A Two-Dimension Process in Explaining Learners’ Collaborative Behaviors in CSCL

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ABSTRACT
Computer supported collaborative learning (CSCL) has captured many educators and researchers to contribute their efforts on this domain. This study proposed a two-dimension concept to explain learners’ collaboration behaviors in a CSCL laboratory setting. A two-dimension process, namely perceptual dimensions and supportive dimensions, is useful to explain why learners’ are willing to collaborate online. One hundred undergraduate students were divided into 20 work groups, each group consisting of 5 members. The result showed different group composition of extraverts will influence learners’ perceptual dimension of group context variables, which in turn will be associated with supportive dimension of CSCL process. We conclude that educators and CSCL developers should focus not only on the technical factors of system development, but also on learners’ psychological factors because of its impacts on the latter process-supportive dimension which especially stands for learners’ collective behaviors of collaboration.

Keywords
Knowledge sharing, Workload sharing, Collaborative process, Group norms, Task conflict

Introduction
Computer supported collaborative learning (hereafter CSCL), as an emerging field in educational research, has captured many educators and researchers to contribute their efforts on this domain. Its anywhere - anytime characteristics and great potential to support interactive group learning make it one of the most promising next generation of educational tools. There is already an ample literature of research reporting its positive impact on learning (Altinay & Paraskevas, 2007; Ellis, 2001; Joiner, 2004; Rourke & Anderson, 2002; Salovaara, 2005). In sum, these studies acknowledged that collaborating can lead to information sharing, problem solving, and evaluation feedback, which are the result of interaction of the understandings of those who participate in the group activities. While accompanied with these benefits, CSCL inevitably poses some challenges. Kreijns, Krischner, and Jochems (2002) were among the first to identify that the design of CSCL environments do not completely fulfill expectations on supporting interactive and coordinated group learning. In fact they found a pitfall came from the assumption that collaborative interaction is taken for granted and that it will automatically happen in a CSCL environment.

Regarding the pitfall raised by Kreijns et al. (2002), we believe one approach to enhancing learners’ collaborative behaviors in CSCL is to identify characteristics that differentiate low collaborating face-to-face (FTF) groups from high collaborating FTF groups and then determine if groups in CSCL also have these characteristics. If they do, and if those characteristics can be properly managed, groups in CSCL may enjoy fruitful experience in collaborating online. Two flaws most frequently mentioned in FTF groups are social loafing and free riding (see Williams & Karau, 1991; Albanese & Van Fleet, 1985). Actually social loafing and free riding essentially share a similar characteristic that an individual who is not providing the maximum effort is due to feeling of dispensability to the group (Kidwell & Bennett, 1993). Therefore, both of which reduce learners’ willingness to make contributions for the group, as such it may handicap engendering of collaborative behaviors. DeSanctis and Gallupe (1987) also noted that while dealing with unstructured problems does not required members of the group to be in the same physical location, it is required for them to be aware of one another and to perceive themselves as being part of the group. An individual who feels himself as a member of a group may internalize the group’s merit as part of his own preference,
which will help overcome problems of collective behaviors and barriers to resource exchange. For example, parents often make sacrifices for their children; however, they may not refer the actions to a sacrifice. In this regard, whether one considers oneself part of a group determines whether the welfare of the group is important to the individual, therefore a sense of group seems play an important role in explaining occurrence of collective behaviors.

In this regard, to explain engendering of collaborative behaviors in CSCL, this study referred the previous study by Gray (1989) who indicated a dynamic nature of collaboration, thus, more specifically, proposes a two-dimension process, namely perceptual, and supportive dimension. Considering past research (De Dreu, 2007) appreciated that effectiveness of a virtual group is significantly affected by conflicts or difference of opinions and shared motivations, this study consider task conflict and norms of cooperation critical in explaining collaborative behaviors. Therefore, we refer them to factors of perceptual dimension. Although the corresponding factors of perceptual dimension in this study are not uniquely related to CSCL settings, the nature of the CSCL settings has made them more salient and critical than in FTF environments. Indeed, the special nature of telecommunication used in the CSCL can affect the effectiveness of exchanging information and gaining consensus on information meaning (Daft, Lengel, & Trevino, 1987). In addition, a personality trait is a distinguishing characteristic, which is an individual’s relatively consistent way of thinking, feeling, and behaving across situations. Besides, the relationship between personality and behavior has been extensively investigated and examined, which also draws our attention on this linkage.

Additionally, past research agree that diversity among group members can cause variations in their attitude, beliefs, and behaviors, which in turn affect overall performance (Shaw, 1981; Hackman, 1987). Shaw (1981) suggested that individual characteristics of group members are important factors related to group effectiveness. Specifically, Hackman (1987) indicated that personality is likely to contribute to work-team effectiveness. More recently, literature on CSCL confirmed that individual’s personality influence learner’s participation level (Ellis, 2001; Tiene, 2000; Palloff & Pratt, 2001). These results all suggested that one’s personality plays a critical role in FTF groups, therefore we expect it is influential in CSCL groups as well. Seeing that personality profile of extraversion/introversion has been widely agreed to be the first “Big Five” personality factor and which is particularly a valid predictor for tasks involving social interaction (McCrae & Costa, 1992), this study employed learners’ personality profile of extraversion/introversion as individuals’ characteristic and regarded it as the foremost determinant of collaborative behaviors. In line with the assumption, this study proposed that (a) learners’ personality profile of extraversion/introversion would influence the perception of group context factors such as task conflict and norms of cooperation and (b) learners’ perception of group context factors will guide their supportive behavior in CSCL setting.

