The Impact of Task Type on Learners' Argumentation, Participation and Collaboration in Online Discussions

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Ying-Ting Hsiao

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Name: **Ying-Ting Hsiao**

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Examining Committee:

Chair: Michelle Nilson, Assistant Professor

Alyssa Wise
Senior Supervisor
Assistant Professor

John Nesbit
Supervisor
Professor

Kevin O'Neill
Internal Examiner
Associate Professor

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Abstract

Task type is a fundamental element that directs learners' interactions in collaboration. The study grounds its design in McGrath's (1984) *Group Task Circumplex* and examines students' online behaviors, processes of argumentation, and collaboration. Students were asked to solve an authentic organizational challenge in a five-day online discussion in a blended (face-to-face and online) undergraduate business course. Two kinds of tasks were given: a task with an open-ended question, and a task with two contrasting alternatives. Twenty-three groups (107 students) agreed to participate; the content of their posts and participation (click-stream) data were collected. The results show that the groups given an open-ended question participated more actively in reviewing and reading activities; they also challenged others more often and provided more supporting reasons and evidence, but there seemed to be an unequal distribution of efforts among group members in the time they spent reviewing and the length of posts they made.

Keywords: task type; asynchronous discussion forums; argumentation; student participation; mixed methods

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1. Introduction

As distance education continuously expands in the number of courses and learners enrolled (Allen, Seaman, & Garrett, 2007), computer-mediated communication tools have been applied to support group interaction and discussion (Jeong, 2003). One of the prevalent tools used to engage learners in active meaning-making and argumentative discourse is the asynchronous discussion forum (ADF) [Carabajal, LaPointe, & Gunawardena, 2003]. An ADF is a virtual online space where learners can read and post messages that can be replied to at any time. Kaye (1989) described it as "a means for the weaving together of ideas and information from many people's minds, regardless of when and from where they contribute" (p.3). ADFs can facilitate collaboration and in-depth interactions between learners and teachers, as well as provide time for reflection which can trigger higher-order cognitive learning processes (Garrison, Anderson, & Archer, 2000; Jonassen & Kwon, 2001). According to Weinberger and Fischer (2006), learning through text-based ADFs can be considered as one kind of Computer-Supported Collaborative Learning (CSCL). At different times and from difference places, posts are accumulated in the tool when learners make their contributions. These learners can then interact with these posts at their own pace, both by reading others' comments before composing their own and by shaping their propositions while taking others' views into consideration. Consciously or unconsciously, through participating in the activity, learners' viewpoints might be dynamically influenced by the previous reading they engaged in (Suthers, Dwyer, Medina & Vatrapu, 2010). In this manner, learners can develop both individual and collective knowledge through diverse cognitive activities such as sharing, debating, negotiating, synthesizing, and testing in virtual space without being restrained by time and location.

1.1. Challenges for Collaboration and Argumentation in Online Discussions

Despite the attractive possibilities described above, in practice, online discussion forums often lack in-depth interactions. For example, many studies have found that learners were not actively involved in the discussion activity (see review by Hew, Cheung, & Ng, 2010) and that their participation was driven by the simple goal of fulfilling the course requirements (Dennen & Wieland, 2007; Hara, Bonk, & Angeli, 2000; Palmer, Holt, & Bray, 2008). These findings suggest that learners often have low cognitive engagement when participating in online discussions forums (Angeli, Valanides, & Bonk, 2003; Dennen & Wieland, 2008; Webb, Jones, Barker, & van Schaik, 2004) and fail to collaborate effectively (Paulus, 2005; Straus & McGrath, 1994). The following sections identify several possible contributing factors to these problems and propose a solution to improve online interactions that will be the focus of inquiry in this thesis.

1.1.1. Lack of attention to others' ideas

Low cognitive engagement is particularly evident when looking at the interactivity in learners' message content. For example in one study, over half of learners' messages did not receive any reply and many replies were not built on previous comments (Thomas, 2002). In another, learners did not work to fit their ideas into the discussion as a whole (Hewitt, 2001). Knowlton (2005), in his theoretical framework, also described about learners' tendency to state their perspectives as academic mini-essays without developing their ideas based on existing comments in the discussion. The lack of responsive messages and low level of engagement in many discussions suggests that learners might not take in enough input from each other when participating in a discussion.

Visualizing a discussion overflowing with unresponsive messages, we may expect much duplication of ideas and little on-going cognitive development as learners may not read what others posted before making their own statement. Even though discussion forums support multiple perspectives from participants, without any deeper

processing such as synthesizing and making judgment of ideas proposed, learners are unlikely to benefit from merely reading the disjointed information.

1.1.2. Lack of disagreement

Even when learners attend to others, the interaction is often limited in that they tend to share ideas, and ask and answer questions rather than challenging others' comments to advance their information exchange to higher levels (Cheung & Hew, 2006; Dennen & Wieland, 2007; Gunawardena, Lowe, & Anderson, 1997; Hew & Cheung, 2011; Jeong, 2003; Kanuka & Anderson, 1998; Schellens & Valcke, 2005). Put simply, learners rarely state disagreement in discussions. Conversation theorists have pointed out the human nature of preferring agreement in social interaction (e.g. Brown & Levinson, 1987). Studies have also found that learners are reluctant to express disagreement with their peers (Chinn, 2006), and they exhibit difficulties in generating and comparing counter arguments (Kuhn, 1991). Theoretically, computer conferencing should be more amenable to extensive argumentative discussion than in face-to-face groups due to the advantages of non real-time interaction. Nevertheless, the tendency to disagree remains rare in online academic discussion forums (Dennen & Wieland, 2007; Koschmann, 2003; Veerman, 2003). Yun and Park (2011) have found that people were less likely to make a post when they perceived their opinions to be the opposite of most messages in the forum, even when their identities were kept anonymous. If participants don't go beyond sharing ideas, participation in online discussions will be homogeneous and superficial; no further interaction among participants can take place.

A step beyond sharing information is to explore the inconsistencies in ideas and the interaction of the meanings which can be constructed as a result of conflicts (Jeong, 2003). This conflict, viewed as a disequilibrium (Piaget, 1970), a problematic (Dewey, 1938), or a cognitive puzzlement (Savery & Duffy, 1995) can stimulate inquiry, reflection, and conceptual change, and moves knowledge attainment forward. In text-based discussion forums, conflicts can be conceptualized as posts that challenge or disagree with previous posts. When learners clarify, challenge and counter others' ideas, they add, explain, evaluate, and modify knowledge to solve the learning problem (Veerman, Andriessen, & Kanselaar, 2002). These constructive activities can be considered as argumentative moves and are critical elements to productive online learning discussions.

As Chinn (2006) described, argumentation is mostly likely to facilitate learning when learners express disagreement. Jeong's (2003) sequential analysis of group interaction also supported the benefits of a transition from simple disagreement to advancing arguments. Opposing opinions represent alternative perspectives which prompt learners to think from different directions. A discussion that is agreement-laden and has little or no cognitive conflict is less likely to benefit learners' critical thinking and knowledge advancement.

1.1.3. Failure in making decisions online

Another problem that can help explain the poor quality of collaboration in online discussions is learners' tendency to build quick consensus when they are asked to make decisions online. Collaboration requires members of a group to actively interact with each other through an exchange of ideas (Kirschner, Pass & Kirschner, 2009). One technique to reinforce collaboration is to impose consensus on the group task. Consensus encourages collaboration instead of competition as group members can freely explore conflicts without trying to win the debate; thus, reaching group consensus has been considered as an optimal outcome for decision-making process (Priem, Harrison, & Muir, 1995). Nevertheless, groups were found to fail in making decisions and forming consensus in online discussion (Farnham, Chesley, McGehee, Kawal, & Landau, 2000; Hiltz, Johnson, & Turoff, 1986; Straus & McGrath, 1994). In addition to learners' reluctance to express disagreement, this might be due to the increasing amount of new posts contributed by others as time goes, disrupted turn-taking, or incoherent message sequence ADFs impose on learners (Graetz, Boyle, Kimble, Thompson, & Garloch, 1998; Herring, 1999). In several studies, individual messages were found to be scattered and isolated from one and other, and no collaborative development of arguments was found (Herring, 1999; Thomas, 2002). Argumentation in online discourse is often shallow and unfocused (Nussbaum, 2005). These ill-structured conversations impede learners from obtaining the necessary information for thinking deeply (Thomas 2002), especially when they join the discussion late or revisit the discussion after a long interval. In these situations, the increased number of unread messages and the complexity of threading structures make the discussion content even more difficult for learners to process.

Due to such constraints, learners have been found to be more task-focused in online contexts than in face-to-face situations (Jonassen & Kwon, 2001). When different perspectives arise, learners might simply accept others' ideas without actually changing their views just to move the discussion forward (Clark & Brennan, 1991). This kind of quick consensus building eliminates possibilities of negotiation between divergent ideas, thus undermining knowledge construction (Weinberger & Fischer, 2006). Put together, this body of evidence suggests that learners may not know how to collaborate effectively in online contexts and need to be supported in the process.

1.2. Incorporating Disagreement in Task Structure to Improve Collaboration and Argumentation

Both agreement and disagreement are beneficial for problem solving processes and should coexist with a well-balanced ratio. While agreements push the current problem solving trajectory forward, disagreement attracts others' attention (De Dreu & West, 2001; Nemeth & Rogers, 1996) and calls for reexamination of ideas (West, 2000). The presence of disagreement stimulates the likelihood for other people with minority perspectives in the group to voice their opinions (Nemeth & Chiles, 1988). Multiple perspectives are an indispensable prerequisite for social negotiation which is fundamental to collaboration (Hakkinen & Jarvela, 2006). To negotiate meanings and obtain mutual understanding, learners have to take others' viewpoints into account in light of their own positions. Ideally they would delve deeper into providing reasons, reflecting and reconsidering both others' arguments and their own. When disagreement occurs, the person who proposes the original idea can attempt to understand the criticism and defend his or her position (Paulus, 2000). Therefore, disagreements can also benefit the quality of argumentation. Price, Cappella and Nir (2002) found that when people encountered more disagreements, they tended to generate more reasons, grounded their arguments with more deliberate viewpoints, and understood more opposing arguments others might make. Similarly, a high frequency of challenges was found to instigate learners' generation and incorporation of strong grounds for their positions (Clark, Sampson, Weinberger, & Erkens, 2007). This may be because learners are more likely to raise high quality reasons when they compose rebuttals to challenge others' ideas.

One way to promote cognitive engagement and support effective collaboration in online discussions is to seed disagreement in online discussion by incorporating contrasting alternatives in the learning task (Dennen & Wieland, 2007). A task focusing on a narrow topic and personal opinions might not encourage social negotiation; a task with an open-ended topic might not promote cognitive conflicts; however, a task with contrasting positions might stimulate different standpoints thus instigating distinct propositions that need to be solved through social negotiation.

Little work looking at the impact of task type has been done in the context of online collaborative learning, and that which exists has seldom been grounded in a theoretical task framework. Initial evidence has documented that learners approach different online discussion tasks differently (Paulus, 2005), and specific tasks were found to either facilitate or hinder the processes of argumentation and collaboration. For instance, in examining two discussions Gunawardena et al. (1997) found that broad-topic discussion tasks encourage learners to share ideas but not to explore dissonance, whereas debate-tasks tend to generate disagreements but impede learners from reaching consensus. This suggests that certain group processes may not be mutually inclusive in a task.

Task type is an important area of investigation because it could potentially influence learners' argumentation, participation, and collaboration in online discussions to address the problems described above. For instance, requiring learners to reach a consensus may encourage expression of different viewpoints which directly affect their argumentation; going through the decision-making process would also indirectly affect how they participate and collaborate in completing the assigned task. Different from other interventions like scripting, task design presents initial conditions that might possibly influence learners' natural behaviors so learners have more freedom to collaborate in a manner or sequence of their choice. Moreover, altering and tailoring tasks is a very economical and convenient instructional design method for instructors and educators. Designing and implementing an appropriate task to achieve certain instructional goals does not require specific background knowledge about technology. Further research on how task type affects the ways learners interact in online discussions is needed to build a more complete picture of learning processes through virtual conversations. In addition, grounding task design on a theoretical framework

allows one to compare the effect across studies. The results will provide empirical support for designing interventions to facilitate better interactions and meaningful conversations.

The purpose of this thesis is to investigate the impact of theoretically-designed tasks on students' discussion behaviors in online discussion forums, specifically how they develop arguments, participate and collaborate under two task conditions (tasks with an open-ended question and tasks with contrasting alternatives) when they are asked to solve an ill-structured organizational problem. Chapter 2 reviews the theoretical underpinnings of learning through conversation and examines several existing argumentation models and task type frameworks, as well as applications of each. Chapter 3 presents an overall study framework that lays out the research questions, provides a rationale for the chosen scheme and variables, and hypotheses for each of the argumentation, participation, and collaboration dimensions. Chapter 4 describes the research method including the experimental environment, the assigned tasks, and data processing and analysis. Chapter 5 reports the result of participants' argumentation, participation and collaboration variables under the two task-type conditions. Chapter 6 discusses the results and compares them with previous studies. The thesis concludes with educational implications for practices, limitations, and avenues for future research.

2. Literature Review

This chapter first sets the stage for the study by reviewing the theoretical foundations of learning through conversations. Focusing on the context of online discussions, the chapter moves forward to conceptualize measures for the quality of an online learning conversation through participation, collaboration, and most importantly, argumentation. Related argumentation theories and models of argumentation are reviewed. Several studies pinpointing the critical role disagreement plays in encouraging the change of ideas are highlighted. In considering how task design can be used to incorporate disagreement into online conversations, the chapter reviews recent and past studies about task type in both face-to-face and online contexts. Using McGrath's *Group Task Circumplex* (1984) as the main design framework, the chapter attempts to locate previously reviewed tasks on the same framework for comparison, as well as provide justification for the tasks examined in this study.

2.1. Theoretical Underpinnings of Learning from Conversations

The question of how people learn has been considered by many educational researchers to date. Some think that knowledge resides independently within individuals and is discrete and transmissible while others believe it exists among social interactions and is embodied and contextual (Hannafin & Hill, 2007; Jonassen, 1991). Those working from a contextual knowledge perspective attempt to induce meaningful learning that engages students in active sense-making (interpreting new information based on prior knowledge) and knowledge construction through collaboration (Renkl, 2009; Stahl, 2006). This work takes a constructivist perspective and discusses two different epistemological schemes underlying constructivism as well as how they influence our view of learning. Through such lenses, learning discourses (oral or textual) are regarded as observable evidence of how individuals and/or the group think (Stahl, 2003).

2.1.1. Epistemological beliefs and learning in social contexts

Epistemology is a field of research concerning the nature of knowledge. It looks at how we acquire knowledge and how we know what we know (Hannafin & Hill, 2007). Cobb (1994) associated two main epistemological beliefs in constructivism with Jean Piaget and Lev Vygotsky as individual cognitive and sociocultural perspectives. While the two perspectives posit different views on where knowledge first originates (Duncan, 1995), both emphasize the role of active sense-making and the importance of social influence on individuals' development. In both, learners are thought to interpret the external world based on their unique set of prior knowledge and through working with others, they are able to discuss their individual understanding of matters and develop meanings (Jonassen, 1991). These perspectives each provide a lens through which we understand how learning takes place.

From an individual cognitive perspective, learners make sense of the world through individual constructive activities (Duffy & Cunningham, 1996) and through comparing their understanding with that of others (Savery & Duffy, 1995). According to Piaget, we organize our understanding of the world in a basic unit of cognitive structure called schema, and we use schema to adapt our behaviors. In situations where disequilibrium takes place, we strive to resolve the balance through adaptation processes by fitting new information in existing schema (assimilation) or by altering existing schema/developing new ones (accommodation). In this process of altering or creating schema (Harlow, Cummings, & Aberasturi, 2007), we continuously build knowledge. Piaget believed that knowledge is first constructed internally within individuals before it is externalized in the environment (Duncan, 1995). Children's egocentric speech (e.g. explanatory monologue during self-play), which fades as they mature and become capable to think internally before speaking, is an example of the "outward" thinking process (Duncan, 1995; Glassman, 1994).

From a sociocultural perspective, Vygotsky (1978) believed that knowledge originates externally in social interactions before it is internalized and individualized. Interacting with others elicits individual mental processes and in turn the processes individuals undertake can be traced back to these social interactions (Palincsar, 1998). More importantly, many social exchanges are mediated by language; we negotiate,

consider, and reflect on ideas to obtain meanings. Thus, teaching means encouraging dialogues between novice learners and experts within learners' zones of proximal development (Vygotsky, 1986). The mental structure learners use to store knowledge influences and is influenced by individual-in-social interactions and the culture learners are immersed in (Woolfolk, Winnie, Perry, & Shapka, 2009). Vygotsky (1978) further highlighted the notion of "co-construction" by inferring that learning is a process of internalizing the shared activities and both learners and the people they interact with negotiate, construct, and internalize the knowledge they experience together. By examining the interaction, we can study how their engagement in the shared activity influences their cognitive development (Palincsar, 1998).

