commissives as opposed to commissives to future action (29% versus 12%), indicating her proactive behaviour and supporting her leading role. Peter and especially Nicolas displayed the opposite pattern (17% versus 23% and 5% versus 14%, respectively), suggesting a hesitation to take proactive action. They tended to have Liza sanction ideas and suggestions before action was taken. In total, Group 2 had the lowest percentage of post-hoc commissives of all the groups, see Table 3.

Jarvenpaa et al. [12] find that possibilities for and readiness to engage in independent activities are crucial to successful virtual collaboration. When a strong student assumes leadership and the other group members accept subordinate roles there will be few individual initiatives and independent activities. Nicolas' reluctance to volunteer for tasks that were brought up in group discussions led to some situations in which Liza and Peter encouraged him to participate more actively by addressing directives specifically to Nicolas. Messages containing directives were frequent in all groups but directives addressed at specific persons were mostly found in Group 2.

A characteristic common to all the groups was that the number of directives clearly exceeded the number of commissives to future actions, see Table 3. Some directives probably went unnoticed because they were stated too vaguely or because other parts of the message captured the reader's attention. People are often reluctant to state directives clearly and this may hamper communication in VU where students needed to state their directives in writing and without instant feedback from other group members. Other directives were probably noticed but neglected because the reader had a different opinion about how to proceed or was otherwise unwilling to commit to the suggested action. People often prefer to avoid confrontation and in written virtual negotiations it is especially easy to simply not respond. Cramton [7] asserts that it is psychologically hard to state directives explicitly and comparatively easy to avoid them in virtual negotiations. The possibility of avoiding directives without confrontation makes it easier for the students in Group 1 to insist on their individual views in spite of periodic calls for compromises and easier for Nicolas to remain reluctant to commit himself in spite of periodic directives addressed specifically at him.

In previous work, lack of information and an ensuing reduced ability to act competently have been identified as the major deficiencies of subordinate roles [14]. In Group 2 the major deficiency of the subordinate roles was the reduced engagement and participation on the part of the subordinate students. The subordinate students displayed less initiative and were to a considerable extent dependent on input and instructions from their leader. Students that do not perceive themselves as equal partners have been found to learn less from project work [3]. Also, Group 2 largely bypassed the complex process of negotiating a shared agreement about the focus of their project and, thus, did not develop their open skills and abilities to identify and reach closure on compromises among their individual views. That is, the division of the group into a leader and several subordinate students ran counter to the educational learning objectives. Additionally, common ground was fragile in this group because Liza was the only person who fully understood and was able to articulate how the project hung together.

Group 3: Building Consensus

In Group 3 the low level of activity, especially during the

Table 3. Distribution of messages with respect to illocutionary acts. A message can be in several of the five categories from Searle's (1979) taxonomy, but in at most one of the two subcategories of commissives.

Group	Assertives	Directives	Commissives future action	Commissives post hoc	Expressives	Declarations
1	440 (73%)	273 (46%)	67 (11%)	241 (40%)	50 (8%)	0 (0%)
1A	111 (83%)	42 (32%)	26 (20%)	63 (47%)	12 (9%)	0 (0%)
1B	244 (71%)	140 (41%)	91 (27%)	138 (40%)	33 (10%)	0 (0%)
1C	16 (57%)	16 (57%)	4 (14%)	17 (61%)	6 (21%)	0 (0%)
2	302 (60%)	217 (43%)	82 (16%)	97 (19%)	46 (9%)	0 (0%)
3	136 (59%)	77 (33%)	43 (19%)	70 (30%)	25 (11%)	0 (0%)

first month of the project, was common to all students. The most active student in this group wrote fewer messages a week than any member of Groups 1 and 2 (see Table 2). The negotiation strategy in Group 3 was very different from both Group 1 and Group 2 in that Group 3 began by conducting teambuilding activities, which have previously been found to affect virtual collaboration positively [35]. The emphasis on teambuilding meant that the group did not really start negotiating the problem statement until a month into the project period. Their interaction in VU was fairly constant throughout the project period with a small peek in week 20 (see Figure 1). Either Group 3 communicated less than the other groups or they made more frequent use of other media beside VU. In negotiating their problem statement the group employed a consensus building strategy and made an effort to be open toward each other even when they disagreed. A key incident concerned the use of the concept 'intercultural', which was advocated by John. This discussion went on for several weeks but eventually Emma emerged in a mediating role:

> "I would also like to move the process forward. However, I believe we still have small differences and uncertainties about where we want to go with the project. I believe we need to discuss and decide on these matters. Off the top of my head I see a difference between my interest and John's suggestion. Our primary task is to find a common course so we can all become "almost happy" and get on with it." [Emma, #34, 5th of March, 11:38, Problem statement conference]

Emma introduced the notion of striving for being 'almost happy' with the problem statement, a consensus-seeking approach. Her mediating role is also reflected in the distribution of illocutionary acts. As the only person in Group 3 Emma made fewer post-hoc commissives than commissives to future action (12% versus 28%).