Theoretical Foundations

Collaborative learning is understood as a dynamic process of social interaction and participation. In this dynamic process, learners are first required to recognize their cognitive styles and abilities through observing capable others or a community in which the learning occurs. In fact, it is not a novel idea that collaborative learning refers to a dynamic process. In her early definition of collaboration, Gray (1989, p.5) described collaboration as “a process through which parties who see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited vision of what is possible.” She believes the process of collaboration is seldom simple and straightforward. In this regard, Gray (1989) thus proposed a three-phase process to describe the dynamic nature of collaboration. The first phase, which she calls the prenegotiation phase, is dedicated to address arriving at a shared definition of the problem. During the second phase, the parties identify the interests which brought them to the table, determine how they differ from the interests of others, set directions and establish shared goals. The final step of the collaborative process is the implementation phase during which parties gain the support from others. In line with the definition, both first and second phases mainly concentrate on carefully defining and, if need be, redefining the issues involved before moving on to solutions. And the last phase determines what support the participants may gain.

Intuitively, the objective of CSCL should not only to duplicate the features of a FTF environment, but rather to create a more effective learning environment to enhance the development of perception of belonging to the group. This study suggests that the dynamic process of CSCL can be divided into two dimensions, perceptual dimension and supportive dimension, which are rooted from Gray’s (1989) definition of dynamic collaboration process. As shown in Table 1, perceptual dimension of CSCL covers learners’ perception of norms of cooperation and task conflict, as
these aspects mainly cope with the interaction between members and the group to which they belong. Supportive dimension of CSCL focuses on the collaborative behaviors which are mutually beneficial to the group; thus it deals with learners’ workload sharing and knowledge sharing. In particular, the former dimension is much important because a sense of group seems play an important role in leading later supportive behaviors (DeSanctis & Gallupe, 1987; Kidwell & Bennett, 1993; Rourke, 2000). Therefore, perceptual dimension is worthy for us to shed light on it.

Many studies have documented that individuals may exert less effort when working collectively without sense of belonging to the group (DeSanctis & Gallupe, 1987; Kidwell & Bennett, 1993; Rourke, 2000). Obviously, collaborative learning is not always beneficial in that students may encounter a set of problems such as non-contributing group members, unequal workload, and personal/social conflicts between group members (Becker & Dwyer, 1998). To overcome the unwilling result, group members collaborating online need to consciously strive to engage in group activities to create a perception of belonging to the group, therefore they can gain supports and benefits from CSCL.

Table 1. A two-dimension of CSCL process

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Descriptions</th>
<th>Factors included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceptual</td>
<td>Measuring extent of collaborative norms in the group</td>
<td>• Norms of cooperation</td>
</tr>
<tr>
<td></td>
<td>Assessing extent of task conflict in the group</td>
<td>• Task conflict</td>
</tr>
<tr>
<td>Supportive</td>
<td>Measuring extent of sharing resources or assisting those deficient in their work</td>
<td>• Workload sharing</td>
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<tr>
<td></td>
<td>Examining learners’ new ideas which gain through peer collaboration by interpersonal discourse</td>
<td>• Knowledge sharing</td>
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Perceptual dimension: norms of cooperation and task conflict

In fact, group activities conducted by members of problem solving groups, mainly deal with two types of pressures in achieving quality solutions and high solution acceptance (Maier, 1967). On the one hand, there is pressure on each member to contribute unique, and possibly controversial, information to maximize the group’s resources. On the other hand, members of the group tend to believe that a strong solution acceptance is best achieved through conformity of opinions. Consequently, individuals in a problem-solving group usually engage in activities such as dealing with disagreement in tasks and shared expectations that constrain and drive the action of group members. Thereby, engaging in these activities may shape learners’ perception about the group to which they belong. This study adopts Maier’s idea to refer group activities to dealing with task disagreement and shared expectations because the nature of CSCL also mainly focuses on the group work. In addition, shared expectations in this study are more specifically defined as norms of cooperation not only because they are essentially kind of norms, but also because cooperation is the major concern of this study. We also drew on Maier’s (1967) description of the pressure aspects of a group for defining group context that group member may perceive. Learners’ perception of group context variables thus includes perception of task conflict and perception of norms of cooperation across all individuals within a group. Norms are informal rules of conduct for behaviors that are considered important by most group members. According to Coleman (1990), a norm exists when the socially defined right to control an action is held not by the actor but by others. Thus, it represents a degree of consensus in the social system. Along with this perspective, Bettenhausen and Murnighan (1991) conclude that group norms tell group members how they are expected to behave. As a result, groups with shared norms of how to behave would waste less time in group meeting and use their resources better by avoiding duplication of work by group members.

The notion that CMC can accentuate, rather than attenuate, normative influence has received consistent empirical supports (Coleman, Paternite, & Sherman, 1999; Postmes, Spears, & Lea, 1998; Reicher, Spears, & Postmes, 1995). In fact, this finding can be derived from two theoretical perspectives, including social identity model of deindividuation effects (SIDE) and uncertainty reduction theory (URT). According to SIDE, interaction via a computer network can actually heighten group salience and, hence, conformity to a group norm because anonymity in CMC may induce a shift in focus from individual identity to collective identity (Reicher, Spears, & Postmes, 1995). The principal reason is that the decreased visibility of individuality can shift the emphasis away from concerns about others’ individuality within the group, and towards the shared communalities and group concerns (Postmes, Spears, & Lea, 1998). Researchers have also suggested that anonymity and physical isolation in CMC not
only allows group members to separate posters from specific ideas (Jessup, Connolly, & Tansik, 1990) but also “serves to focus individuals’ attention on the task to glean the most possible information from the text-only medium” (Coleman, Paternite, & Sherman, 1999, p.61).