Combining individual cognitive and sociocultural perspectives, Stahl (2000) proposed a model of collaborative knowledge building that includes both personal and social perspectives. Initiating with the personal understanding cycle, learners decode information to resolve the conflicts by adjusting their mental structures with the help of their existing knowledge. When information cannot be resolved through this process, learners externalize their inquiry into the public sphere where other people's statements are taken into accounts for conflicting arguments. Learners then collectively refine and fortify their arguments about possible alternatives, and the interaction may likely converge to a shared understanding. The framework highlights the significance of tools (cultural artefacts, language) and conflicting perspectives in moving discourse forward for individuals and the groups they are in. The current study takes on Stahl's model to view learning in online collaborative contexts.

2.1.2. Measures of quality in online learning conversations

If we apply Stahl's model in the context of online discussion forums, learners might first express their ideas to public, observe new information, and then adjust or assimilate their schemas; it is also possible for learners to start interacting with others and then internalize their mutual understanding of the matter. In both cases, knowledge is mediated by the context and subjects one interacts with, and these interactions (e.g. posting ideas to the forum, reading posts of others) have been considered as observable indicators of online participation in prior studies (Hewitt, 2003; Thomas, 2002). Therefore,

at a basic level to understand how knowledge emerges from learner interaction, we need to examine how learners *participate* in online discussions.

As learners participate, their actions influence and are influenced by those of others; the individuals and the group they belong to are interwoven. Thus, how individuals work together as a group becomes an important aspect to consider. How a group functions and acts depends not only on the task, but also on how individuals constituting the group make use of their unique mix of the knowledge and personality (Levi, 2011; Steiner, 1972). The later (how individuals put members' available souce into use), based on Stahl's (2000) interpretation, is *collaboration*; it is a process where learners converge from distinct directions to a shared understanding which helps the group act as a decision maker. Thus, in addition to learner participation, *collaboration*, specifically group decision making processes, can be taken as a measure of quality of an online learning conversation.

There are several ways to conceptualize collaboration. Two models of thinking about consensus building are presented here. First, Weinberger and Fischer (2006) categorized three manners of consensus building: quick, integration-oriented, and conflict-oriented consensus building. In quick consensus building, learners vote for a solution, or commit to the first acceptable solution without further examining other alternatives. In integration-oriented consensus building, learners consider others' ideas and build on them, while in conflict-oriented consensus building, they question, criticize, and challenge peer contributions in order to search for a middle ground. Conflict-oriented consensus building is deemed to be a richer form of interaction than the other two as it involves disagreement exchanges, and learners would be more likely to experience a change of ideas throughout the negotiation process.

Alternatively, Levi (2011) proposed three decision-making approaches for groups: consultative, democratic, or consensus. From one end, groups might have a leader who arbitrarily decides, or assigns an expert to make the decision or consults with the team first and make the decision on his own. The group might also average members' opinions, apply decision-making techniques (e.g. nominal group technique, Delphi technique), or choose the majority opinion. On the other end, groups might also make a decision based on members' consensus. Consensus decision making requires

full participation which uses all individual resources in a team. This might be time-consuming, but if done successfully, it improves group dynamics and ensures the likelihood of its implementation because when a group reaches consensus, even though not every team member may believe the solution is best, they commit to provide support and go along with the solution (Levi, 2011).

The third measure—*argumentation* accounts for a major part of the conversational quality and because it is central to the current study, it is elaborated separately in the next section.

2.2. Argumentation Shapes the Learning Discourse and Outcomes

2.2.1. The role of argumentation in discourse

As previously mentioned, the quality of the learning discourse depends on how learners participate and collaborate in the learning process, but to a greater degree it depends on "what they say." When learners make meanings through discourse, it is important to examine the learning conversations to unfold the evidence of critical thinking and knowledge construction. In this study, similar to participation and collaboration, argumentation serves as a key process measure to examine individual cognitive construction (building arguments to express thinking) and group interaction (exchanging reasoning with other interlocutors) which takes place in collaborative discourse (as a term of dialogue). According to Walton (1998), dialogue is a sequence of argument exchange between two interlocutors reasoning to reach a common goal. More and more researchers have turned their attention to analyzing argumentation discourse because it serves as a useful tool to evaluate learners' reasoning ability in different subject areas (Erduran, Simon, & Osborne, 2004; Nussbaum, 2011).

To capture the features of such kinds of discourse, Nussbaum (2008) coined a term—critical, elaborative discourse and claimed that it could facilitate conceptual learning because it encourages learners to critically evaluate a diversity of perspectives by using arguments and refutations to resolve conflicts and by connecting ideas with prior knowledge to elaborate their arguments. When examining alternative viewpoints,

learners are exposed to other possibilities which may induce conceptual change. Different kinds of dialogues may be more or less effective in eliciting a critical, elaborative discourse.

Walton (1998) classified six types of dialogues: persuasion dialogue, information-seeking dialogue, negotiation dialogue, inquiry dialogue, eristic dialogue, and deliberation dialogue. Each has its own goals and rules that govern the appropriateness of certain types of argumentative moves. Certain dialogue types are more argumentative and require their participants to argue from different points of view. For instance, the goal of persuasion dialogue is for the proponent to convince the respondent that a certain proposition is true by using respondents' propositions as premises. On the contrary, negotiation dialogue aims at bargaining to get the best deal by insisting and compromising on something. In eristic dialogue, instead of making concessions, people are not open for conceptual change and argue emotionally for argument's sake. Other types of dialogues (information-seeking dialogue, inquiry dialogue, or deliberation dialogue) focusing more on gathering information to solve a problem, prove a particular question, or make a decision based on established premises. According to Walton (1998), arguing from distinctive perspectives can help participants understand different positions better (as in persuasion dialogue) and settle to consensus (as in negotiation dialogue).

As argumentation is essential in discourse, several computer-supported collaborative learning environments have been used specifically to support argumentative discourse (e.g. Clark et al., 2007; Clark & Sampson, 2008; Veerman, 2003). Specifically, ADFs provide an ideal context for investigating argumentation because they give learners equal opportunity to participate, more time for reflection and the system logs all participation actions and content automatically (Nussbaum, 2008; Scardamalia & Bereiter, 1994; Schellens & Valcke, 2006; Veerman, 2003).

2.2.2. Engaging in argumentation promotes learning

Engaging learners in argumentative dialogues has been suggested to facilitate learning, in particular content understanding, conceptual change, critical thinking and reasoning, as well as mastery goal adoption (Darnon, Butera, & Harakiewicz, 2007).

Firstly, to argue about an issue with others, learners need to express their ideas first, and the arguments they produce reflect the re-examination of their thinking. This could be referred as the “self-explanation effect” which promotes the integration of prior and new knowledge, leading to conceptual understanding (Chi, Bassok, Lewis, Reimnn, & Glaser, 1989; Chinn & Osborne, 2010; Erduran et al., 2004; Weinberger & Fischer, 2006). When learners collaboratively explore alternative ideas in order to solve a common problem, they might present reasons for or against a proposition which offers multiple perspectives; this may broaden and deepen learners’ understanding of the content material (Nussbaum, 2008).

Secondly, when the presented perspectives are contradictory, it increases learners’ awareness of challenging concepts which may lead to conceptual change (Clark et al., 2007). In addition, evaluating and rebutting the supporting evidences for an argument might lead to conceptual change as well (Erduran et al., 2004; Nussbaum & Sinatra, 2003). At a basic level, having conceptual change during argumentation means that learners are listening to what other people say, as well as reflecting on the content examined. Capturing conceptual change might also provide information about how a group reaches an agreement.

Thirdly, argumentation is also considered to foster critical thinking and reasoning ability (Chinn & Osborne, 2010). Argumentation requires learners to ground their arguments with reasons, facts, or causations. As they generate reasons, they think deeply about the claims they make; this includes gathering and evaluating evidences, as well as considering alternatives. Critical thinking is likely to take place when learners develop reasons to back up their positions in order to solve a problem (Duffy, Dueber, & Hawley, 1998).

Finally, argumentation might foster mastery goal adoption. Arguing under a collaborative environment makes learners free from competing with others but concentrated on understanding what others say in order to build a common ground. According to Pintrich (2000), learners with mastery goals are more cognitive engaged and learning-oriented as opposed to learners with performance goals who target outperforming others. The purpose of having disagreement in collaborative argumentation is not to stimulate competition but to encourage alternative views, and it

has been found that when disagreement is present in a discussion, learners who were given mastery goal instruction learned better than those were given performance goal instruction (Darnon et al., 2007).

2.2.3. Argumentation theories

O'Keefe (1982) differentiated two types of argument theories as being based on argument-as-product and argument-as-process. The former focuses on the outcome which should be inferred from premises using a series of propositions while the later focuses on the social process whereby individuals exchange their arguments by engaging in a dialogue. Almost all argumentation theories or frameworks can be categorized based on these two kinds.

Seeing argumentation as a product, Toulmin's argumentation model (1958) has been applied extensively to analyze structure and strength of arguments in both face-to-face and online learning contexts (Clark et al., 2007; Erduran et al., 2004; Nussbaum, 2011). Toulmin's framework regarded a complete argument as integration of the following six components: (1) claims, (2) data, (3) warrants, (4) backing, (5) rebuttals, and (6) qualifiers. A concise example to illustrate the six components is shown in Figure 2.1. However, critiques of Toulmin's model have been made around the distinction of data, warrants and backing as they are often implicit and embedded in the context (Clark & Sampson, 2008; Erduran et al., 2004). To avoid such confusion, some researchers simply counted the number of arguments or counterarguments without defining the argument structure; however these approaches have been critiqued for failing to fully present the argumentation quality (Nussbaum, 2011).

Expanding from Toulmin's model, researchers such as Clark and Sampson (2008) saw an argument as a product consisting subparts like claims or counterclaims which resulted from learners' interaction with each other. To these researchers, argumentation is like a stand-alone behavior that could be viewed in isolation of other types of cognitive activities.

Harry is likely a British subject (CLAIM) because he was born in Bermuda (DATA), and people born in Bermuda generally are British subjects (WARRANT), on account of the following British statutes (BACKING) unless he became a naturalized American or both his parents were aliens (REBUTTAL). So the conclusion that he is a British subject is only likely (QUALIFIER) and is not certain. The conclusion is subject to exception.

Figure 2.1. Example of the Six Components in Toulmin's (1958) Argumentation Model

[Cited from Nussbaum, 2011, p.85]

From a different point of view, Walton's (1998) dialogue theory has been considered as an alternative framework to Toulmin's (Nussbaum, 2011). Seeing arguments as process, Walton (1998) recognized that arguments are disclosed during the dialectical interchanges among participants. Dialogue theory conceives that discourse is shaped by the dialogue types, as previously mentioned, which are governed by the joint goals of its participants. Concurrently, the discourse is also shaped by three elements: argumentation schemes, critical questions, and answers or refutations generated by participants based on plausible and defeasible inferences (Walton, 1998). Argumentation schemes (e.g. argument from example) are types of arguments that are appropriate in certain type of dialogue, and critical questions (e.g. is the example typical?) are determinants used to verify if an argumentation scheme is being used appropriately under such circumstance. The correct answer to these questions will further shape the discourse while the incorrect answer will lead to refutation which can also be used in shaping the discourse. The foundation for these three elements is the ability to make plausible (reasonable propositions) and defeasible (arguments that could be defeated) inferences. This dialogue theory has been applied in instructions and assessment. Nussbaum and Edwards (2011) found that asking and answering critical questions help learners build stronger arguments. However, when coding using these argumentation schemes, some found Walton's argumentation schemes were reliable to code while other found them ambiguous (Duschl, 2008; Ferretti, Lewis, & Andrews-Wekerly, 2009).

Viewing argumentation as a process of knowledge construction, Weinberger and Fischer (2006) considered learners' behaviors not only on argumentation dimension but also participation, epistemic and social-mode dimensions. They stated that when learners engage in specific discourse activities that make them construct arguments to interact with others and to understand the content discussed, they are involved in argumentative knowledge construction. In this process, learners first state their own positions with justification. Then as a group, they receive contrasting opinions in forms of counterarguments or rebuttals from other students in the group. Then in a process of continuously providing reasons and rebuttals for or against solutions, they change, modify or refine their initial positions in light of others' ideas and finally converge at a collective solution. Through the process, they encounter conceptually challenging conflicts which enable them to perceive multiple perspectives upon the problem. This process is helpful for learning as obtaining multiple perspectives to a problem is found to help learners use what they learn in other problems flexibly (Spiro, Feltovich, Jacobson, & Coulson, 1991). Although Weinberger and Fischerregarded an argument in subparts, as Clark and Sampson did, it is the concept of contextualizing argumentation together with other types of learning activities (participation, epistemic and collaborative activities) that makes their model a process-oriented one. Conceptually, this study aligns with Weinberger and Fischer (2006)'s conceptual view of seeing argumentation in light with other types of learning activity.

2.2.4. Disagreement and multiple perspectives as essential elements to argumentation

Disagreement is involved in all frameworks reviewed above but its importance is particularly highlighted when regarding argumentation as a process. According to Golanics and Nussbaum (2008), argumentation takes place when individuals construct arguments and critique arguments of others through critical thinking processes in social contexts. However, as mentioned in Chapter 1, studies have shown that learners in both face-to-face and online contexts are reluctant in expressing disagreement when participating in learning conversations (Chinn, 2006; Dennen & Wieland, 2007; Koschmann, 2003; Veerman, 2003, Yun & Park, 2011). A crucial step to move a discussion forward is to challenge other people's arguments. Therefore, disagreement is an important element that the study intends to include.

A primary motivation to have learners engage in argumentation is to have cognitive conflicts and different views towards a problem. These two elements are highly intertwined. When contrasting alternatives to a problem have been introduced, learners will either stick with their own views, evaluate diverse perspectives, or are prompted to think about other possibilities. Likewise, having multiple viewpoints can also increase the chance for learners to argue (Nussbaum, 2008). Therefore, seeding disagreement in a form of contrasting alternatives in discussion does not necessarily mean to generate debate, but to prepare learners opportunities for multiple perspectives in the argumentation. They are free to change their positions, and in fact, that is a good sign indicating they are paying attention to what other people say in the discussion.

One technique to elicit disagreement and multiple perspectives is to embed these elements in the task design. The following section reviews studies related to tasks.

2.3. Task Type as a Fundamental Factor Influencing the Learning Conversations

Prolific instructional designs have been implemented to support collaboration and knowledge construction processes including various forms of scripting (e.g. reciprocal teaching, guided peer questioning, and role assignment; for an overview, see Rummel, 2004) and task types (e.g. Carabajal, et al., 2003). While many types of interventions serve as additional resource to facilitate learners' discussion processes, the task is the core element that sets up how people interact in group work and how they construct collective knowledge through their learning conversations (Baltes, Dickson, Sherman, Bauer, LaGanke, 2002; Carabajal et al., 2003; Hackman, 1968; Hackman & Vidmar, 1970; McGrath, 1984; Paulus, 2005; Steiner, 1972). Specifically, with respect to the goals of this thesis, task type can act as a means to promote disagreement.

The reason to choose task type over other types of intervening techniques is that as opposed to explicit scripting, task structure does not specify explicit group processes. Instead, tasks determine what individuals or groups need to accomplish and the task demands affect how groups utilize their resources and proceed to the task (Steiner, 1972). By externalizing their thoughts and taking in ideas of others, learners can discuss

different ideas with arguments and rationale, negotiate and build up knowledge, and gradually converge to a shared understanding that they can apply in new situations (Gunawardena et al., 1997; Stahl, 2000). These knowledge construction processes can be considered as the building blocks of a learning conversation, and the nature of the task would implicitly drive the conversation without explicitly prescribing how the processes should be assembled. Thus, in order to promote meaningful learning conversations, there is a need to look at how task type affects learner interactions and knowledge construction in online discussion forums.