Group 3 were slow starters and had not accomplished much after the first month. This was a cause for concern among the students and explicitly raised by their supervisor. However, during the remainder of their project the group seemed to benefit from the time they had spent on teambuilding activities during the first month. They kept listening to each other after the teambuilding activities and also when the time pressure increased. The openness involved designated efforts toward reaching a consensus (e.g., Emma's notion of 'almost happy') and a willingness to "kill one's darlings" though it is hard (e.g., in spite of his affection for 'intercultural' John agreed to let go of this concept). In contrast to Groups 1 and 2, Group 3 embraced the challenge of collaboratively identifying, formulating, and reaching closure on a problem statement reflecting their joint interests.

APPROPRIATION OF TECHNOLOGY

While technologies such as VU certainly have an impact on group processes, these technologies are open-ended and in no way determine how groups collaborate. Through their enactment and appropriation of technologies people create ways of working and continuously experience and react on the opportunities provided by technologies as well as the constraints they impose. We have identified three main areas where VU impacted the ways in which the groups accomplished their virtual negotiations.

First, VU provided a permanent record of the groups' previous messages and thereby made it possible to refer to and revisit prior messages. For the students in Group 1 this became a vehicle for basing their arguments on their own previous messages. Individual interests kept reappearing through references to previous messages, and one can speculate whether consensus building in this group would have benefited from the forgetfulness inherent in the ephemeral nature of oral communication. Certainly, the persistence of messages in combination with the students' individualistic proactive behaviour had a negative effect on the outcome of the virtual negotiations in Group 1. Conversely, for the students in Group 3 the persistence of the messages provided additional opportunities for taking other group members' views into account when new messages were written. Group 3 used the easy access to previous messages as a vehicle for reflection and, partly for this reason, managed to maintain an open dialog.

Second, the asynchronous nature of the groups' negotiations brought about multiple parallel discussions. When group members sat down in the evening to work on their project they would normally read and respond to new messages in each discussion in turn, creating a batch of messages. If other group members were online at the same time quasi-synchronous exchanges could occur, otherwise the batches resulted in consecutive messages in VU authored by the same person. For Groups 1, 2, and 3 such consecutive messages (termed self transitions in Table 2) comprised 38-41% of the messages written by the groups. The average time that elapsed from posting a message to receiving a reply was 0.97-1.11 days, which is a typical rhythm for email-like communication [32]. The batch way of responding to messages, typical of asynchronous communication, has caused group members to read messages out of the sequence in which they were written and thereby increased the difficulty of interpreting both the contents of messages and their silence on issues raised in previous messages. Cramton [7] find that one of the biggest challenges group members face in asynchronous virtual negotiations is interpreting the various meanings of the periods of silence between messages.

Third, technologies like VU make it necessary to state directives rather explicitly and, conversely, make them easier to avoid by simply not responding. This may jeopardize virtual negotiations because people often find it difficult, or impolite, to state directives clearly and often are somewhat unwilling to commit themselves. As for other aspects of VU, the implications of this aspect differed across the groups. In Group 1 the possibility of avoiding directives without direct confrontation made it easier to insist on individual views. In Group 2, Liza's leading role was not reflected in a proportional number of clearly stated

directives, and it was difficult to ascertain whether absence of commitments from the subordinate students was due to disagreements, unwillingness, or not having noticed the directives.

CONCLUSION

We have investigated how negotiation of a shared project focus is accomplished in a text-only groupware system by three groups of dispersed students. Negotiation of a shared project focus is a complex task that involves rich and frequent communication. It has been suggested that unless goal agreement has been achieved prior to virtual collaboration, the prospects of virtual collaboration will be uncertain. In the educational setting studied in this paper negotiation of the problem statement is a key element of the entire process, not an activity that can be confined to the initial stage of the project. Consequently, goal agreement must be achieved through virtual negotiations.

We have identified two issues that may jeopardize virtual negotiations in an educational context:

- A risk of individualistic proactive behaviour that constrains consensus building and prevents progress. To support students in countering this risk, technology must contribute to decreasing the psychological distance between students. Facilities for team- and consensus building may hold promise.
- A risk of one student taking the lead while the other students assume subordinate roles and learn less. In countering this risk, students need alternative means of stating directives and making commitments as well as more elaborate techniques for interpreting other students' silences.

Learning exists beyond educational settings, thus our findings may also be relevant in other settings. Though one of the three studied groups split up after about a month, all the students completed their projects with good results. This across-the-board success was, however, brought about through very different processes of virtual negotiation. The differences concerned the students' abilities to articulate their ideas and interests in writing, their self confidence and negotiation strategies, their enthusiasm and the time they had available for the project, their familiarity with collaborative problem-based project work, and their readiness to explore and embrace groupware technologies. Technologies for supporting collaborative learning must accommodate such differences, both within and between groups.

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