Another theoretical perspective that CMC can enhance conformity to induce group norms is due to URT (Berger & Calabrese, 1975). In line with its assumption, information exchange serves as an input that enables individuals to predict and explain the other’s behaviors (Berger, 1988). Apparently, this assertion to reduce uncertainty would be fundamentally unique in CMC interactions. In fact, it might be argued that many CMC settings offer conditions where uncertainty is high because of, for instance, anonymity or a lack of course of proper actions. In the absence of uncertainty, observation of others engaging in a behavior is likely to be associated with individuals’ own understanding of the appropriate mode of conduct. Further, if one does not perceive uncertainty, one is not likely to seek out normative information via active or interactive means (Berger & Calabrese, 1975).

In sum, CSCL is a cyberspace under which a situation of uncertainty develops, though it is usually free from constraints of regulation or boundaries. However, several studies have shown that anonymous CMC may serve as a vehicle for strong normative influence in groups (Coleman, Paternite, & Sherman, 1999; Jessup, Connolly, & Tansik, 1990; Postmes, Spears, & Lea, 1998). As such, a norm of cooperation allows group members to conduct their activities in supportive ways that are consistent with group expectations, because an absence of social cues provides a context in which individual differences are obscured. Being unable to perceive the self and the other as individuals may accentuate the unity of the group, and cause individuals to be perceived as group members rather than as unique individuals (Postmes, Spears, & Lea, 1998). Therefore, norms of cooperation give group members a common perspective that enables them to develop similar perceptions and interpretations of actions, leading a high level of supportive behaviors.

Another indicator used in perceptual dimension is task conflict. Conflict exists when inconsistent activities occur (Deutsch, 1973), which means disagreement between people or groups. Collaborative learning helps learners to discuss and finally comes up with an acceptable solution or consensus on given tasks. The consensus can be obtained by different ways, one of which is by discussing and reviewing disagreements with the task from each other. We focus on the task conflict is because which can increase group members’ tendency to scrutinize task issues and to engage in deep and deliberate processing of task-relevant information (Jehn, 1995). Therefore, in this study we defined task conflict as the different viewpoints and opinions about the task being performed.

It’s widely accepted that learning arises from the opportunities for the group members to explore multiple representations or perspectives on a specific task. However, it’s not that easy to have things happen naturally. Rourke (2000) remarks that “if students are to offer their tentative ideas to their peers, if they are to critique the ideas of their peers, and if they are to interpret others’ critiques as valuable rather than as personal affronts, certain conditions must exist. Students need to trust each other, feel a sense of warmth and belonging, and feel close to each other before they will engage willfully in collaboration and recognize the collaboration as a valuable experience.” In other words, a sense of group seems to be the first step for collaborative learning, and then the process of the deliberation for reaching shared understanding can move on.

In the context of CSCL, communication is one of the processes most affected by CMC and yet is central to the success of deliberation. Although the CSCL is designed to provide a communication environment that is similar to FTF communication, past research suggested that these two environments are clearly not the same (Joiner, 2004). A number of characteristics of CSCL have potentially benefited the process of collaboration. First, group members can reflect on previous arguments and reply with a thought-out response. Second, it provides the opportunity for group members to post opinions simultaneously. Finally, groups interacting via CMC have more equal participation among members than groups interacting FTF (Joiner, 2004). In this regard, learners in CSCL are more likely to achieve an agreement on the task through explicit and complete discussion on everyone’s ideas. Because such reflective behaviors (i.e., providing and receiving explanations) may help students clarify misunderstanding and enhance mutual comprehension (Chi & Bassock, 1989), therefore can help learners fill in gaps in their understanding.

In an enduring relationship, groups are more willing and more able to provide deliberation and reflection through repeated interactions (Coleman, 1988). Through repeated interactions, group members thereby become more similar regarding how to complete the task and develop similar understanding. In this regard, individuals are more likely to understand what others think and what problems embarrass their members; therefore they can provide pertinent
resources and assistance. The process of eliminating disagreement in cognition fosters learning and the development of new and sometimes highly creative insights, leading the group to become more effective (De Dreu & West, 2001; Jehn, 1995), thus may enact intensive supportive behaviors.

**Supportive dimension: workload sharing and knowledge sharing**

While accomplishing the task at hand, group members are forced to look for free riding or social loafing because which significantly increase the other group members’ burden of completing the task. If one member free rides, others may notice and, so as not to be victimized by the free rider, may also free ride. Obviously, if all members free ride, the group task will not be finished. In this sense, there should be workload sharing to avoid social loafing or free-riding in the collaborative groups (Albanese & Van Fleet, 1985). Moreover, according to Vygotsky, learning is seen as a social and cognitive process in which different perspectives are incorporated. The contribution of different understandings leads to a new, shared knowledge. Accordingly, researchers on collaboration propose that knowledge is created as it is shared, and the more it is shared, the more knowledge is created (Rogoff, 1995; Lave & Wenger, 1991). Seeing that past research have confirmed that workload sharing and knowledge sharing play important roles either in task accomplishment or in collaborative learning, this study, thereby regarded them as factors of supportive dimension.