Empirical work in the online context supports the notion that task type can impact the approaches learners take in online discussions and the knowledge construction phases they engage in. Paulus (2005) analyzed the approaches and processes students took when performing two types of tasks: a “Synthesis” task (discussing multiple learning theories from textbook chapters) and an “Application” task (applying learning theories to solve problems). Both tasks required students to create a report at the end of the discussion. Even when specifically asked to collaborate, students were inclined to take a cooperative approach (dividing tasks to be completed by individuals) when doing the Application task while they seemed to take a collaborative approach (completing the task collectively through dialogue) when performing the Synthesis task. This might be due to the differences in the levels of task difficulty, grading schemes for the tasks and whether there was perceived to be a correct answer for the task or not. The Application task required a higher level of skills such as applying, analyzing and evaluating while the Synthesis task focused on identifying useful theories and summarizing them in the final report. In addition, the final report was graded for the Application task but not for the Synthesis task. This was speculated to foster a cooperative approach in the groups with the Application Task (Paulus, 2005). Finally, in the Application task a preferred solution was needed for each issue, thus a collaborative approach might not be efficient as students would have to debate or coordinate to choose a best answer for each issue as a group. On the contrary, in the Synthesis task, all ideas were welcomed and at the end of the discussion, one member summarized what had been said informally. Paulus (2005) concluded that although the cooperative approach used in the Application task might increase the efficiency of the group process, it did not facilitate knowledge construction.

In another study, Dennen and Wieland (2008) examined students' interaction and volume of participation when they were asked to do two distinct tasks over the course of one week. A "Film" task asked students to identify themes about a film they watched; it focused on demonstrating knowledge to the instructor. A "Paper" task asked them to help peers develop ideas for an assignment; it focused on providing formative feedback among peers. Generally, students created more posts and replies in the Paper task but the quality and the level of interaction for both tasks were low. The results showed that students tended to create monologue type of messages when the content was addressed to the instructor in the Film task. A greater degree of learner interdependence was found when the audience was their peers in the Paper task. One possible explanation for this discrepancy might be the audience orientation. In the Film task, students did not feel the need to further address others' comments because it was not designed for conversation while in the Paper task, the chain of questions and answers were more likely to continue because they were required to provide feedback to their peers.

Fox and MacKeogh (2003) assigned two different tasks in online discussion forums to examine learners' higher-order thinking skills and the time a tutor devoted in moderation. Participants were divided into the Open Resource/Debate Group (ORD) and the Peer-tutoring Group (PT). Students in the ORD Group were given a topic, and were asked to look for resources, take a stance, and defend their position. In contrast, in the PT Group each student was assigned an article to write a summary of and to answer the questions from other students. As the discussion was not graded, low participation was found in both conditions, and the findings suggest that all posts contributed were low in critical thinking: lower cognitive skills (sharing resource and making statements) were found to be evident most often while higher cognitive skills (re-evaluating personal position and proposing solution based on what is discussed) were rare. However, the ORD Group did outperform the PT Group in generating evidences of critical thinking skills, indicating that debate might encourage students to ground their arguments more strongly.

Gunawardena et al. (1997) applied their interaction analysis model to examine social construction of knowledge in two distinct contexts. In one context, over 500 geographically-distributed participants were invited for an online seven-day debate

where they were forced to choose and argue from one side of the polarized topic about "interaction" in effective distance education. In the other context, 25 workplace managers participated in an open discussion about the impact of teaching and learning technologies on workplace learning for three weeks. The results showed a broader distribution of knowledge construction phases for the debate, exemplifying evidences in all five phases of the model, but mostly in Phase II (Exploring Dissonance) and Phase III (Negotiating Meaning); whereas a much narrower allocation was found for the open discussion, focusing primarily on sharing ideas (Phase I, Sharing Information). They also found that while the debate fostered activities in Phases I, II and III, it hindered the group from reaching a compromise or synthesis (Phases IV and V) as the debate leaders strived to set the two sides apart. An alternative explanation as to why there was a broader distribution of knowledge construction in the debate might be the demographics of participants: they were mostly from academia and interested in distance education. Another explanation might be that the debate was moderated and synthesized at certain points in time; these kinds of activities have been found to help move discussions forward to higher level of knowledge construction (see Wise & Chiu, 2011).

From the empirical evidence presented above, it can be seen that task type is a central driving force of learners' interactions and the process of knowledge construction. The last two studies also demonstrate the possibility and challenge of implementing disagreement as part of task design. Thus, crafting a well-designed task for collaborative learning should help learners engage in process of active sense-making and critical thinking. These studies shed light on the significance of task type, each depicting some facets of how the task drives learners' behaviors. However, the current literature on online group work is inconsistent in describing the types of task chosen and the measures used to evaluate the learning outcomes. Many studies simply measure the quantified products as group outcome by counting the number of posts, words or agreements participants created (Dennen, 2008; Paulus, 2005; Straus & McGrath, 1994; Straus, 1999), not many looked into how task types have specifically influenced the knowledge construction process and the quality of students' learning. More importantly, it is difficult to compare the tasks given in these studies since they were not designed based on a common theoretical framework, or in fact any theoretical framework at all. The phenomena identified in one type of tasks might not be applicable to other task type.

Currently, no existing typologies have been developed for online collaboration tasks; however, there is a well investigated body of literature about task typologies in face-to-face interactions which could potentially provide the theoretical grounding.

2.3.1. Reviewing early task typologies in face-to-face interactions

A boom of task typologies emerged in the 1970s and early 1980s when researchers worked to classify different discussion tasks based on the behavioral and conceptual requirements they entailed. Early work was mainly applied in face-to-face discussions and was limited in focus, addressing partial aspects of group tasks. To address the gap among different typologies, McGrath (1984) proposed a unifying framework for group tasks, incorporating all extant task types (Arrow, McGrath, & Berdahl, 2000). This has since been examined in both face-to-face and online group discussions.

Prior to McGrath, earlier development of task typologies primarily were used to evaluate either group processes or outcomes. Shaw made a classification of group tasks to measure group processes based on task characteristics by surveying the past and then-present group studies (as cited in Morris, 1966). Six dimensions were empirically derived to define group tasks: task difficulty; solution multiplicity (multiple or one solutions); cooperation requirements; intellectual-manipulative requirements (mental or motor skills); population familiarity (whether the task performer is familiar with the task or not); and intrinsic interest (whether the task itself is motivating or motivates task performers). The first three dimensions were the strongest and most stable predictors to understand group processes (as cited in Morris, 1966).

With a goal to examine group outcomes, Hackman (1968) delimited the focus on tasks with intellective requirements, in particular those with written products. He characterized three types of intellective tasks: production (producing and presenting ideas or information); discussion (evaluating issues with group consensus); and problem-solving (planning a course of actions and carry it out to solve a specific problem). An outcome measure was developed to assess the products in terms of action orientation (whether actions are stated or planned to be carried out); length; originality; optimism (whether the tone of the written product is positive); quality of presentation

(grammatical or rhetorical qualities); issue involvement (whether goals, issues or procedures are involved); creativity; and adequacy. It was found that task type significantly affected seven of the eight dimensions (except for adequacy); production tasks were highly related to originality, discussion tasks were high on issue involvement and problem-solving tasks were significantly associated with action orientation.

Looking at process, Steiner (1972) made a distinction between divisible and unitary tasks. Only unitary tasks are described here because they address the critical value of collaboration. Steiner further classified four models of how individual contributions could be combined in a group. First, disjunctive tasks (e.g. problem-solving, judgment tasks) require people to determine which of several specified solutions to a problem is correct. In this sense, the success on this task can be said to be decided by the “best” or the “most active” member of the group. On the contrary, conjunctive tasks determine group success based on the least able member of the group. For instance, a task that demands all members to submit an essay about a part of the problem in order to be combined for a complete project. The group success is determined by the rules (each member completes his part of work) rather than group consensus, and the group outcome is reflected by the conjunction of members’ operation. Third, additive tasks require turn-taking and the group success is decided by the sum of the individual’s effort. Finally, in some circumstances, group members can decide to combine their contributions in any manner they prefer (either to put weight on all or one member). This fuzzier type is called discretionary tasks. Despite the comprehensive classification of collaboration patterns, Steiner seemed to regard the group outcome in terms of cooperation (combining individual’s works in different ways) rather than collaboration (working collectively on the same product) [Paulus, 2005].

Davis, Laughlin and Komorita (1976) also examined group processes and defined small group interaction relationships to be cooperative or mixed-motive based on the task characteristics, instructions and the reward structure for the task performers. Problem solving and group decision making were classified as cooperative interactions since they require either social information processing to discover a correct answer (defined as intellective task) or collective effort in selecting response specified by the task (defined as decision task). When profits are offered upon completion of task, groups seem to exhibit mixed-motive relationships. In mixed-motive tasks, members represent

conflicting parties. Based on the relationship between group members and the nature of the conflicts, mix-motive interactions could be (a) two-person and/or N-person, two-choice situations, (b) bargaining and negotiation tasks, and (c) coalition formation. These types of tasks do not demand individual members to combine their efforts to yield the group product, and the profits are not shared equally.

To sum up, prior findings help elucidate some of the effects of task characteristics (Davis et al., 1976; Hackman, 1968), cooperation patterns (Steiner, 1972), and motives (Davis et al., 1976) on the group process, as well as the written products (Hackman, 1968). Nonetheless, the relationships between distinct tasks remained to be established.

2.3.2. McGrath's unifying task typology for group interaction

Surveying all prior task typologies discussed above (as well as others), McGrath (1984) proposed a circumplex model of group task type, divided into four quadrants as basic processes (generate, choose, negotiate and execute). The *Group Task Circumplex* also contains a 2-D axis to further specify task characteristics. The horizontal axis indicates the degree to which a task demands cognitive or behavioral performance; Quadrant II (Choose) and Quadrant IV (Execute) represented the two extremes on this axis. The vertical axis reflects the extent to which a task requires collaboration, coordination and conflict resolution (see Figure 2.2).

Each Quadrant is divided into two subtypes. Quadrant I reflects Hackman's (1968) problem-solving (planning) and production (creativity) tasks which engage groups in generative process. Planning tasks, placed next to the performance-based quadrant (IV, Execute), are tasks that generate action-orientation plans which could be carried out to solve problems. Creativity tasks, adjacent to the intellectual quadrant (II, Choose) are brainstorming tasks that demands idea generation which demands cognitive ability.

Quadrant II is based on Davis et al.'s (1976) intellective tasks and decision tasks with the distinction being whether the task has a correct answer or not. In intellective tasks, the group needs to collectively search for and select the demonstrably true answer. Examples of this kind of tasks could be Eureka tasks with self-evident answers, facts, and task with answers based on consensus of experts (McGrath, 1984). On the

contrary, for judgement tasks, the group pursues a preferred answer based on its members' decision which requires much coordination and some degrees of conflict resolution. The legitimate correct answers are situational, based on the members' social and cultural values.

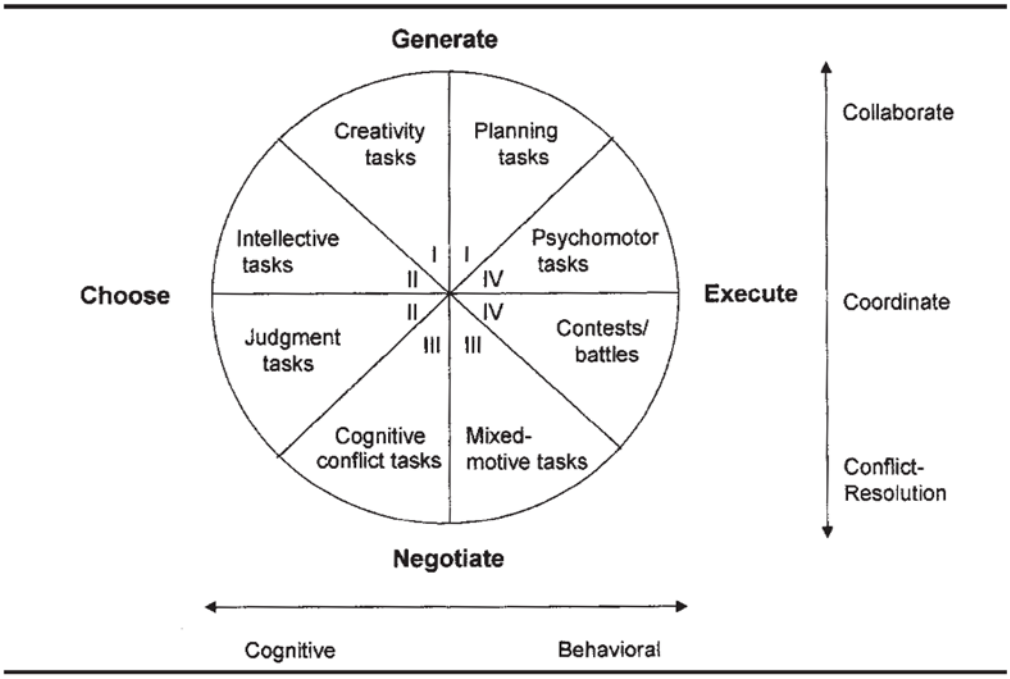

Figure 2.2. McGrath's Group Task Circumplex (Straus & McGrath, 1994, p. 169).

Used with permission from *Small Group Research*, Sage Publications, 1999.

Residing in the dimension of conflicts where disagreement plays an important part, Quadrant III reflects Davis et al.'s (1976) competitive and mix-motive tasks and is divided into conceptual and behavioral performance. On the conceptual side, cognitive conflict tasks involve resolving conflicts among contrasting viewpoints from members who may have fundamentally different preference structure but share the same goal and purpose for the problem (e.g. jury). On the other hand, when rewarding structure or interaction of payoff is involved, and when members have different motives and interests, members are likely to behave differently in order to achieve their own goals at the expense of others. This kind of task (mixed-motive tasks) requires members to resolve conflicts of various interests.

Quadrant IV contains the most pervasive tasks in our everyday life but is the least investigated area of inquiry in group research (McGrath, 1984). It deals with physical behaviors and is distinguished by the members' relationship (conflicting or cooperative). Contests/battles are featured in the competition mode in which there are winners and losers; because the payoff distribution is involved, it is placed adjacent to the mixed-motive tasks. Psychomotor tasks necessitate coordination between members rather than competition, and the success of a performance is determined according to the actions and the sequence of those actions executed, which creates a loop back to the features of planning tasks.

McGrath's model integrated past task typologies and laid out theoretical relationships between distinct but related tasks and the group processes they involve. It provides structured and comprehensive information about tasks, corresponding group processes (generate, choose, negotiate, execute), and group outcomes. While the task categories have been criticized for not being mutually exclusively (Zigurs, Buckland, & Connolly, & Wilson, 1999), the framework still provides a potential base for investigating online collaborative tasks with respect to fostering disagreements for this study.

2.3.3. Findings using the Group Task Circumplex

Despite its potential value, the *Group Task Circumplex* has not been widely adapted in the field of collaborative learning. Initial attempts to use it compared tasks' impact in face-to-face and online discussions. Straus and McGrath (1994) looked at creativity, intellective and judgement tasks in both face-to-face and online contexts and found that online groups outperformed face-to-face groups in creativity tasks but struggled for intellective and judgement tasks. In addition, the group productivity suffered when a consensus was required. This suggests that online participants tend to excel at sharing ideas but not coming to a decision. In a later analysis of the same data, Straus (1999) indicated that the online groups experience more conversation turns when a consensus is needed. Regardless of tasks, both face-to-face groups and online groups had much more events of agreement than disagreement; this aligns to Wise and Chiu's (2011) finding that learners tended to concur with each other more often than they contended.

Hollingshead, McGrath and O'Connor (1993) applied 13 tasks of four task types (generative, intellective, judgement, and negotiate tasks) in both face-to-face and online discussions in a semester-long course. They examined how group process, task performance, and member reactions were influenced by the interaction between media and the task type, as well as by the impact of change on group membership, medium and task. The findings showed that online groups performed worse on negotiation and intellective tasks but equally well on creativity and judgement tasks to their face-to-face counterparts. The authors noted that the statistical power was too weak to detect differences in the other two tasks due to small number of groups involved in the study.

An important mitigating factor to consider in interpreting these results is that online groups might be able produce the same quality of work as their face-to-face counterparts if they are given enough time to work (Straus & McGrath, 1994). All of the studies described above allocated the same time for participants to perform the assigned task without considering the fact that online dialogues usually takes days (rather than minutes) to form. In fact, it was found that when online groups were given ample time (as opposed to restricted time) for problems that have a preferred solution (similar to intellective tasks) they were more capable of selecting the correct answer (Campbell & Stasser, 2006). As this discussion shows, reviewing studies using the same theoretical framework helps us to understand task effects across different study samples; therefore, it is useful to locate other past studies (that did not explicit use McGrath's framework) on the circumplex for a more complete picture of task impacts.

2.3.4. Locating previously used online discussion tasks on the circumplex

Trying to locate tasks previously used in online collaboration settings, Paulus' (2005) Synthesis task can be categorized as an intellective task because it requires students to provide the learning theories related to the topic discussed in textbook chapters and create a group report. There are a set of expected answers and students need to choose theories pertinent to the topic. Her Application task is more similar to a judgement task because multiple theories might be applied to solve the problem and there is no definite solution to the problem. Both tasks are located in Quadrant II (Choose). Dennen and Wieland's (2008) Film tasks could be considered as a creativity

task since students need to generate ideas about the film, while their Paper task is similar to a planning task because students need to provide feasible feedback for their peers' ideas about the final assignment. Both tasks are located in Quadrant I (Generate) where ideas are generated to address to instructor or peers. Gunawardena et al.'s (1997) Debate-task is similar to a cognitive conflict task (Quadrant III, Negotiate) because it involves two parties of different viewpoints trying to solve a common problem while their Open-ended discussion task (Quadrant I, Generate) is similar to a creativity task where participants are asked to share their own opinions about a topic related to their work. Fox and MacKeogh's (2003) ORD group is similar to a cognitive conflict task (Quadrant III, Negotiate) and the PT group is similar to a planning task (Quadrant I, Generate). Interestingly, these two studies contain tasks that are in two totally different quadrants which mean that the task characteristics required in these studies may vary greatly and one would be more likely to expect learners perform distinctly. As shown in Figure 2.3, mapping these tasks on McGrath's *Group Task Circumplex* provides potential alignment of different tasks but it also suggests that these studies may not have planned their task systematically as they seem to scatter irregularly on the circumplex.

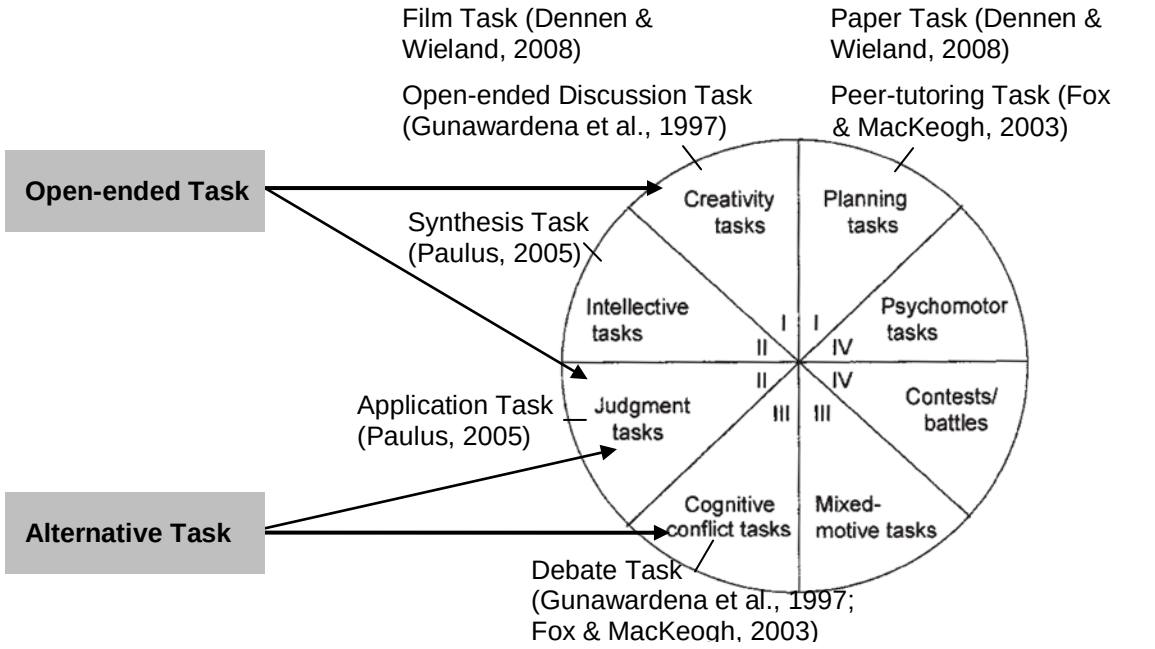

Figure 2.3. Locating Past Studies on McGrath's Group Task Circumplex.

2.3.5. Application of McGrath's Group Task Circumplex to the current study

The current study primarily aims at examining how individuals as well as the groups think and work together; thus, it emphasizes the left hemisphere of the circumplex focusing on cognitive performance. Then on a vertical scale, these tasks involve different degrees of disagreement and correspond to different member interaction (collaborate, coordinate and conflict resolution). Creativity tasks which require collaboration and do not particularly encourage disagreement and cognitive conflict tasks which demand conflict resolution and contain a great degree of disagreement are posited as two extremes. The study decides to compare these two tasks. However, as coordination is important to ensure member interaction, the need to reach consensus (a group decision) is added. Intellective and judgement tasks both ask learners to make choices and the main difference between these two is whether a task has a correct answer or not. It is speculated that tasks with no correct answer may stir more discussion and multiple perspectives than tasks with fixed answers, so judgement tasks were chosen. Therefore, in order to incorporate disagreement and consensus into group task, the current study designed two types of tasks, an open-ended task (a combination of creativity task and judgement task) and an alternative task (a combination of judgement task and cognitive conflict task). Both involve choosing one solution based on group consensus to ensure that all members are not confined in extreme group processes; the former one focused more on Quadrant I (Generate) while the later one emphasized on Quadrant III (Negotiate) [as indicated with the line weight in Figure 2.3].

3. The Current Study

3.1. Research Purpose

The goal of this study is to develop an understanding of how learners interact with each other in online academic discussions when contrasting alternatives are explicitly seeded in the learning task. Specifically, my goal is to examine if the task design influences learners' argumentation, participation, collaboration in online discussion forums. These three dimensions were chosen because they represent different aspects of the quality of learning conversations: participation entails learners' observable actions (what they did), and collaboration measures the group process (how they did what they did), while argumentation reflects how in-depth the content of learning conversations are. The study compared discussions based on two different tasks; a task with open-ended questions where the main goal was to generate solutions and pick one, and a task with two contrasting alternatives where the main goal was to choose one with supporting arguments. These two tasks were chosen because they represent two extremes of task properties on McGrath's *Group Task Circumplex* (the former being collaborative where little disagreement is necessarily involved and the later being conflicting where a great degree of disagreement is present). However, both tasks involved the requirement of consensus building. The study examined learners' interaction in terms of argumentation, participation and collaboration by analyzing learners' click-stream data and coding the post content. The following section describes the overall study framework, followed by research questions, and then the rationale for the operationalization of specific study variables as well as hypotheses based on previous research for each of the three dimensions respectively.

3.2. Study Framework

In order to examine the effect of task design on learners' interaction in asynchronous online discussion forums, a study framework was built to look at the argumentation, participation, collaboration and performance dimensions (see Table 3.1 for an overview). The rationale for the research questions, variable dimensions and hypotheses are given in the following sections.

Table 3.1. Study Framework

1. Argumentation Dimension		
Research Questions	Operational Questions	Hypothesis
Does the discussion task type assigned influence learners' argumentation?	1A. In terms of number of solutions generated	H1A. Learners who are given alternatives in their group discussion will propose fewer solutions.
	1B. In terms of positive positions proposed	H1B. Learners will propose a similar number of positive positions regardless of the task assigned.
	1C. In terms of negative positions proposed	H1C. Learners who are given alternatives in their group discussion will make more negative positions against solutions.
	1D. In terms of level of supporting reasons given 1E. In terms of level of qualifier given 1F. In terms of level of evidence used	H1D~H1F. Learners who are given alternatives in their group discussions will be more likely to use more supporting reasons, qualifiers and evidence.
	1G. In terms of a change of ideas	H1G. Learners who are given alternatives in their group discussion will change their ideas more often.
	1H. In terms of number of argumentative posts	H1H. Learners who are given alternatives in their group discussion will have more argumentative posts.

2. Participation Dimension		
Research Questions	Operational Questions	Hypothesis
Does the discussion task type assigned influence learners' participation?	2A. In terms of number and length of sessions had	H2A Learners who are given alternatives in their group discussion will have more sessions and sessions of greater length.
	2B. In terms of percent of sessions with posts	H2B Learners who are given alternatives in their group discussion will have a smaller percent of sessions with posts.
	2C. In terms of time spent on reading and percent of posts read vs. scanned	H2C. Learners who are given alternatives in their group discussion will spend more time reading and read (versus scan) more frequently when they open a post.
	2D. In terms of percent of unique post viewed	H2D Learners who are given alternatives in their group discussion will read more, different posts.
	2E. In terms of number, length and word counts of posts made	H2E. Learners who are given alternatives in their group discussion will make more and shorter posts and spend longer time on them.
	2F. In terms of number and length of reviews had	H2F. Learners who are given alternatives in their group discussion will have more reviews and spend longer time on them.
3. Collaboration Dimension		
Research Questions	Operational Questions	Hypothesis
Does the discussion task type assigned influence learners' collaboration?	3A. In terms of homogeneity of participation	H3A. Groups that are given alternatives in their task will participate more equally.
	3B. In terms of homogeneity of argumentation	H3B. Groups that are given alternatives in their task will contribute more equally to the formation of the arguments.
	3C. In terms of supporting group consensus	H3C. Groups that are given alternatives in their task will have more learners supporting the group consensus

3.3. Research Questions

Specifically, the study examines the following three overarching research questions.

1. Does the discussion task type assigned influence learners' argumentation?
2. Does the discussion task type assigned influence learners' participation?
3. Does the discussion task type assigned influence learners' collaboration?

As task type is expected to affect how learners conduct their conversations in order to reach the assigned goal, the argumentation dimension was the most important measure chosen to reflect the quality of conversation; participation was chosen to reflect the quantity of learner engagement as learner behaviors in online discussions are easily and reliably observed. Collaboration was chosen as a dimension between learners' performance on argumentation and participation as it captures the group process.

3.4. Operationalization of the Argumentation Dimension

The presence of specific argumentative moves was used as evidence of argumentation quality in many analytic frameworks (for a detailed review, see Clark et al., 2007). Nussbaum's (2008) scheme examining interactive argumentation in online discussion forums was built based on an initial global claim that frames the discussion, with other participants supporting, opposing, qualifying, or diverging from that first global claim. The scheme is ideal for coding arguments in online discussion forums looking at how all participants' arguments in a discussion evolved as a whole, but it may not be ideal for examining how diverse ideas are supported or rebutted and how group consensus is built. Although ideas in Weinberger and Fischer's (2006) work was adapted conceptually, its measures were not used in this study because they require multiple levels of segmentation and are extremely time-consuming to conduct (500 working hours for training, 1200 hours for coding per study).

Clark and Sampson's (2008) analytic framework for assessing dialogic argumentation was chosen for use in this study because it addresses the disadvantages of both of the above schemes (see Appendix A for Clark and Sampson's coding scheme). Clark and Sampson's framework is less time-consuming and more flexible for modification. Their framework seeks to examine discussions with different viewpoints, critiques and a goal of reaching a consensus (Clark & Sampson, 2008). Despite the fact that their scheme is a product-oriented measure, it is argued that together with other

dimensions this study examines, it can be used to assess argumentation as a process. The framework codes discourse moves in terms of argument structures (i.e. claims, counterclaims, rebuttals). The level of grounds students used to warrant their claims is coded at a meso-level. Data, warrant and backing are collapsed to grounds to avoid the difficulty of identifying types of reasoning that occurred in arguments (Erduran et al., 2004). Clark and Sampson's scheme also identifies the conceptual quality of a post by matching the discussed ideas with a predetermined list of ideas that could be discussed. Finally, on a macro-level, the discussion is parsed into discourse episodes based on its threading structure, and the overall oppositional quality level is assigned to each episode. The hierarchy assumes that claims or counterclaims with grounds are of higher quality than those without, and argumentation with rebuttals is better than that without.

In this study, Clark and Sampson's (2008) scheme was adapted to fit the specific kinds of tasks used. The modified version coded solutions (represented by *Number of Unique Solutions,* Operational Question 1A in Table 3.1, hereafter referred as 1A) which is similar to the "Claims" and "Counterclaims" in Clark & Sampson's (2008) terms; Solutions were further distinguished as having Positive and Negative Positions. Positive positions were similar to "Claims" (the solution was supported); negative positions were similar to "Rebuttal against Thesis" (the solution was rebutted). Thus, *Number of Positive Positions* and *Number of Negative Positions* could be calculated for each solution and overall to index levels of agreement and disagreement (1B and 1C respectively). Past studies repeatedly indicated that learners in online discussions tend to agree with others more often than they dissent (Gunawardena et al., 1997; Hew & Cheung, 2011; Jeong, 2003). As the alternative task was designed to reduce learners' tendency to share ideas, it is hypothesized that learners given contrasting alternatives would focus on debating between the two (hence having more negative positions, Hypothesis 1C) rather than generating solutions (Hypothesis 1A) or agreeing with others (Hypothesis 1B).

To indicate how much a solution was considered, the scheme coded supporting reasons (similar to "Supports of a Comment") and qualifiers (similar to "Rebuttal against Grounds"). These two were calculated as *Average Level of Supporting Reasons* and *Average Level of Qualifiers* (1D and 1E respectively). Moreover, to capture how learners warrant their arguments, the coding scheme measured Evidence Used (which is similar

to the “Ground Quality” scheme in Clark & Sampson’s framework). This code was calculated as *Average Level of Evidence Used* (1F).

The presence of disagreement and learners’ tendency to reason and elaborate seem mutually influential. Price et al. (2002) counted the number of reasons participants generated and identified a positive correlation between the number of reasons and the frequency of disagreement. Mao (2009) argued that counting the number of reasons reflects its quality and the quantity of reasons is highly related to the presence of arguments. With a premise that disagreement might bring more arguments (Nemeth & Chiles, 1988), learners who are given contrasting alternatives and thus elicit more disagreement are hypothesized to generate more reasons (Hypothesis 1D) and back them up with a variety of sources (Hypothesis 1F). To the same extent, they might provide more qualifiers (Hypothesis 1E) since disagreement allows them to consider multiple perspectives.

Posts that do not have any of the discourse moves above can be considered as Non-argumentative (similar to “Organization of Participants” and “Off-task” codes from the original scheme, 1H). A student’s argumentation moves overall can be considered as their change of ideas (similar to Change of Claim, 1G). The codes for each of these categories were further calculated into *Number of Change of Ideas* and *Percent of Argumentative Posts* (1G & 1H respectively).

Clark and Sampson (2008) argued that disagreement is more likely to elicit conceptual change as this takes place only when a piece of valid evidence is challenged (Erduran et al., 2004). Price et al. (2002) also stated that people are more likely to generate reasons when having disagreement and these reasons are often stronger (Clark et al., 2007). Thus, learners given contrasting alternatives might express more disagreements and thereby undergo more events of conceptual change (Hypothesis 1G). In addition, as learners given contrasting alternatives are hypothesized as having more negative solutions, supporting reasons, qualifiers, evidence, and change of ideas, it can be expected that they would also have more argumentative posts (Hypothesis 1H).

The coding schemes for conceptual quality and the levels of opposition used by Clark and Sampson (2008) were omitted from the study because generating a complete

list of suitable concepts for the discussed issues was not possible. This is due to the fact that the current context involved socio-scientific issues in problem-solving cases whose answers were subjected to personal interpretation. This nature reflects the characteristics of the judgement tasks. This is different from Clark and Sampson (2008) as well as Erduran et al.'s (2004) studies examining science discussions where there were epistemologically right and wrong answers. It was argued that two of the previously discussed codes— *Average Level of Supporting Reasons* and *Average Level of Evidence Used* might provide sufficient information about the quality of argumentation. For the level of opposition, it was argued that the modified coding scheme already measured the extent of agreement and disagreement in discussions which could help determine the level of argumentation in the discussion.

3.5. Operationalization of Participation Dimension

Previous studies looking at both data in aggregate and individually showed evidence that learners distribute their participation in various distinctive ways (Wise, Speer, Marbouti & Hsiao, 2012; Wise, Perera, Hsiao, Speer, Marbouti, 2011). The notion of sessions (a series of consecutive actions) was one construct used to index how learners distribute their participation (del Valle & Duffy, 2007; Wise, Speer et al., 2012). Thus, *Total Number of Sessions* (2A), *Average Session Length* (2A) and *Percent of Sessions with Posts* (2B) were calculated to capture how learners distribute their time and actions in the discussion. It is expected that learners given contrasting alternatives would have more sessions with moderate length as they may constantly check in the discussion for new posts (Hypothesis 2A). Therefore, they would also have more sessions where they mainly read others' posts instead of posting (Hypothesis 2B).