Workload sharing is dividing work equally among group members. In this study the concept of workload sharing was similar to helping behavior, which was defined as “voluntary actions intended to help or benefit another individual or group of individuals” (Eisenberg & Mussen, 1989, p.3). Helping other group members, such as sharing resources or assisting those deficient in their work, benefits the immediate work group and the organization (Anderson & Williams, 1996; Borman & Motowidlo, 1993). As CSCL provides social connections for individuals to collaborate online, indeed it also stimulates the resources embedded within the social connections, such as one’s experience, time and effort. Through repeated interactions, individuals are able to access and mobilize such resources on the task at hand. Van Dyne et al. (1995) confirmed that when a group has strong norms of cooperation, members expect mutual support from one another to enhance task completion. In other words, groups with norms of cooperation will encourage members to assist other group members.

In line with the past research that documented the significance of informal interaction, a learning environment should encourage active participation, interaction, and dialogue among learners to engage in a process of knowledge construction (Lin Hsiao, 1996). However, there are reduced informal interactions in virtual settings that would normally take place in a traditional collocated environment (Ellison, 1999). Thus, individuals who have experienced coworking with distant colleagues reported that this solitary environment engenders a feeling of remote isolation (Turban, McLean, & Wetherbe, 1996). The nature of solitary of a virtual setting in which CMC is used for collaboration adversely affect individuals’ commitment toward their task and their members (Civin, 1999). Accordingly, if a CSCL setting provides learners strong feeling of solitary, learners may not commit to the group task and then prefer to work alone, which in turn leads to less willingness to share other members’ workload.

CSCL system is centered upon the communications and interactions of individuals to generate specific domain knowledge that enable them to perform common functions and to learn from, contribute to, and collectively build upon that knowledge (Lee et al., 2003). While CSCL bring learners together virtually from all over the world, knowledge sharing among them has not lived up to expectation. Pfeffer and Sutton (1999) found that knowledge management in many organizations only emphasize on technology, particularly information technology. Dixon (2000) also pointed out that “build it and they will come” is the myth of knowledge sharing. Clearly, the biggest challenge in fostering CSCL system is the willingness to share knowledge with other members. By understanding what stimulates members of groups to share knowledge, it is possible for us to distinguish the mechanism that eases the sharing of knowledge among learners.

Knowledge sharing occurs in CSCL settings is significantly different from that occurring in conventional contexts in several ways. First, CMC allows a much larger number of individuals to be connected by informational linkages with nearly no more extra effort, which is quite different from in the case of FTF. For instance, the effort to email a message to all contacts in the address is only slightly more than the effort in sending the message to just only one recipient. This reduction in the effort needed to reach out to others increases the number of occasions for individuals to share various information or knowledge. Second, in order to better construct a new knowledge, learners are
required to be exposed on various perspectives elaborated by others. Different perspectives help individuals to glean information/data for the purposes of knowledge construction. Nonetheless, the evanescent nature of ephemeral messages means that it must be captured immediately before it loses. In this regard, a CSCL system that can automatically records learners’ message content encourages the learners to resolve their own disputes by using CMC for knowledge sharing.

The sharing of knowledge is interwoven with the processes of interaction of different understandings. It is not limited to simple information exchange, but is related to the influence among members as a result of more frequent and in-depth interactions. This influence process is necessary for achieving mutual understanding between groups. For instance, individuals usually seek to either influence others into accepting these ideas or be influenced by others' ideas and attitudes. One way the influence is developed is likely through a shared expectation. Because individuals expect payback for contributions to an exchange, the perception of reciprocal benefits leads to mutual influence and success in future group exchanges (Cohen & Bradford, 1989). In this view, the perception of reciprocal benefits, specifically, is analogous to norms of cooperation because of their similar substance. Integrating the abovementioned and in line with the past study that documented that knowledge sharing behavior is likely to be influenced by contextual forces (Yoo & Torrey 2002), we then suspect it will be enhanced by the two indicators in perceptual dimension because of a sense of group (DeSanctis & Gallupe, 1987; Kidwell & Bennett, 1993; Rourke, 2000).

**Group composition**

Research studies on factors affecting learners’ outcome in CSCL indicated the importance of group composition (Adrianson, 2001). This study focuses on learners’ personality profile as one way to distinguish different group compositions because past research acknowledges that members’ diversity can cause variations in their attitude, beliefs, and behaviors, leading to affect overall performance (Shaw, 1981; Hackman, 1987). The greatest advance in personality research has been the emergence and broad acceptance of the “Big Five” model of personality (Digman, 1990; Hogan et al., 1996). Extraversion, widely agreed to be the first “Big Five” personality factor, appears to be a valid predictor for tasks involving social interaction (McCrae & Costa, 1992). Accordingly, we supposed that personality traits play an important role in individuals’ social-communicative competence (Busato et al., 1999; Smolensky et al., 1990; O’Hair et al., 1995), because learning to behave adequately in virtual communicative settings requires the active interaction of a student with certain personality characteristics with other members.