As a prerequisite criterion for argumentation, how learners take in ideas of others can affect how they form or respond to arguments (Suthers et al., 2010). Reading of others' posts in online discussions has been used to indicate the basic presence of taking up ideas of others, and the amount of time spent on this activity can be used to denotes its depth (Hewitt, Brett, & Peters, 2007; Wise, Speer et al., 2012). Therefore, *Total Time Reading* and *Percent of Posts Read vs. Scanned* were used to indicate the depth of learner engagement with the ideas of others (2C), and *Percent of Unique Posts*

Viewed was used to operationalize its breadth (2D). Aligning with previous hypotheses, learners given contrasting alternatives would be more active in reading other people's posts; thus, they are expected to spend more time reading and scan less posts (Hypothesis 2C), as well as reading more posts overall (Hypothesis 2D).

In order to argue, learners have to provide reasoning and defend their positions. Posting is an externalization of learners' thoughts, and the volume of posting is a preliminary index for learners' engagement. Discussions with a low number of posts were claimed to have low engagement (Dennen, 2005; Webb et al., 2004).Thus, the extensiveness of idea externalization was indexed by *Total Number of Posts Made*, *Average Number of Words per Post* and *Average Posting Length* (2E). It is expected that learners given contrasting alternatives would be more active in spending more time making more posts, and the posts may not be too long as they try to carry over the ongoing discussion (Hypothesis 2E).

When learners engage in the discussion, they may also reflect on previous comments in light of other's perspective to make a pertinent argument or simply to monitor their process of thinking (Wise et al., 2011). Thus, reflection was measured by *Total Number of Reviews* and *Average Reviewing Length* (2F). It is expected that, as learners given contrasting alternatives get more engaged and active in their participation, they may be more aware of their own actions. Thus, they may review their own posts and spend longer time on them (Hypothesis 2F).

3.6. Operationalization of Collaboration Dimension

The main focus of the collaborative dimension is to measure differences in individual efforts in group work in terms of participation and argumentation. Weinberger and Fischer (2006) examined the homogeneity of learners' participation by looking at the standard deviation of the number of posts and number of words made. The higher the standard deviation is, the bigger the difference among members' efforts is. In this study, their approach was applied to examine the standard deviations of several key participation and argumentation variables between the two conditions (3A & 3B).

Collaboration was defined as a “process of shared creation” by Schrage (1990, p.40), so a favorable form of collaboration could be considered as equal contribution to the shared creation. Thus, it is hypothesized that learners given contrasting alternatives would likely have equal contribution in participation and argumentation as they are more deeply involved in choosing a commonly agreed option instead of generating their own individual solutions (Hypotheses 3A and 3B).

Moreover, specific to the tasks assigned, the study also examined the number of group members who explicitly supported the group solution to infer the strength of the group consensus-building (3C). As reviewed in Chapter 2, group consensus can be reached via different manners. For groups that collaborate well, an ideal way to reach a common ground is to have all members in a group voluntarily give consent to a proposition and commit to the idea (Levi, 2011). Conversely, the group decision (the preferred answer) may also be made by one or few members in the group (Steiner, 1972). Therefore, it is speculated that if learners contribute evenly in the discussion, the final decision they made would be supported by more people as well (Hypothesis 3C).

4. Methods

In the previous chapters I explored the current state of relevant understanding about the importance of discourse, task type, and argumentative skills in a computer-supported collaborative environment, and presented my research questions and study framework. This chapter describes the methods used to enact the study. It first describes the learning context, the task, experimental conditions and assignment, participants and the experimental procedure. The chapter then explains the specific argumentation, participation and collaboration variables used and how they were calculated. Lastly, the chapter delineates the analysis of collected data to answer the research questions.

4.1. Learning Context

The study was conducted in a large (157 students) blended (face-to-face and online) introductory undergraduate business course at a midsize university in Canada. The course consisted of a weekly two-hour lecture (on Thursdays) and one-hour tutorial sessions (on Thursdays and Fridays). The discussion activity took place in Phorum, an asynchronous threaded discussion forum. Students were each assigned to one small group discussion only available to group members (details of group assignment are given in the following section). To simplify the searching, reading and posting processes, students were only allowed to make replies to a single discussion prompt made by the instructor. In this way, the function of creating new threads was limited to the Teaching Assistants (TAs) and the instructor. The instructor also facilitated the discussion by acknowledging students' contributions and encouraging them to post when needed. Each discussion period ran from Friday 12:01 am to Tuesday 11:59pm, five days in total. Students were allowed to make their replies during this period; they could still read the posts in their discussion after it had been closed. The discussion weeks took place in Week 4, 5, 9 and 10 of a 13-week term.

4.2. Discussion Assignment—Video Case Analysis

There were nine tutorials in total and the instructor arbitrarily divided each tutorial into three to four subgroups (three~six people in each group). Each group participated in one discussion based on a video case; groups drew lots to decide which of four possible video cases they would analyze. In the assigned discussion week, students were asked to watch a short video presenting an authentic organizational challenge (see Table 4.1 for a summary of the four cases) and come up with a solution in the online discussion. The videos were chosen by the instructor from an online video database from the Center for Leadership Development and Research at Stanford University (http://www.leadershipinfocus.net/).

Table 4.1. Summary of the Challenges in the Video Cases

Week	Topic	Summary
Week 4	Motivation: Reaching Generation Y	A CEO wanted to find a way to manage and motivate young employees who often neglect the chain of command.
Week 5	Communication: Learning from a mistake	A junior manager wrestles with how to react to negative feedback received during a senior management meeting.
Week 9	Conflict & Negotiations: Working with difficult peers	A manager clashes with a new colleague whose team must work closely with her own.
Week 10	Ethical Decision Making: Making exceptions	A captain found out a top performing soldier who was going to be promoted tested positive for drug use.

The assignment required the group to reach consensus on their solution to the challenge by the end of the discussion, and apply what they learned to lead a face-to-face class discussion on the video case in their tutorial. For the weeks they were not presenting, students were required to participate in the face-to-face discussion led by other groups. Each subpart of the video case analysis (online discussion, tutorial leading, and participating in others' discussions) was worth 5% of students' final course grade. The TAs graded students' performance in the online discussions based on the following rubric (Table 4.2). The tutorial leading was graded based on their creativity and interactivity. A designed observation sheet for grading and reporting the case analysis presentation was given to the TAs in order to get a sense of how students applied their online discussion to lead the case in the tutorial. However, not all TAs used this sheet so

it was excluded from analysis. Thus in the end, only the actual online discussion was analyzed in this study.

Table 4.2. Marking Criteria for Online Participation

5%	Makes At LEAST two original discussion postings and responds to AT LEAST two other postings with value-added messages. Postings are thoughtful, and contribute well to the group discussion.
4%	Makes two original discussion postings and responds to AT LEAST one other posting with value-added messages. Postings are thoughtful, and contribute well to the group discussion.
3%	Makes one original discussion posting and responds to AT LEAST two other postings with value-added messages. Postings are thoughtful, and contribute well to the group discussion.
2%	Makes one original discussion posting and responds to one other posting with value-added messages. Postings are thoughtful, and contribute well to the group discussion.
1%	Makes only one or two postings which are short, lack quality, or come toward the end of the discussion.
0%	No posts at all

4.3. Discussion Tasks Conditions

Two task conditions were designed based on McGrath's (1984) *Group Task Circumplex.* In the open-ended task condition (OT Condition, a combination of McGrath's Creativity and Judgement tasks, see Figure 2.2), students were asked to come up with possible solutions to the organizational challenge and decide on a best solution with supporting rationale. In the alternative task condition (AT Condition, a combination of McGrath's Cognitive Conflict and Judgement tasks), students were given two contrasting alternatives to debate; they needed to argue with each other and come to a group consensus at the end of the discussion with reasoning. If students thought that neither of the given solutions was good, they could also create their own and explain why it was better. As consensus is a critical element in stimulating collaborative argumentation, students in both conditions were required to reach an agreement; thus both tasks involved elements of McGrath's Judgement task type.

Both conditions received similar discussion prompts that provided several common elements: an external link to the video, instructions for the task, three guiding questions, the grading rubric, and suggestions for making good contributions. The guiding questions asked students to summarize the context for the problem, apply

theories from the textbook, and relate to their personal experience if possible. The only difference between conditions was the third guiding question. In the OT Condition, students were asked about possible solutions the person in the video could try in this situation while in the AT Condition, students were given two contrasting alternative solutions and asked to choose only one (see Appendix B for a sample discussion prompt from each condition). The opposing alternatives for the AT Condition were generated by the instructor and were 1) based on different theories related to the course content, and 2) equally elaborated so they were contrasting and in-depth enough to promote alternative perspectives.

4.4. Condition Assignment

The condition assignment was done in a systematic manner to maintain a balance between conditions. In each assigned discussion week, tutorials were split into two sections (Tutorial 1~4, Tutorial 5~9). As students were required to participate in the face-to-face discussion led by other groups in their tutorial, they could indirectly experience presentations resulting from the different discussion tasks. Thus, each section alternated between the OT Condition and the AT Condition (see Table 4.3 for detailed distribution). A preliminary analysis was conducted by comparing the number of posts made for tutorials that started with open-ended tasks and tutorials that started with alternative tasks, and the result showed no significant difference between the different orders. Thus the task order did not appear to be a confounding variable.

Table 4.3. The Condition Assignment Matrix

	Week 4		Week 5		Week 9		Week 10		Total
Tutorial #	1-4	5-9	1-4	5-9	1-4	5-9	1-4	5-9	
OT	4/4	-	-	3/5	3/4	-	-	2/3	12/16
AT	-	3/5	3/4	-	-	4/5	1/4	-	11/18

Cells are number of groups assigned to each condition in the discussion and was shown as: # of consented groups / # of all groups

4.5. Participants

One hundred and seventeen of the 157 students agreed to participate in the study by allowing the researcher to access their discussion data (click-stream data and post contents) in the online discussion forum, as well as their course grade. Only groups where all students consented were analyzed for the study. Therefore, 23 groups (107 students) were included in total. The average of students' final grade was 75.47 (*SD* = 4.7). Among the analyzed dataset, 13 students had grades in the average range A, 33 had grade range B, 49 had grade range C, 9 had letter grade D, and three failed the course. Comparing the students in the two conditions revealed no significant difference between the two groups on grades ($t(21) = 1.345$, $p = .973$). However, a significant difference with a large effect size was found when comparing the standard deviation of grades between conditions ($t(21) = 2.968$, $p < .01$, $d = 1.24$). This suggests that learners in the OT condition had a bigger variation of ability in the course subject matter.

4.6. Procedure

At the beginning of the course, the researcher gave a short tutorial of the discussion tool to the class, explained the purpose of using discussion forums in class, and provided an instructional manual on the course website. All enrolled students received a default username and password. Consent to participate in the study was requested during the first two weeks of class. For consistency, the instructor decided to use two different kinds of prompts for the discussion assignment regardless of whether students participated in the study or not. In the third week, students were put into groups with whom they signed a group contract indicating that they would contribute as much as they could to accomplish all the group work in the course. All groups (including groups consisting of non-consenters) then drew lots to see which case they would analyze and they were assigned discussion task. At the end of the course, the instructor provided final grades and discussion activity grades for consenting students to the researcher. Phorum automatically kept a log of individual actions and posts made; consenters' data was extracted after the course ended.

4.7. Data Sources

4.7.1. Post content processing and analysis (argumentation variables)

The researcher and another graduate student with sufficient understanding in online discussion forums coded all posts made by participating students. Clark and Sampson's framework (2008) was modified as described earlier to capture argumentation in the discussions (for complete coding scheme and notes, see Appendix C). The argumentative moves coded and the argumentation variables deriving from it are described below. All argumentation variables were calculated at the group level because the discussion task was assigned to the group as a whole and argumentation is a group phenomenon mediated by group dynamics. As the proposed solutions varied from group to group and topic to topic, coders needed to identify possible solutions before coding. Thus in a preliminary phase, the two coders first separately went through all discussions and generated a list of solutions given in each group, naming each solution based on the group's language. Then the coders discussed their answers together and made one consolidated solution list for each group. Each group was then coded based on their unique solution list. In total, 23 solution lists containing 184 unique solutions were generated (see the solution lists in Appendix D).

1. **Number of Unique Solutions:** This variable captured the total number of ideas in a discussion. It was calculated by summing the number of unique solutions discussed in a group. The move "Solution" was coded based on a solution list previously generated by the coders (as described above).

   A post could have a Positive or Negative Position on a solution. It was also possible for a post to contain multiple solutions with Positive or Negative Positions on each one. When a solution was mentioned, the position taken on the solution was determined based on the surrounding language. Each proposed solution received a key (e.g. "email method") and a code that could be 0 (no solution at all), + (positive position), and – (negative position).

2. **Number of Positive Positions**: This variable captured the amount of agreement in a discussion. It was calculated by summing the number of Positive Positions discussed

in a group. For example, the claim “I think the emailing method was the solution for Lisa” would be coded for the solution “email method” and received a +.

3. **Number of Negative Positions:** This variable captured the amount of disagreement in a discussion. This variable was calculated by summing the number of Negative Positions discussed in a group. For example, the claim “I don’t think email was a good way of communication” would be coded for the solution “email method” and received a -.

4. **Average Level of Supporting Reasons**: This variable captured the average degree of reasoning (i.e. data, warrant, and backing) to which learners in a group backed up the positions for their solutions. The move “Supporting Reasons” only applied to posts that contained at least one solution. The codes for Supporting Reasons could be 0 (no reasons), 1 (single reason) and 2 (multiple reasons) and were applied to the highest level of reasons given in a post. For instance, “I agree with emails because they’re efficient” would receive a code 1. The variable was calculated as the average of level of supporting reasons given in argumentative posts with solutions.

5. **Average Level of Qualifiers**: This variable captured the average degree of reasoning to which learners in a group limited the validity for a position or proposed alternative perspective for a supporting reason. This category also only applied to posts with solutions. The codes that could be applied were 0 (no qualifier), 1 (single qualifier) and 2 (multiple qualifiers). For instance, a post with the sentence “I disagree with email communication because it increases misunderstanding, but it may be effective if done carefully” would receive a code 1. The variable was calculated as the average level of qualifiers given in argumentative posts with solutions.

6. **Average Level of Evidence Used**: This variable captured the breadth of sources learners in a group used to support the arguments. It applied to all posts in the discussion (even posts without solutions because it may contain identification or analysis of problems). The codes for evidence used was assigned based on information in the entire post and could be 0 (no evidence), 1 (explanation only), 2 (explanation coordinating with single source), 3 (explanation coordinating with

multiple sources) and were applied to the highest level of evidence given in a post. For example, the post “I think we should use email as the video describes…, and the textbook said...” would be coded as a 3. The variable was calculated as the average level of evidence used in argumentative posts with solutions.

7. **Percent of Argumentative Posts:** This variable captured the ratio of argumentative to non-argumentative posts in a discussion to reflect the focus on argumentation. It was calculated by dividing the number of argumentative posts in a discussion by the total number of posts in the discussion. Posts that did not have any evidence for the above six argumentative moves were considered non-argumentative posts. One common example of a non-argumentative post was a logistical post coordinating the tutorial presentation of the case.

8. **Number of Change of Ideas**: This variable captured the number of times any individual in a group changed their position on a solution. It was calculated by summing the number of Change of Ideas in a group. Change of Ideas was the only variable that was not directly coded in this process; it was calculated post-hoc by the researcher after the coding process by summing the number of Change of Ideas in a group.

In preparation for coding, the coders went through a calibration practice using sample posts from consenters in groups that did not have all consented members. Explanation, clarification and descriptors were added to the coding conventions as needed and additional notes were added to help making coding decisions. After four rounds of calibration (20 hours in total), the coders reached an average of 90% agreement, suitable for moving forward.

The coding process rotated between joint and separate phases (see Table 4.4) as coders’ views and judgements may deviate over time. The researcher randomly distributed the discussions to the stages of coding using the principle of equal proportion of discussions in each condition and video case. In total, 28% of the posts were double coded with inter-rater reliability computed. All inconsistencies were resolved. Cohen’s kappa was used to calculate inter-rater reliability to take into account agreement by chance. According to the criteria proposed by Cohen (1960), the argumentation

dimension was measured with an excellent inter-rater agreement beyond chance based on the result from joint coding stages (see Table 4.5).