In their study, Smolensky et al. (1990) suggest that individual’s personality profile of extraversion/introversion has a positive influence on verbal interaction in CMC environments. This coexistence of extraversion/ introversion is particularly relevant to the way of learning in CSCL setting. This is because the unique components of the CSCL may assist introverted learners to express themselves more freely on the net than they feel able to in an offline relationship. For instance, studies have reported that extraverts tended to speak more often with longer comments and to be more talkative than introverts (Borman & Motowidlo, 1993; McCrae & Costa, 1992). However, Maldonado et al. (2001) evaluated messages on CMC and found that introverted subjects send messages with more information than they do in FTF settings. While CMC is different on a number of criteria, there is no reason to believe that frequent and open contact between learners in CSCL does not influenced by individuals’ psychological profiles (Amichai-Hamburger & Furnham, 2007).

Conceptually, collaborating via the Internet inherently requires more intensive and active communication among one another and participation in the group activities. In this regard, personality profile of extraversion/introversion seems important. In fact, extraversion as a communication style contains two important components i.e., talkativeness and enthusiasm (Borman & Motowidlo, 1993; McCrae & Costa, 1992; Smolensky et al., 1990). Groups that have an extraverted communication style are more likely to generate more intensive and active interaction, because the number of learners answering actively to a post is supposed to be high. Thereby extraverts are more likely to dominate in CMC to impact on social influence (Smolensky et al., 1990). Seeing that many others actively participate in the group activates and individuals use the group to glean information on how to cope and behave, therefore individuals collectively engender group norms.

Unlike individuals in FTF setting where they glean this information by observing and communicating with others, individuals may not perceive both types of awareness without intensive interaction with one another in virtual groups. This is especially important because in a CSCL environment individuals’ emphasis can only be placed on the
content of one’s historical posts. Along with intensive interaction with one another to create a common understanding of the work being done, group members understand and incorporate each others’ differences in opinions and viewpoints (Moreland & Myaskovsky, 2000). Thus, extravert groups are believed to have high level of awareness of who knows what in the group, and group members become more efficient at solving problems, coordinating, and allocating responsibilities for the task. This is likely to result in smoother task implementation and accomplishment, and subsequent reduction in disagreement or conflict about the task.

Research Methods

A total of one hundred undergraduate students enrolling in a business organizational behavior course in Taiwan participated in this study. Participants were divided into 20 work groups, each consisting of 5 members. Groups engaged in academic work for course credit and were functioning as work teams with performance incentives. Two groups were dropped from the study later because of incomplete questionnaire data. The analyses we reported were based on a sample of 90 individuals within 18 groups. The course required a total of eighteen-week of instruction, lasting from mid-September 2005 to late January 2006. Upon the completion of group formation during Week 4, each group chosen a real-world business case from the case list and all participants completed an on-line personality assessment instrument. Each of the business case describes a unique real-world problem with no explicitly provided analytical strategy and no singly correct answers. During Week 7, each participant handed in an individual case report in which he (she) propose an analysis on the case and summarize written solution on its problem task. During Week 14, participants completed group dynamics instruments, including perceptions on task conflict, norms of corporation, and workload sharing. Groups were required to hand in a group term paper describing the written solution and analysis for the case problem during Week 15. One question asking the plausible solution on the business case problem was included in the final examination, which was held during Week 16.

A sample screen of the discussion board system is shown in Figure 1. It includes two main sub windows; the upper window is for learners to read course material, and the lower window is for learners to post any message they want to discuss or share with their members. To discourage interference from nonmembers, the system separated the intra-group spaces of different groups and hindered outsiders from intruding. This would further facilitate group members’ feeling of belonging and provide opportunities for them to collectively reflect on their group’s norms. In sum, on the one hand, participants used this inter-group space to discuss different opinions proposed by other group members and read course content shared by instructors. On the other hand, groups can get together to cooperate or compete with one another. Under the virtual group space, individuals were more likely to refer to other members’ behavior.

In Figure 2, if participants click the button to post a message, the lower window will pop up the next interface asking them to fill in information such as subject, content and, if any, multimedia files. As shown in Figure 2, in the lower window, participants can chose to send a multimedia file which contains a drawing by using the electronic whiteboard or a voice by using the electronic recorder. The electronic whiteboard allowed all the group members to collectively come out a graphic metaphor illustrating the plausible model they developed. Because a computer-
generated visual aid could add interest to the group discussion, thus the electronic whiteboard enabled group members to have an effective brainstorming by drawing graphics asynchronously, and then made them more like a group. In addition, studies have pointed out that verbal cues are conducive to the collaborative or dialogic construction of knowledge in asynchronous communication context. The use of electronic recorder was then served as another supportive tool.

Annotation tool is another function that supports electronic brainstorming in our system. Participants used it to mark up any comment on the course or group work material and the system would share these comments to their group members. As such, when individuals move to the phase of evaluating others’ ideas, they could easily understand what others think by referring to their members’ annotations on the material, and then provided the opportunity for themselves to fill in gaps in disagreement with the task. Group members may be stimulated to build on the ideas of other group members. In sum, this system include one-to-one and one-to-many asynchronous text, image, audio, or video communications in its design.

Measures

We use four measures to assess corresponding constructs. Group Composition. We used the extraversion/introversion subscale of Myers-Briggs Type Indicator (MBTI) instrument (Myers, 1984) to measure subject’s extravert and introvert type. Participants were asked to judge the accuracy level of each adjective as a description of self from one of two options. A person’s MBTI score determines his or her type, a label based on his or her dominant preference for the extraversion/introversion dimension. Accordingly, three team composition types were classified based on the proportion of extraverts in the team: introvert team (0-1 of extroverts), extravert team (4-5 of extraverts), and hybrid team (2-3 of extraverts).

Task Conflict. Task conflict was measured by 3 items adapted from Jehn (1995) and Jehn and Shah (1997). The items were assessed on a 5-point Likert scale. A sample item of task conflict is “To what extent are there differences of opinion in GROUP.” Norms of cooperation. We measured norms of cooperation with three items adapted from Wageman’s (1995) cooperation norm scale. A sample item is “In my group, we think that everyone should volunteer to do things for the group”. Workload sharing. Individual’s workload sharing was referred to and measured by Van Dyne and LePine’s (1998) scale. The scale includes 4 items. A sample item is “We regularly take time to figure out ways to improve our group’s work processes”. Knowledge Sharing. In order to measure group knowledge sharing, we operationalized two variables: individuals’ pre-discussion knowledge and individuals’ post-discussion knowledge. The former is counting the number of feasible solutions proposed in individual’s case report. The latter we included a question asking participants to list again all the feasible solutions in the final examination at the end of the semester. The individual gained one point of knowledge sharing if a solution which hadn’t revealed in one’s own pre-discussion knowledge but had appeared in other members’ pre-discussion knowledge was presented in one’s final examination. Finally we accumulated each group members’ knowledge sharing points to serve as the indicator of group knowledge sharing.

Results and Discussion

The reliability coefficients of task conflict, norms of cooperation, and workload sharing, measured by Cronbach’s α, were 0.813, 0.801 and 0.837 respectively. In this study three types of group composition were classified: hybrid group, introvert group, and extravert group. Table 2 presents the descriptive statistics associated with our research variables for each type of group.

<table>
<thead>
<tr>
<th>Dimensions of CSCL Process</th>
<th>Perceptual</th>
<th>Supportive</th>
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<tbody>
<tr>
<td></td>
<td>Norms of cooperation</td>
<td>Task Conflict</td>
</tr>
<tr>
<td>Group type (# of group)</td>
<td>Mean (std)</td>
<td>Mean (std)</td>
</tr>
<tr>
<td>Hybrid groups (n=10)</td>
<td>4.13 (0.29)</td>
<td>3.04 (0.25)</td>
</tr>
<tr>
<td>Introvert groups (n=5)</td>
<td>4.13 (0.18)</td>
<td>2.87 (0.29)</td>
</tr>
<tr>
<td>Extravert groups (n=3)</td>
<td>4.60 (0.12)</td>
<td>2.50 (0.22)</td>
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</tbody>
</table>
Of the three types of group, hybrid groups had the highest task conflict, the lowest workload sharing, and moderate group performance. Introvert groups had moderate task conflict and workload sharing. Extravert groups had the lowest group task conflict and the highest level of workload sharing and cooperative norms. The correlation matrix shown in Table 3 indicates cooperative norms was positively associated with workload sharing but was negatively associated with task conflict. Workload sharing was negatively associated with task conflict. None of the relationship between knowledge sharing and other variables was significant in this study.

Table 3. Correlation matrix of study variables

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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>1. Norms of cooperation</td>
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<td></td>
<td></td>
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<tr>
<td>2. Task conflict</td>
<td>-0.58*</td>
<td>1.00</td>
<td></td>
<td></td>
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<tr>
<td>3. Workload sharing</td>
<td>0.73**</td>
<td>-0.69**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>4. Knowledge sharing</td>
<td>0.25</td>
<td>0.13</td>
<td>0.09</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**: Correlation is significant at the 0.01 level; *: Correlation is significant at the 0.05 level

The impact of group composition on perceptual dimension

One-way ANOVA test was conducted to examine the effect of team composition on learners’ perceptual dimensions of CSCL process, namely task conflict and norms of cooperation. Table 4 shows significant group differences on task conflicts (F = 4.92, p < 0.05). Turkey’s LSD post hoc analysis was employed to further identify which groups differ significantly. As a result, Table 5 shows that the difference on task conflict between extravert group and hybrid group is statistically significant (p < 0.05). Extravert groups had the lowest task conflict whereas hybrid groups perceived the highest task conflict. Regarding the group norms of cooperation, Turkey’s LSD post hoc analysis indicated that extravert groups perceived a significantly higher norms of cooperation than both hybrid and introvert groups.

Table 4. Effects of team composition on learners’ perceptual dimension of CSCL process

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task conflict</td>
<td>Between Groups</td>
<td>0.66</td>
<td>2</td>
<td>0.33</td>
<td>4.92</td>
<td>0.02*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>1.01</td>
<td>15</td>
<td>0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1.67</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norms of cooperation</td>
<td>Between Groups</td>
<td>0.55</td>
<td>2</td>
<td>0.27</td>
<td>4.51</td>
<td>0.03*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>0.91</td>
<td>15</td>
<td>0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1.46</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*: p<0.05

Table 5. Multiple comparisons on norms of cooperation and task conflict

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(I)</th>
<th>(J)</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norms of cooperation</td>
<td>H</td>
<td>I</td>
<td>0.00</td>
<td>0.14</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>I</td>
<td>-0.47</td>
<td>0.16</td>
<td>0.01*</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>E</td>
<td>-0.47</td>
<td>0.18</td>
<td>0.02*</td>
</tr>
<tr>
<td>Task conflict</td>
<td>H</td>
<td>I</td>
<td>0.17</td>
<td>0.36</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>I</td>
<td>0.53</td>
<td>0.43</td>
<td>0.01*</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>E</td>
<td>0.36</td>
<td>0.48</td>
<td>0.43</td>
</tr>
</tbody>
</table>