Table 4.4. Coding Process

Stage	Joint 1	Separate 1	Joint 2	Separate 2	Joint 3
Coder 1	2 Groups 1 OT 1 AT 86 posts	5 Groups 3 OT 2 AT 100 posts	2 Groups 1 OT 1 AT 52 Posts	4 Groups 2 OT 2 AT 138 posts	2 Groups 1 OT 1 AT 48 Posts
Coder 2		4 Groups 2 OT 3 AT 112 posts		4 Groups 2 OT 2 AT 128 posts	

Table 4.5. Inter-rater Reliability (Cohen's Kappa)

Coding Stages	Solution (0, +, -)	Supporting Reasons (0,1,2)	Qualifiers (0,1,2)	Evidence Used (0,1,2,3)	Non-argumentative (X)
Joint 1	0.88	0.74	0.93	0.70	1.00
Joint 2	0.96	0.74	0.96	0.80	0.96
Joint 3	0.88	0.81	0.91	0.78	1.00

4.7.2. Click-stream data processing and analysis (participation variables)

Click-stream data are user activities automatically logged by the discussion tool based on mouse clicks. For each click, the timestamp, identity of the action (view, post, review, edit) and the content of posts were documented. The method of online discussion click-steam data processing was adapted from Wise, Speer et al. (2012). In Phorum, users were identified by their user ID which was a unique number assigned to them. For consenting users, data was extracted and filtered by this user ID. The extracted data was then categorized into four types of actions: "views" (opening others' posts), "posts" (creating a post), "reviews" (revisiting one's own posts later), and "edits" (making changes to one's previously submitted posts). Views were later categorized as

reads or scans with a threshold of 6.5 words per second (see Hewitt et al., 2007) to index the depth of user's viewing action.

Action durations were calculated by subtracting the time between subsequent actions by a user. As students did not have to log out the system, this approach resulted in some posts with an apparently long duration when there was a big gap between two subsequent actions. For instance, if one read a post at 10 am and the next action was at 10 pm, the action length would be calculated as 12 hours. Such duration was unlikely to reflect learners' true behaviors, thus adjustments were made as follows: 1) all actions were divided into sessions, defined as a series of user actions performed consecutively. A maximum action length of 60 minutes was set based on examination of two frequency tables: one of the duration of all actions performed in the system and one of the duration of posting actions only. Posting actions were important to examine separately because students typically spent a longer time making posts and since students were graded on their posts, they were less likely to abandon the, thus their times were more likely to indicate actual activity. The frequently tables revealed that 91% of all participants' action length and 97% of their posting length were less than 60 minutes; this aligns with the maximum action length of 60 minutes used in previous work (Wise, Speer et al., 2012). Thus, if an action length (read, review, post, or edit) was over 60 minutes, it was marked as the end of a session and the duration of that action was replaced with an estimate value based on that user's average action speed. For example, if the last action in a session was a reading action, the estimate duration would be the number of words in the post the user read times his or her average reading speed. In the case that a replaced duration was longer than the actual duration which could occur for posting actions, the actual time was kept and the session was not marked as ended.

The participation variables used in this study were examined at the group level (as averages of individual group members' participation) because individuals' behaviors participating in an online discussion cannot be assumed to be independent from each other (Schellens, van Keer, Valcke, & de Wever, 2007). The 11 variables used are defined as follows (partial definitions modified from Wise, Speer et al., 2012).

1. **Total Number of Sessions**: measured the distribution of participation a learner had in the discussion by summing of all sessions the learner had in the target discussion forum.

2. **Average Session Length**: measured the extent to which a learner spent a consecutive time-span in the discussion by dividing the total time (in minutes) the learner spent in the system by the total number of sessions.

3. **Percent of Sessions with Posts**: measured the temporality to which a learner performed posting and reading behaviors in all sessions by dividing the number of sessions where the learner made a post by the total number of sessions a learner had.

4. **Total Time Reading**: measured the overall depth with which a learner took in the ideas of others in the discussion by summing the time a learner spent in reading.

5. **Percent of Posts Read vs. Scanned**: measured the depth with which a learner read others' posts in the discussion (as opposed to scanned) then by dividing the number of times the learner view others' posts at a rate lower than 6.5 words per second by the total number of views the learner had.

6. **Percent of Unique Post Viewed**: measured the breadth with which a learner read others' posts in the discussion by dividing the number of unique posts made by others that the learner opened by the total number of posts made by their group members to the discussion forum.

7. **Total Number of Posts**: measured the overall contribution a learner made to a discussion. It was calculated by summing the number of posts a learner made in the discussion.

8. **Average Number of Words per Post**: measured the quantity of idea externalization a learner produce in a discussion by dividing the total number of words posted by the total number of posts created by the learner.

9. **Average Posting Length**: measured the attention a learner put into making posts in the discussion forum by dividing the time (in minutes) a learner had the posting window open by the total number of posts created.

10. **Total Number of Reviews**: measured the quantity of reflection a learner had in a discussion by summing the number of times a learner re-opened their own posts in a discussion.

11. **Average Reviewing Length**: measured the attention a learner put on reflecting on their own thinking by dividing the total time a learner re-opened their own posts by the total number of reviews.

4.7.3. Collaboration variable processing and analysis

Collaboration variables were calculated as the standard deviation of each argumentation and participation variables for each group to examine the homogeneity of individual efforts in a group. The smaller the standard deviation is the more homogeneous individuals' contributions were. Collaboration variables included the following three kinds:

1. **Standard Deviation of Argumentation Variables:** this included the standard deviation of the five following argumentation variables that had individual values from which a standard deviation could be calculated: *Number of Positive and Negative Positions*, *Average Level of Supporting Reasons*, *Average Level of Qualifiers* and *Average Level of Evidence Used*. Three variables: *Number of Unique Solutions*, *Number of Change of Ideas*, and *Percentage of Argumentative Posts* were not calculated because they were already group variables.

2. **Standard Deviation of Participation Variables:** this included the standard deviation of all the 11 participation variables mentioned above.

3. **Number of People who Supported the Group Consensus**: this variable captured the strength of support a group consensus has. It was calculated by counting the number of people who posted a positive position for the solution that was given as the group consensus for groups that reached a consensus in the online discussion.

4.8. Data Analysis

As the sample size in the current study was relatively small, Cohen's *d* (Cohen, 1988) was used as a measure of effect size to examine the magnitude of differences between conditions for the study sample. The standard deviations of the two outcome measures for the study samples were not equal, so pooled standard deviation was used to calculate Cohen's *d* (Hartung, Knapp, & Sinha, 2008). Following Cohen's (1988) guidelines for effect size interpretation, *d*=.20 was considered as small, *d*=.50 was medium, and *d*=.80 was large. In addition, independent-sample *t* tests were used to determine if between-group differences were statistically significant. For variables in which the data violated normality (based on the Shapiro-Wilk Test), the Mann-Whitney U Test (*U* test) was used (Carver & Nash, 2002).

5. Results

As described in the previous chapter, two types of data were collected in this study: (1) learners' post contents; and (2) their participation click-stream data in the discussion forums. A coding scheme was applied to capture evidence of argumentation in learners' posts and the codes were processed into eight argumentation variables. The click-stream data was extracted and processed into 11 participation variables to index different aspects of learner's participation in the discussion forum. The standard deviations of five of the argumentation variables and all 11 participation variables were calculated as collaboration variables to index the difference of individual efforts in groups in the discussion forum. This chapter reports the results for these variables for the 23 participating groups, including descriptive statistics for each condition, effect sizes, as well as results from inferential *t* tests.

5.1. Argumentation Dimension

Two consenters did not participate in their respective discussions at all, and thus were removed from analysis. In total, the remaining 105 participants made 676 posts in the formal discussion forums. Twelve posts that were empty, duplicated or contained technical problems participants encountered at the beginning of the discussion were removed from the analysis. The remaining 664 posts were coded as described earlier. Overall descriptive statistics for the argumentation variables based on these posts are shown in Table 5.1.

Table 5.1. Descriptive Statistics for Argumentation Variables Calculated by Group (N=23)

Variables	Mean	SD	Min	Max
Number of Unique Solutions	8.00	2.41	3	13
Number of Positive Positions	22.48	8.08	11	40
Number of Negative Positions	4.87	3.72	0	14
Average Level of Supporting Reasons	1.45	0.26	0.88	1.83
Average Level of Qualifiers	0.20	0.19	0	.81
Average Level of Evidence Used	1.62	0.32	1.17	2.58
Number of Change of Ideas	1.13	1.06	0	3
Percent of Argumentative Posts	89%	17%	45%	100%

Only 11 groups reached a clear agreement at the end of their discussion, though other groups may have continued their discussion face-to-face. On average, each group made 23 posts (*SD*=9.5) discussing an average of eight different solutions: the number of solutions proposed by a group ranged from three to thirteen. However, further inspection revealed that many of these solutions were variations of similar ideas (e.g. “Demote down to rank 0” or “Demote only a little bit”).

In terms of positions for solutions, for all solutions proposed in a group, the number of positive positions taken was almost 5 times as many as the number of negative positions taken. Learners tended to use more than one source of evidence (e.g. video, textbook theories) in addition to explaining their arguments and used at least one reason to support their position. However, learners seldom used qualifiers in their arguments, nor did they seem to change their ideas often. Most posts in group discussions were argumentative (85%); only a few non-argumentative posts were coded.

Table 5.2 shows values for each variable by condition, Cohen’s *d* and the results of *T*-test/*U*-test for all argumentation variables. A large effect size was found for *Average Level of Supporting Reasons*, indicating that participants in the OT condition used a great deal more supporting reasons than their counterparts. Effect sizes just below the threshold for medium were found for *Number of Negative Positions*, *Average Level of Evidence Used,* and *Percent of Argumentative Posts*, showing that learners in the OT

condition proposed somewhat more negative positions, used some more sources of evidence, but had somewhat less of a focus on argumentative posts. A small effect size was found for *Number of Unique Solutions* and *Number of Positive Positions*, indicating that participants in the AT condition generated slightly fewer unique solutions and had slightly more positive positions. Negligible effect sizes were found for *Average Level of Qualifiers* and *Number of Change of Ideas*. This may because none of the conditions had many such events overall. The findings indicate that different task types affected the degree of support learners provided to their arguments; learners in the OT condition used more reasons and somewhat more evidence to support their arguments; they also had somewhat more negative positions, and discussed a few more unique solutions. Conversely, learners in the AT condition took a few more positive positions, and had a moderately greater percentage of argumentative posts.

Table 5.2. Comparing Argumentation Variables between Conditions with Effect Size and Inferential Tests

Variables	OT Condition Mean (SD) N=12	AT Condition Mean (SD) N=11	Cohen's *d*	*T* value	*P* value for *U* test
Number of Unique Solutions	8.33 (2.23)	7.64 (2.66)	0.29	0.684	-
Number of Positive Positions	21.42 (6.16)	23.64 (9.95)	-0.27	-0.650	-
Number of Negative Positions	5.67 (4.29)	4.00 (2.93)	0.45	1.077	-
Average Level of Supporting Reasons	1.55 (0.20)	1.35 (0.29)	0.80	1.914	-
Average Level of Qualifiers	0.21 (0.23)	0.18 (0.14)	0.17	-	.951
Average Level of Evidence Used	1.68 (0.38)	1.55 (0.23)	0.41	0.982	-
Number of Change of Ideas	1.08 (1.16)	1.18 (0.98)	-0.09	-	.671
Percent of Argumentative Posts	85% (20%)	92% (13%)	-0.40	-	.925

* p <.05

The result of *t*-tests and *U*-tests failed to support any inference of the influence of task type on learners' argumentation behaviors to the larger population. However, the *p*-value for *Average Level of Supporting Reasons* ($p = .069$) is only slightly above the .05 threshold. A post-hoc power analysis (using alpha level .05, $d = .80$ $N = 23$) revealed with the given sample size, the power to detect a significant difference was .45 and for

the effect found, the sample size would need to be increased to 50 to detect statistical significance (power= .8, Cohen, 1988).

5.2. Participation Dimension

In total, the 105 participants performed 17,225 actions in the system. Table 5.3 shows the descriptive statistics for the participation variables to illustrate an overview of learner's participation in the online discussion forum. Overall, individuals in each group engaged with the discussion on an average of 10 sessions during their five-day discussion period with an average of 34 minutes per session. Of the total 5.6 hours learners spent in the system on average, about 61% of the time was spent viewing other's posts, 23% was spent posting, 11% was spent reviewing their own posts, and 1% was spent editing. The remaining 4% of time was attributed to rounding difference and automatic actions generated by the system.

Table 5.3. Descriptive Statistics for Participation Variables Calculated by Group (N=23)

Variables	Mean	SD	Min	Max
Total Number of Sessions	10.11	2.62	6.67	16.75
Average Session Length (in min)	34.09	9.89	15.74	59.94
Percent of Sessions with Posts	36%	7%	26%	53%
Total Time Reading (in min)	200.85	104.34	82.71	626.77
Percent of Posts Read vs. Scanned	65%	8%	44%	73%
Percent of Unique Post Viewed	69%	10%	51%	85%
Total Number of Posts	6.48	2.3	2.4	12
Average Number of Words per Post	131.25	46.93	62.75	270.05
Average Posting Length (in min)	13.13	5.59	8.17	33.59
Total Number of Reviews	11.81	6.46	3.75	30.25
Average Reviewing Length (in min)	2.93	2.25	0.41	10.37

In general, participants seemed to distribute their participation as short and frequent visits, coming to the discussion forum at least once a day for a half hour. In terms of breadth, on average participants viewed about 69% of other's posts in their

group discussion and they tended to read about 65% of the time when they opened a post. On average, participants spent a total of 3.3 hours reading other people's posts; however, as evidenced by the high standard deviation (1.38 hours), this varied greatly from group to group. When externalizing their own thoughts, most learners were generous in expressing themselves; on average they made six posts in their discussion when the requirement to get the 5% participation score was only four. Not only were they active in making their voice visible in the discussion, they were also reflective in inspecting what they have said in the discussion, reviewing their own posts 11 times on average (approximately two times per posts), for an average of 3 minutes. This was not significantly different from their average reading length for others' posts (*M* = 4.55, *SD* = 1.11 min).

Table 5.4. Comparing Participation Variables between Conditions with Effect Size and Inferential Tests

Variables	OT Condition Mean (SD) N=12	AT Condition Mean (SD) N=11	Cohen's *d*	*T* value	*P* value for *U* test
Total Number of Sessions	10.98 (3.04)	9.17 (1.76)	0.72	1.724	-
Average Session Length	35.81 (11.27)	32.21 (8.26)	0.36	0.867	-
Percent of Sessions with Posts	33% (8%)	38% (6%)	-0.69	-1.653	-
Total Time Reading	235.81 (129.4)	162.71 (49.64)	0.73	-	.056
Percent of Posts Read vs. Scanned	66% (7%)	64% (9%)	-0.23	-0.540	-
Percent of Unique Post Viewed	71% (10%)	66% (10%)	0.56	1.345	-
Total Number of Posts	6.78 (2.58)	6.15 (2.02)	0.27	-	.340
Average Number of Words per Post	140.9 (51.67)	120.73 (40.92)	0.43	1.031	-
Average Posting Length	13.81 (6.47)	12.39 (4.63)	0.25	-	.196
Total Number of Reviews	13.26 (8.28)	10.24 (3.33)	0.47	1.165	-
Average Reviewing Length	3.92 (2.54)	1.84 (1.25)	1.03	2.458*	-

* $p < .05$

Table 5.4 shows values for each participation variable by condition, the effect size and the inferential test results for all participation variables. Because participation

variables are not true group variables and were calculated for each group as the average of its members' participation variables, there is potential deflation of the standard deviation at the group level. Thus, the effect size values reported here should only be compared within the participation variables, and not to the argumentation variables.

A large effect size was found for *Average Reviewing Length*; learners in the OT condition seemed to spend a much longer time reviewing their own posts. A moderate effect size was found for *Total Number of Sessions, Percent of Sessions with Posts, Total Time Reading,* and *Percent of Unique Post Viewed*, showing that the OT condition tended to have more sessions in which they spent more time reading instead of posting and they also viewed more posts of others. A close to medium effect size was found for *Average Number of Words per Post* and *Total Number of Reviews*, suggesting that the OT condition made longer posts and had more reviews. Lastly, a small effect size was found for *Average Session Length*, *Percent of Posts Read vs. Scanned*, *Total Number of Posts,* and *Average Posting Length,* showing that the OT learners had only slightly longer session in which they spent more time making more posts. Compared to the AT condition, they also tended to scan less frequently when they opened a post.

In terms of drawing inferences to other situations, a significant difference was detected only for *Average Reviewing Length*, showing that groups who have open-ended discussion tasks are likely to review their own posts longer than groups with alternative tasks. No statistically significant differences were detected for any other participation variables.

5.3. Collaboration Dimension

The standard deviation of each group's values for participation and argumentation variables was used to index the heterogeneity of individual efforts. Tables 5.5 and 5.6 show the means for each condition, the effect size and the inferential test results for the collaborative variables for argumentation and participation respectively.