*: p<0.05

“H” stands for hybrid groups; “I” stands for introvert groups; “E” stands for extravert groups

Relationship between learners’ perceptual dimension and supportive dimension

Regression analysis was used to investigate whether learners’ perceptual dimension of CSCL process would lead to supportive behaviors, namely workload sharing and knowledge sharing. Table 6 indicates that the effects of norms of cooperation and task conflict on workload sharing were significant (β= 0.48, p < 0.05; β= -0.40, p < 0.05,
respectively). This result indicated that groups perceiving stronger norms of cooperation and less task conflict resulted in more workload sharing. However, neither norms of cooperation and task conflict were significant in explaining knowledge sharing. Accordingly learners’ collaboration process of perceptual dimension can only partially predict one of the indicators in the supportive dimension, namely workload sharing.

**Table 6. Regression analysis of variables of perceptual dimension on workload sharing**

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>Norms of cooperation</td>
<td>0.53</td>
<td>0.21</td>
<td>0.48</td>
<td>2.58</td>
</tr>
<tr>
<td>Task conflict</td>
<td>-0.41</td>
<td>0.19</td>
<td>-0.40</td>
<td>-2.15</td>
</tr>
</tbody>
</table>

Dependent Variable: Workload sharing

$R^2 = 0.63$, Adj-$R^2 = 0.58$

*: p<0.05

The present study has two aims: (1) to test whether learners’ personality profile of extraversion/introversion would influence learners’ their perception of group context variables such as task conflict and norms of cooperation and (2) to test if these variables predict learners’ supportive behaviors in the CSCL setting. After testing the two questions, we believe our study makes several contributions. First, we propose a two-dimension process, perceptual dimension and supportive dimension, to explain engendering of collaborative behaviors in CSCL. Second, we demonstrate the importance of group composition and show its impact on learners’ perceptual dimension. Finally, rather than identifying the relationship between perceptual and supportive dimension, this study corroborate there exist a perception of group context that affects learners’ willingness to conduct collective behaviors in CSCL.

This study explored and identified two possible factors affecting learners’ supportive behaviors and then integrated Gray’s (1989) definition of collaboration to propose a two-dimension process for explaining how collaborative behaviors were engendered. The results reveal that learners’ supportive behaviors (workload sharing) can be enhanced by perception of group context (norms of cooperation and task conflict). Based on a wide review of identifying critical antecedents leading to collaborative behaviors in CSCL, this study suggests perceptual dimension as the first stage of enhancing collaboration in CSCL. After experiencing high cooperation and low task conflict, learners perceive a sense of group and are more willing to contribute their effort to share workloads.

Extraversion contains an element of positive affectivity (George, 1992), which is an overall sense of well-being. Accordingly, an extravert group develops norms of cooperation that are likely to persist as the group moves toward task completion. Furthermore, a low level of task conflict in extravert groups indicated that different viewpoints on a specific task seldom emerged. Compared with hybrid groups, the result was consistent with the suggestion from previous literature that increasing group diversity can lead to conflict between members (Jehn 1995). Task conflict exists when group members disagree about the content of the tasks, aid differ in viewpoints, ideas, and opinions. This suggests that learners in homogeneous group composition are more likely to reach a shared cognition, which can reduce disagreement.

We propose a two-dimension process and test the link between them. In fact, by testing the relationship, we documented that learners’ perception of group context variables play an intermediate role in controlling their later collaborative behaviors. It not only help us explain how collective behaviors were engendered, but implies a shift in focus from duplicating parallel functions in FTF setting to maintaining social and psychological perception of group context as designing a CSCL system. Along with the consecutive advance in information technology, developers can now provide more novel and parallel mechanisms to duplicate features in FTF. While accepting its usefulness in fulfilling learners’ requirement to study online, we suggest educators and developers should not restrict learning mechanisms to instructional functions aimed at cognitive processes. In contrast, perceptual functions aimed at social and psychological processes should also be emphasized and established. We can’t tell which variables other than this study related to group context are required to be facilitated and monitored by information technology in that only two indicators of perceptual dimension were used in this study. However, it is reasonable to suppose that other critical variables may shape learners’ perception of group context. If we can identify more of these factors and determine the predictive power of each in explaining learners’ supportive behaviors, it is possible for instructors and educators to manage and enhance behaviors conducive to online collaborative learning.
Conclusion

This paper proposes a two-dimension of dynamic process for further our understanding of what factors lead learners to conduct collective behaviors of collaboration in CSCL settings. From the empirical evidence, the impact of group composition of extraverts/introverts on learners’ perception of task conflict and perception of norms of cooperation has been supported. It was also supported that learners experiencing high level of shared norms of cooperation and low level of task conflict are more likely to conduct supportive behaviors of workload sharing.

Our results indicated that extravert groups are more likely to reach shared norms of cooperation in CSCL setting. Extraversion usually affects interpersonal relations through the quality of social interactions. As such, extraverts are active participants in group interactions, even in CSCL setting; therefore it seems that they play an important role in explaining engendering of collaborative behaviors. In this regard, we believe extraverts may have high intragroup popularity to influence others to accept their ideas and are more likely to perceive normative information and to match other members’ expectations. Further, there is another alternative. Given that extraverts are active and usually adept at interacting, it is reasonable to suspect that they are more likely to establish norms of cooperation rather than to follow it. Our study cannot rule out this alternative, future research may take into account the influence of norms establishers and norms followers while considering questions about collective behaviors.