Learners in both conditions seemed to contribute in equivalent distributions to the process of argumentation. A small effect size was found for *Number of Positive*

Positions, showing slightly more variance in the AT condition while all the other variables had negligible effect sizes. In terms of participation, a large effect size and significant difference was found for *Average Number of Words per Post* and *Average Time Reviewing*, indicating that learners in the OT condition had more variance in their participation for these two variables. In addition, a medium effect size was found for *Total Number of Sessions, Total Time Reading, Total Number of Posts,* and *Total Number of Reviews* showing greater heterogeneity of participation for the OT condition as well. A small effect size was found for *Percent of Sessions with Posts* and *Average Posting Length*; negligible effect size was found for *Average Session Length*, *Percent of Posts Read vs. Scanned,* and *Percent of Unique Post Viewed*, showing almost no difference in heterogeneity of collaboration on these variables between the two conditions. On the whole, learners in the AT Condition tended to participate more homogenously as indicated by their lower standard deviations.

Table 5.5. Comparing the Standard Deviation for the Argumentation Variables between Conditions with Inferential Tests

SD of Argumentation Variables	OT Condition Mean (SD) N=12	AT Condition Mean (SD) N=11	Cohen's *d*	*T* value	*P* value for *U* test
Number of Positive Positions	2.55	3.21	-0.39	-	.479
Number of Negative Positions	.94	.91	0.06	0.141	-
Average Level of Supporting Reasons	.43	.45	-0.06	-0.146	-
Average Level of Qualifiers	.22	.22	-0.04	-0.086	-
Average Level of Evidence Used	.30	.31	-0.04	-0.095	-

* p <.05

Number of People who Supported the Group Consensus was a planned collaboration measure to evaluate the overall support the chosen solution had received from its group members; however, it turned out to be problematic for two reasons. First, a large number of groups did not clearly come to a consensus in the online discussion. Second, as the solutions were complex and frequently a combination of different ideas, the distinction of "support" was not always clear. People might agree with part of the

solution but not all. Therefore, this measure was dropped from the study. It would however provide useful information about collaboration in future studies where learners' main task goal was to make a decision from a predetermined list of solutions.

Table 5.6. Comparing the Standard Deviation for the Participation Variables between Conditions with Inferential Tests

SD of Participation Variables	OT Condition Mean (SD) N=12	AT Condition Mean (SD) N=11	Cohen's *d*	*T* value	*P* value for *U* test
Total Number of Sessions	4.74 (1.68)	4.05 (0.97)	0.50	1.201	-
Average Session Length	15.02 (10.22)	13.33 (8.63)	0.18	-	.667
Percent of Sessions with Posts	16% (7%)	19% (9%)	-0.35	-0.835	-
Total Time Reading	172.03 (129.93)	103.36 (58.93)	0.67	-	.097
Percent of Posts Read vs. Scanned	10% (4%)	9% (3%)	0.09	0.216	-
Percent of Unique Post Viewed	13% (6%)	14% (5%)	-0.17	-0.419	-
Total Number of Posts	3.31 (2.03)	2.25 (1.79)	0.55	-	.074
Average Number of Words per Post	59.33 (28.5)	33.94 (21.68)	1.01	2.412*	-
Average Posting Length	8.39 (6.2)	6.47 (3.36)	0.38	-	.295
Total Number of Reviews	11.64 (8.65)	7.29 (2.96)	0.66	1.639	-
Average Reviewing Length	3.71 (2.6)	1.74 (1.19)	0.96	2.377*	-

* $p < .05$

6. Discussion and Conclusion

Both similarities and differences in argumentation, participation and collaboration were found for learners in the two conditions employed in this study. This chapter begins by interpreting and grouping these similarities and differences in themes based on the results presented in the previous chapter to answer the three research questions. Then the chapter moves on to present an initial evaluation of the use of McGrath's (1984) *Group Task Circumplex* as a tool for examining online collaborative contexts and identifying potential mitigating factors among the individuals that could have influenced the group result. The chapter concludes with implications for theoretically-grounded practice, limitations of the study, and directions for future research.

6.1. Did the Discussion Task Type Assigned Influence Learners' Argumentation in Current Study?

The discussion task type assigned may have stimulated learners in the OT condition to provide more supporting reasons and evidence for their arguments as well as to propose more negative positions to challenge other's ideas. This is surprising as the study hypotheses predicted the opposite. In terms of the level of supporting reasons, the assigned task stimulated learners in the OT condition to provide more reasons to support their arguments than those in the AT condition (contradicting Hypothesis 1D, see Table 3.1). In addition to the level of support, OT learners used more sources of evidence to warrant their positions compared to their counterparts (contradicting H1F). Another factor contributing to OT learners' depth of argumentation is that they proposed more negative positions (contradicting H1C) while learners in the AT condition stressed more on positive positions (contradicting H1B). However, in terms of argumentative posts, as the hypothesis suggested, learners in the AT condition did have more argumentative posts in their discussion than learners in the OT condition (supporting

H1H), they also proposed fewer unique solutions than their counterparts (supporting H1A).

Secondly, in both conditions, students still lacked disagreement. Even though OT learners had more negative positions, the ratio to the number of positive positions was still 1:5. As for the level of qualifiers given, both conditions had very few qualifiers in their arguments, confirming that learners were reluctant in considering counterarguments (failing to support H1E). As for learners' tendency to change their ideas, no difference was found; very few learners changed their positions throughout the discussion (failing to support 1G).

6.1.1. Lack of disagreement

Parallel to previous studies (Dennen & Wieland, 2007; Koschmann, 2003; Veerman, 2003; Yun & Park, 2011), participants in both conditions appeared reluctant to express disagreements and consider alternative reasoning (a prerequisite for any conceptual change to occur) [Clark & Sampson, 2008; Erduran, et al., 2004]. Based on the descriptive statistics and Cohen's *d*, both conditions had very few events of qualifiers and conceptual change at all. This indicates that the task assigned did not affect learners' argumentation in terms of changing ideas or qualifiers given. Even though learners in the OT condition proposed more negative solutions, the average number of negative positions was still much less than those of positive positions. This finding is disheartening since the task was specifically designed to address the problem of infrequent dissent and to circumvent learners' unwillingness to challenge others. This may suggest that learners' reluctance to disagree was too strong for the manipulation to make a difference as task type merely sets up the initial conditions for learners to collaborate in order to reach the task goal. It is possible that other CSCL techniques (e.g. scripting) that impose stronger requirements for collaboration are needed. On average, learners in both conditions tended to offer many supporting reasons (1.55 in OT; 1.35 in AT) and had a lot of positive positions (21.42 in OT; 23.64 in AT). From this, it could be inferred that participants had substantial justification for their arguments, but it lacked negative opinions as to why their proposed arguments may be unfavourable. Thus, they need to be prompted not only to propose disparate opinions but also to

actively contest the ides of others (possible reasons that may limit the validity of their proposals).

6.1.2. A trend of building one solution upon another

Participants in both conditions generated many solutions. Although groups in the AT condition proposed fewer solutions than their counterparts, surprisingly, they still had an average of 7.64 solutions which was 3 times more than what was given to them. One reason to assign contrasting alternatives was to prevent students from engaging in a creativity task and concentrate on sorting out the cognitive conflict. However, it appears that giving learners two ideas to start with does not guarantee that they will not also spend a great deal of time developing their own ideas. This may be due to the nature of ill-structured problems that presents the opportunity for learners to generate ideas. Therefore, thinking about McGrath's *Group Task Circumplex* (1984), virtually all tasks (particularly those with more than one correct answer) may potentially include aspects of a creativity task based on the problem they investigate. In online discussion forums, this could mean that sometimes the tendency to generate ideas may override the main task goal assigned because of the fluid and fragmented nature of posts arrangement in online discussions (Herring, 1999; Thomas, 2002). Previous work (Straus & McGrath, 1994) found that online learners outperformed learners in the face-to-face discussions in creativity tasks but had difficulty in judgement tasks. This might also be why participants were inclined to propose solutions instead of make decisions.

Another possible explanation is that there might have been unintended preliminary solution lists for the topics discussed. The discussion prompt explicitly asked participants to apply theories from specific chapters which delineated a limited range of theories or principles. For instance, in the case *Working with Difficult Peers*, there were two models (each consisted of five to six principles) in the Conflict and Negotiation Chapters about different ways to resolve conflicts in the workplace. Most groups treated these principles as solutions and discussed the rationale of their suitability and applicability to the situation in the video. While such behavior matched the instructor's expectations, it made participants diverge from the two given alternatives. The possibility of a pre-existing solution list for a given problem limited the openness of the problem than it was intended. As the participants had business backgrounds, they may also have

been used to a certain process of conducting case analysis (e.g. Identify Problem-Analyze Problem-Generate Solution). Imposing the debate-task on them may not have necessarily overturned their mindset of problem-solving model. This is particular evident in many discussions where the posts were made with titles such as problem identification, problem analysis, and solution generation.

Finally, it is important to note that in examining the content of the proposed solutions, further investigation of the solution list revealed that they were mostly variations of similar ideas. It was expected that participants would focus either on debate or brainstorming activities, but they seemed to enact these together. The AT condition made variations based on the two given ideas while the OT condition started with no solution but as soon as one appeared, variations surged. This aligns with the collaborative approach identified in Paulus (2005) and Stahl's Model of Collaborative Knowledge-Building (2000) as ideas emerged as personal understanding and were continuously refined and augmented by collaborative efforts.

6.1.3. Possible strong attachment to the proposed solution

It was expected that seeding explicit cognitive conflict in ill-structured problems could encourage learners to focus on the debate task rather than the creativity task. The higher uses of supporting reasons, negative positions, and evidence used by participants in the OT condition were converse to the hypotheses (H1D, H1C, and H1F respectively). One possible explanation is that these findings may be attributed to a sense of ownership participants in the OT condition had. As the OT condition learners were required to come up with their own solutions, they may have developed attachments to the ideas they proposed. Therefore, they would be more likely to ground their argument with sound reasoning and evidence as well as to defend their positions. On the contrary, participants in the AT condition were given two contrasting alternatives to begin with, so they may have granted the given options authoritativeness. As a consequence, they would have felt less of a need to provide supporting reasons or evidence to their choice. Thus, when alternative perspectives arose, they would be more indifferent in arguing and less likely to contest against others' decisions as both options were from the instructor. This hypothesis is supported by Cohen's negative *d* for positive positions, meaning that the AT condition had more positive positions than the OT

condition. The finding contrasts with previous studies suggesting that learners in broad-topic discussions tend to share ideas more than to explore dissonance (Gunawardena et al., 1997). In the current study, learners in the AT condition ended up sharing and agreeing with others more than expressing disagreement.

6.1.4. Differences between participants in two conditions

Another possible explanation for the unexpected results of the OT condition might be the substantial variance in participants' academic ability (a significant higher standard deviation in the OT condition was found in their *Final Grade*). Despite the fact that grouping was assigned arbitrarily by the instructor who was not involved in the grading process and that the experimental conditions were based on an arbitrary matrix, a larger variation of academic performance ended up in the OT condition which may contribute to the findings and confound the experimental design of this study. For instance, it is possible that ardent students in the OT groups were more predominant over other members. The influence they had over the discussions may have contributed to most of the final results identified in the OT condition.

6.2. Did the Discussion Task Type Assigned Influence Learners' Participation in Current Study?

In terms of participation, the assigned tasks seemed to influence learner's participation, indicating that the OT learners were more engaged than their counterparts. In terms of number and length of sessions learners had, on average, OT learners had more sessions but spent about the same time on each as their counterparts (contradicting H2A). In terms of percent of sessions with posts, AT learners integrated their posting actions with their reading actions more frequently than the OT learners (contradicting H2B), showing that they had fewer sessions in which they only read others' posts. In terms of time spent on reading and percent of posts read vs. scanned, OT learners spent more time reading others' posts but for posts they viewed in the discussion, they scanned similar percentage of posts (inconsistent with H2C). As for percent of unique post viewed, OT learners viewed moderately more posts of others' than the AT learners; they opened 71% of others' posts in the discussion (contradicting

H2D). These two results indicate that OT learners were more dedicated to reading posts than their counterparts. As for posting actions with respect to number, length and word counts of posts made, learners in both conditions made similar number of posts and spent similar time on it but OT learners had longer posts than AT learners (failing to prove H2E). Lastly, in terms of number and length of reviews learners had, participants in the OT condition reviewed their posts more frequently and spent significantly more time reviewing their posts on average (contradicting H2F).

6.2.1. High participation in both conditions

Distinct from previous findings where students in online discussion forums often participated only to meet minimum requirements (Dennen, 2008; Palmer et al., 2008; Webb et al., 2004), participants in this study demonstrated a certain quantity and quality of participation in terms of reading and posting activities. Small group size and a compact short discussion period may have accounted for the frequent visits and extensive conversation exchanges. Video case analysis (as opposed to text-based case description) may have also encouraged learners' engagement with the learning material as well. The fact that only one case analysis was required and that a face-to-face presentation based on the online discussion was required may have further elevated their motivation to participate.

6.2.2. Higher engagement for OT learners

The study hypothesized that as learners engaged in the process of choosing between contrasting alternatives, they would be more engaged in argumentation as they attempted to persuade others into choosing a certain solution. Surprisingly, learners who were given alternatives did not seem to be as engaged as their counterparts in terms of their participation. OT learners were found to have a higher number of sessions, and more sessions dedicated to reading actions (2A, 2B); they also read more posts of others for a longer period of time (2C, 2D). This provides a strong support for claiming that participants in the OT condition seemed to be more engaged in participating in the discussion task than their counterparts. Considering the high level of participation along with the high level of argumentation in the OT condition (1D-higher usages of supporting reasons, 1C-negative positions and 1F-evidence used), this may suggest a promising

connection between levels of participation and argumentation as learners were more engaged in the process of argumentation, they were more likely to be more engaged in participating in the discussion. However, this relationship remains to be further verified.

6.2.3. Possible effect of task on reflection

Contradictory to the study hypothesis that the AT learners would revisit what they said in light of others' comments more often than the OT learners (H2F), the observed result points in the opposite direction. It could be explained that as OT learners challenged others' positions more often and provided more reasons and evidence in their arguments, they tended to review their posts more often to re-examine what they had said in order to rebut solutions proposed by other members. OT learners were also found to review their posts significantly longer than AT learners; it could be inferred that engaging learners in argumentation promotes more meta-cognitive listening behaviors such as reflecting on their own thinking and the process of knowledge development (Wise et al., 2011). Alternatively, this might be simply a result of the difference in final grade distribution between two conditions as the OT condition consisted of a greater range of high and low performers. It might be possible that high performers tended to review their posts more often and the extent of such difference could be so great that it could not be balanced out by the low number of reviews from the low performers in the OT condition.

6.2.4. Similar patterns in posting actions

Though OT learners provided more supporting reasons and evidence, the task type did not make much difference in how much effort participants put into composing their posts (2E). Neither did they differ in how long they spent in a session on average (2A) or how often they read a post versus scanning it (2C). This phenomenon is similar to what Wise, Speer et al. (2012) found in their cluster analysis which identified three distinctive patterns by using students' click-stream data from an online discussion. It is possible that these variables were individual behaviors that were subject to the inherent learner differences and therefore were very resilient to external interventions. Schellens et al. (2007), in their study examining the effect of student, group, and task characteristics using a multi-level approach, suggested that student characteristics

played a more important role in influencing learners' final grade than the group characteristics did. In that work, learners' attitude towards learning, learning styles, number of posts made, and the levels of knowledge construction significantly affected their learning outcomes. While the online discussion in the current study only contributed 5% towards students' final grade, Schellens et al.'s (2007) finding concurs with the claim that learners' interactions might be more individually driven than previously thought. However, it is also possible that the intervention was simply too weak to bring the group effects to life.

6.3. Did the Discussion Task Type Assigned Influence Learners' Collaboration in the Current Study?

The discussion task seemed to have had no influence in terms of homogeneity of argumentation (3A) but did have a difference in heterogeneity of participation (3B) pertaining to post length and the average time learners spent on reviewing their posts, indicating that there was a bigger variance in these two variables for OT learners. As mentioned earlier, the data was insufficient to answer how many people supported the group consensus (3C) since learners' support of a group consensus was not always clear and multiple ideas may be present in the final agreement. In this study, only 11 out of 23 groups reached a group consensus by the end of the discussion (five in the OT condition; six in the AT condition) while other groups may have built a common agreement that was not captured by the system. Interestingly, learners in these 11 groups seemed to build consensus in a different manner than previously expected.