Our study found that learners’ supportive behaviors of workload sharing were stimulated by enhancing their perception of group context variables. The coefficient of norms of cooperation indicated that learners are more willingness to share resources or assist those members deficient in their work as they perceived strong norms of cooperation. As one begin to interact and coordinate to finish the group task over time, perceiving cooperative norms would trigger one’s supportive actions to help others. As a result, shared norms of cooperation lead to the positive attitude of workload sharing. Task conflict was proposed as a key source of divergent thinking, encouraging use of unique information, and pooling of resources to create a better solution. However, this study found that it is negatively associated with group members’ supportive behaviors. Contrary to the effect of norms of cooperation, this result suggests that learners’ perceptions of group context not always positively affect their supportive behaviors. Collaborative learning provides equal power relations among peers allow learners to actively take different perspectives (Matusov & Hayes, 2000), leading them to review their own ideas and coordinate actions and perspectives to resolve cognitive disagreements. If these cognitive differences can not be resolved, learners in the group may perceive a high level of task conflict, which in turn decrease willingness to share workload of other members.

Knowledge sharing was not significantly associated with norms of cooperation and task conflict in this study. This unexpected result brings us a question why the relationship was not supported. Compared with prior literatures that confirmed knowledge sharing comes from interactions and clarifications (Lee et al., 2003; Dixon, 2000), our result seems to be contradictory. Apparently there might be other factors leading to intensive knowledge sharing. One of the plausible factors may be derived from the well-known motivation theory. Maslow (1954) suggests that human conduct is motivated by five classes of needs: basic, safety, belongingness, esteem, and self-actualization. Davenport and his colleagues (1998) also argue individuals will not share their knowledge as they think their knowledge is valuable and important, unless a sound incentive system is available. Thus, future research may consider integrating motivational factors into the two-dimension dynamic process. Another plausible explanation stems from media richness theory (Daft et al., 1987), which argues that media are differentially suited to diverse tasks. Asynchronous technologies, such as discussion forum, are useful for arranging meetings and sharing provisional documents, while synchronous technologies are more useful for brainstorming and decision-making (Rourke & Anderson, 2002). The task employed in this study is to solve a real-world business case required a brainstorming from group members to address its unstructured problems. Asynchronous technologies seem to be lack of establishment of brainstorming or be less efficient in this way. As a result, knowledge sharing was not significant as what we had expected. Future research should take Rourke and Anderson’s suggestion into account and try to provide synchronous technologies to see whether learners with synchronous technologies support have more knowledge sharing behaviors.

Implications

From a practical standpoint, our results provide good news for instructors and educators, because in order to stimulate supportive behaviors in CSCL they can affect learners’ perception of group context variables (norms of
cooperation and task conflict) by managing group composition. We use personality profiles of extraversion/introversion as group composition, which means instructors and educators may wish to assign more extravert learners to the group because they can stimulate the enactment of norms of cooperation and help reach an agreement among members on the task at hand. It has been widely emphasized that CSCL brings many advantages for students such as flexibility in terms of time and space. However, it is also a double-edged sword in educational domain. Although it may accompany with a number of advantages, it also hinder teachers to identify each learners’ characters by extending psychological distance as well. Through this study, learners’ impact of psychological distinction on attitude toward the cyber group has been supported, highlighting its indirect influence on collective behaviors online. In this regard, educators and instructors should be aware of learners’ uniqueness behind the fascinating functions enhanced by information technology.

Finally, learners in homogeneous group composition are more likely to reduce disagreement of how to complete the task and increase goodwill in supporting members because of a shared agreement of what should be done. Although not significantly supported, heterogeneous groups seem perform better knowledge sharing. It may imply a contingency for educators and instructors to determine a suitable group composition while considering the task characteristics. For instance, a routine task may not require too much information exchange, but may rely on its members to share required resources. In addition, a non-routine task may require its members to exchange valuable ideas to solve the unstructured problems properly. In sum, we suggest that although CSCL definitely brings learners flexibility in learning, it doesn’t bring educators stability in teaching.

**Limitations of the study**

The main limitation in this study was the insufficient sample size. We have a total of 100 subjects (in 20 groups) participating in the study. However, only the data of 90 subjects (in 18 groups) were employed for further analysis due to data missing. Accordingly, the generalizability of our study results is limited. In addition, our study focused on the non-routine, problem-solving based task. This specific task characteristic could become our study limitation. Future study should employ other types of tasks to examine if different types of task would result in different stories. Finally, many other interesting factors are excluded in this study because of the limitation of research scope. As a result, future research may consider effects of some other factors on individuals’ perception of group context and the latter influence on collaborative behaviors. One of the factors excluded from this study, for instance, is ethnicity. Different ethnicity has different culture that provides basis of how we assert, question, demand, and judge. In fact, a culture is a complex set of shared beliefs, values, and concepts which enables a group to make sense of its life and which provides it with directions for how to behave. Similarly, although not so complicated as the issue of ethnicity, individuals’ gender and age are acknowledged to be critical antecedents in shaping ones’ courses of action. Therefore, a follow-up study dealing with issues of ethnicity, gender, and age seems to be worthwhile.

**Reference**


Rourke, L. (2000). Operationalizing social interaction in computer conferencing. *Paper presented at the 16th Annual Conference of the Canadian Association for Distance Education*, May 3-6, 2000, Quebec City, Canada.