6.3.1. Building consensus without contention

Evidence of consensus building was captured in only 11 of the 23 groups; however, other groups were also expected to reach an agreement as they were required to present the group decision in the tutorial. However, this phenomenon matches with previous findings on the difficulty in making decisions online (Straus & McGrath, 1994). Thus, this interpretation is limited to the 11 groups. Other consensus building interactions for the other groups may have taken place outside of the discussion forum.

Weinberger and Fischer (2006) described three manners of consensus building: quick, integration-oriented and conflict-oriented. Levi (2011) also proposed three types of decision making approaches (consultative, democratic and consensus). Using their categories as analytical lenses, the current study sample mostly adapted quick consensus building (e.g., voting, conceding) and integration-oriented consensus building (e.g. combining different solutions into one) instead of reaching a consensus through a series of conflict resolution and negotiation (conflict-oriented consensus building).

In quick consensus building, participants took a democratic decision making approach to vote for a better solution without necessarily being convinced by others' arguments. In a separate analysis of a subset of data looking at how learners in a group argued and built consensus (Wise, Hsiao, Marbouti & Zhao, 2012), a learner who proposed an opposing opinion to the discussion was found to abandon his original disagreement after exchanging arguments with a dominant participant a few times; his concession was taken as a tacit agreement of consensus. Thus, the group decision was made by the dominant voice (acting as a consultative decision maker). This participant was aggressive in imposing her opinion to the group conversation without being aware of other members' opinions. This illustrates how what was discussed most heatedly may not always ended up as the final decision. In these situations, learners may not resolve the disputes aroused from the discussion and they may only agree part of the final solution, if not all. Though quick consensus building may be strategic in handling interactions online, it does not benefit individual knowledge gain as learners simply disregard other alternatives or repress their own perspectives when they become the minority (Weinberger & Fischer, 2006).

The second type of consensus building that occurred in the study is integration-oriented. Instead of exchanging critiques and evaluating multiple perspectives, some groups simply combined various solutions into one action plan. It is speculated that participants preferred integration to confrontation. In integrated-oriented consensus building, learners synthesize others' perspectives, find connections between different solutions, and obtain a shared conception (Weinberger & Fischer, 2006). Such a process presents both advantages and disadvantages. Positively, in order to combine others' ideas, learners may make efforts to actively revise their own perspectives in order to craft integrative solutions which facilitate individual knowledge building (Keefer,

Zeitz, & Resnick, 2000). Alternatively, this process may also be seen as learners' circumvention of confrontation. If true, this would eliminate the benefits of disagreement and argumentation.

6.3.2. Equal contribution to argumentation but heterogeneous contribution to participation

All groups collaborated homogenously in the argumentation process. This might be a generic benefit of small group discussions being able to engage students more than in a large class (Pollock, Hamann, & Wilson, 2011). It could also be attributed to the grading rubric since individuals were graded based on the quantity and the quality of their posts and the group product (the face-to-face presentation) was graded on a separate scale. Having to present in the tutorial was an effective strategy in motivating individuals' contribution to the discussion.

In terms of equal contribution in participation, OT learners had significant higher variance in the average post length they made and the average time they spent on reviewing. They also had higher values with large effect sizes for several variables. This could be attributed to greater engagement with the discussion task as discussed earlier.

6.4. Evaluating the Role of Task Type

While some differences in argumentation and participation were identified between groups given different types of tasks, the reverse direction of many of the results found brings the use of the task type as a design strategy into question. Unanticipated by the study's framework and hypotheses, the results showed increasing reflection, idea engagement, and willingness to defend one's positions in the OT condition. If these changes are treated as predictable effects of task type, then instead of seeding conflicting viewpoints on purpose, it may be better to hand over the opportunity of discovering cognitive conflicts to learners.

However, these results may also be due to other factors, suggesting that task type was weaker than expected to drive argumentation and participation in online discussions. It should also be noted that the groups can be involved in more than one

process when performing a task (Straus & McGrath, 1994). In this study, participants in the OT condition started with generating ideas (generate), then turned their attention to comparing and evaluating other ideas in light of their own (negotiate), and finally settled down on one (choose) before the end of the discussion. Participants in the AT condition experienced similar processes but rather than generating ideas from nothing, they built on the ideas given by the instructor and this possibly discouraged them from negotiation and decision making. This finding is important in informing instructors or designers to reconsider the group processes they want to elicit when designing discussion tasks based on the current task type taxonomy.

The discrepancy between the conditions may also be due to differences in task complexity. Schellens et al. (2007) found that task complexity seemed to account for significant differences in learners' behaviors between different discussions. The more complex the task is, the less intense the discussion and lower the level of knowledge construction students tend to show. Since the judgement task focused on two alternatives and were more complex to process than the creativity task, this might explain why learners in the AT condition showed a lower engagement of participation and less density of disagreement.

As mentioned above, the results of this study may also imply that the task type is not as effective in influencing learners' argumentative and participation behaviors in online discussions as expected. It is possible that actions in online contexts were highly dependent on group dynamics and individual behaviors since task type only determines the group goal but not how to reach it (Steiner, 1972). Depending on characteristics of the learners, they could choose to focus on certain process instead of the assigned goal. Perhaps stronger intervention in instruction on group process that controls how a group approaches a task would have resulted in more powerful effects.

6.5. What Interaction among Individuals in the Group might have Influenced the Results?

Besides task type, there are other possible interactions among individuals within the group that may have influenced the results. First and foremost is the significant

difference found in the standard deviation of learners' final grade; a bigger variance of academic abilities was found for learners in the OT condition, suggesting that although unintended, the two conditions may represent different populations. This difference may explain some of the observed disparity in learner's argumentation and participation and should be noted.

Second, the existence of a dominant voice may be influential in determining the breadth and depth of argumentation levels, therefore, indirectly affecting learners' participation (Wise, Hsiao et al., 2012). In discussions where a dominant voice urged the group to consider both merits and demerits of the proposed solutions, the average level of supporting reasons and qualifiers were likely to be higher. On the contrary, the number of negative positions would likely decrease in discussions when the most active participant simply disregarded the positive voices. In contrast to dominant voices, inactive participants may also influence the group process in that fewer participants meant less chance of alternative views being presented and the group was unlikely to make a decision with the absence of other members. Late participation of some individuals also created a similar effect; due to the temporal nature of the discussion, learners may pay less attention to solutions that are proposed in a later time (Wise, Hsiao et al., 2012). As a great range of high/low performers exists in the OT condition, we would expect that high performers were more likely to dominate the discussion and low performers were likely to participate minimally, thus difference of argumentation, participation and collaboration may arise.

Another possible factor is the presence of synthesis. Wise and Chiu (2011) argued that synthesis or wrap-up posts tended to create pivotal moments that advance learners' level of knowledge construction in online discussions. Though no role was assigned to group members, it was found that some participants synthesized, categorized and contrasted the proposed solutions in the discussion. This seemed to facilitate their decision making process as well. A further investigation revealed that integrative posts (posts that try to synthesize, categorize or compare different ideas) were present for all of the 11 groups that reached a consensus within the discussion period. With a relevant title, these posts had a higher chance to attract members' attention in viewing and replying (Wise, Hsiao, Speer, Marbouti, & Perera, 2012).

6.6. Implications and Recommendations for Theoretically Grounded Practice

The results of this study raised some questions about McGrath's *Group Task Circumplex* (1984) and pinpointed several important issues for educators and designers who intend to use asynchronous online discussion forums in cultivating students' argumentation and critical thinking. While seeding a debate-task in an online discussion forum did not effectively motivate learners to express disagreement, the study speculated that learners may feel ownership of ideas they proposed in the discussion forum and thus be likely to provide stronger warrants and grounds to defend their positions. Thus, it is suggested that learners can be given the opportunity to develop ownership of ideas in an open-ended discussion or can be grouped based on their initial stance for a debate, to stimulate argumentation and participation. A caveat of this implication is twofold: it is important to fully impose the need to choose only one proposal, and it is critical to maintain the balance between different perspectives to prevent marginalization of an idea when the group size is over two. This implication is similar to Dillenbourg and colleagues' work on the "ArgueGraph" script which visualized students' initial opinion towards a topic on a 2D space based on any two values (Dillenbourg, 2002). In this script, students positioned most differently were paired up to go over the same topic again collaboratively. Then students were asked to write a synthesis of all arguments collected for the topic at the end. The script was designed to create conflicts among students; however, similar to what was found in the current study, students using the system at a distance also tended to avoid conflict resolution by agreeing to ideas more than students who used the same script in a computer room (Dillenbourg, 2002).

Learners have been found to struggle with online decision making (Straus & McGrath, 1994). The fact that half of the groups examined in this study did not reach a consensus by the end of the discussion period speaks to the above-mentioned difficulty. Learners may not be familiar with conducting negotiation online and may need extra time to appropriate it. It is also possible that they preferred making decisions in face-to-face situations. The current study exemplified some instructional strategies that could also be applied to assist the online decision-making process. Having a synthesis post or a list of discussed ideas kept learners the same page. A grading rubric specifically targeting on

the criteria of making a group consensus and challenging others may elicit the desired online behaviors. Previous studies have shown that learners tended to have low participation when online discussion was not graded (Webb et al., 2004) and that they behaved differently when the grading criteria were different (Dennen & Wieland, 2008). In addition, leading a face-to-face presentation after the online discussion may provide learners a practice goal to actively participate in online discussions. In blended learning environment, instructors can also implement a desired behavior (e.g. disagreement) in both online and face-to-face contexts (i.e. conducting an online debate and moderate a class debate afterwards) to maximize the learning effects. Lastly, instructor moderation to enhance the main task goal (debate or create) can also help the online decision-making process as online facilitation has been considered important in keeping learners on topic and motivated (Seo, 2007). In this study, the instructor and TAs only lightly moderated the discussion by reminding and encouraging participation; stronger guidance on the group process can be implemented in future research.

When applying McGrath's *Group Task Circumplex* (1984) into task design, one can also ground the design with discussion interfaces that are equipped with certain features (e.g. labeling subject titles with post functions, regulating the order and the type of messages learners input in the discussion) to address the problem of lacking responsive interactions (e.g. Brooks & Jeong, 2006). Designers should be open to the possibility that the task they design could be involved more than one group process when students perform it (Straus & McGrath, 1994). The quadrants in McGrath's *Group Task Circumplex* (1984) may represent a sequence of processes as opposed to a main group process. In this study, participants in the OT condition experienced "Generate", "Negotiate" and "Choose" processes on McGrath's framework. Maybe a different set of online task taxonomy can be developed in the future. When implementing the task, it is also important to take the fit between task and the technology into account (Zigurs et al., 1999). Certain tasks may render better results with certain types of technology.

6.7. Limitations

The study was limited by the sample size and the statistical methods used. As individuals were not independent in collaborative activities, learners had to be treated on

a group level (Schellens et al., 2007). The number of groups in this study was not big enough for the power to detect significant difference. In addition, due to the curriculum design, each group was required to conduct only one case analysis. This prevented the researcher from looking at the effect of different tasks within the same group and it weakens the potential power of the designed task as learners may still have been getting used to the assigned task.

A more specific limitation for the participation data lies in calculating action duration as it only took into account the time learners had the window open in front of them. It should be noted that they might be engaged in other off-task activities during some of this time. To address this deficit, adjustment of unlogged session exits and a distinction between reading and scanning were used. However, as the experiment took place in a blended classroom setting, specifically in this context, the opportunity for learners to discuss and reach consensus outside the discussion tool was unavoidable and should be acknowledged. As the possibility for participants to reach agreement outside the tool existed, interpretation of how learners built consensus was limited to the 11 groups that reached consensus in the tool. In this study, the instructor made an observation sheet asking TAs to document how the group led the discussion and to identify potential connections between their online discussion and tutorial leading. However, as some TAs did not follow the given structure, this data was not able to be analyzed.

6.8. Conclusion and Future Research

To address the problem of students lacking disagreement in online discussions, I reviewed past research in relation to argumentation and task types and designed two discussion tasks (OT & AT) in an online discussion forum based on McGrath's (1984) *Group Task Circumplex*. I conceptualized the quality of online discussion along three dimensions (argumentation, participation, and collaboration) and studied students' interactions with respect to these. It was expected that tasks seeded with disagreement (AT) would encourage students to voice disagreement and be more engaged in the process of participation and collaboration. Surprisingly, the result suggested the opposite. Students in the OT condition challenged their peers more often and grounded

their arguments with more reasoning and evidence; they were also more engaged in participation despite the fact that they participated heterogeneously while composing and reviewing their own posts.

Even though students differed in the number of negative positions proposed, looking holistically, they were still reluctant in disagreeing with others in online discussions. This raised questions as to how effective/useful the task type can be in promoting disagreement in online collaborative contexts. Compared to being open to all solutions, explicitly seeding conflicts in the task did not result in increasing presence of disagreement. In this study, the OT learners participated and engaged in argumentation more actively in the discussion than the AT learners. There were two main possible interpretations as to why this happened. First, it could be that task type did make a difference in how students interacted, just not as what the study expected. Certain task characteristics in the OT task may have contributed to the difference found in the current study. One speculation was learners' attachment towards the ideas they proposed, but there might be other causes as well. Another interpretation was that the task type did not matter; the differences observed may simply result from the different member composition in the two conditions. The study showed that the OT condition had a larger difference of academic abilities than their counterparts, but if the final grade distribution in both conditions had been similar, the two conditions may have had no difference in their participation and argumentation. Of course, other potential unknown group or individual factors may also have come into play. Therefore, it is suggested that in future work, learners can be compared between the indirect intervention of tasks and other kinds of direct intervention (e.g. scripting) to further test the usefulness of task types. Moreover, task complexity should be taken into consideration when examining effects of task types.

Additionally, it was found that some individual factors such as individuals' final grades, presence of dominant and passive participants, whether they joined the discussion early or late, or presence of synthesis may have influenced the group collaboration process; however, as the current study was limited in size and experiment design, it is suggested that the future research increase the sample size and examine the effect both across groups and within groups with advanced statistical techniques such as Hierarchical Linear Modeling.

An interesting phenomenon was identified for both conditions in that students tended to build new ideas upon existing ones instead of generating conceptually different “new” ideas. This may provide useful information for how learners build knowledge and reach consensus in online discussions which may or may not differ from that of face-to-face situation. In addition, the current study did not connect learner behaviors in online discussion to their performance in the face-to-face discussion (tutorial leading). Future studies can implement and reinforce strict measures to bridge this gap and explore other possible models or strategies to support learners’ decision making process in online contexts.

References

Allen, I.E., Seaman, J., & Garrett, R. (2007). *Blending in: The extent and promise of blended education in the United States.* Needham, MA: The Sloan Consortium. Retrieved from http://www.sloan-c.org/publications/survey/pdf/Blending_In.pdf

Angeli, C., Valanides, N., & Bonk, C. (2003). Communication in a Web-based conferencing system: The quality of computer-mediated interactions. *British Journal of Educational Technology 34*(1), 1-43.

Arrow, H., McGrath, J. E. & Berdahl, J. L. (2000). *Small groups as complex systems: Formation, coordination, development, and adaptation*. Thousand Oaks, CA: SAGE Publishing Co.

Baltes, B. B., Dickson, M. W., Sherman, M. P., Bauer, C C., & LaGanke, J. S. (2002). Computer-mediated communication and group decision making: A meta-analysis. *Organizational Behavior & Human Decision Processes, 87*(1), 156–179.

Brooks, C. D., & Jeong, A. (2006). Effects of pre-structuring discussion threads on group interaction and group performance in computer-supported collaborative argumentation. *Distance Education, 27*(3), 371-390.

Brown, P., & Levinson, S. C. (1987). *Politeness: Some universals in language usage.* New York: Cambridge University Press.

Campbell, J., & Stasser, G. (2006). The influence of time and task demonstrability on decision-making in computer-mediated and face-to-face groups. *Small Group Research, 37*(3), 271-294.

Carabajal, K., LaPointe, D., & Gunawardena, C. N. (2003). Group development in online learning communities. In M. G. Moore, & W. G. Anderson (Eds.), *Handboook and distance education* (pp. 217-234). Mahwah, NJ: Lawrence Erlbaum Associates.

Carver, R. H., & Nash, J. G. (2002). *Doing data analysis with SPSS®.* Belmont, CA: Brooks/Cole Thomson Learning.

Cheung, W. S., & Hew, K. F. (2006). Examining students' creative and critical thinking and student to student interactions in an asynchronous online discussion environment: A Singapore case study. *Asia-Pacific Cybereducation Journal, 2*(2). Retrieved November 10, 2009, from http://www.acecjournal.org/current_issue_current_issue.php.

Chi, M. T. H., Bassok, M., Lewis, M. W., Reimann, P., & Glasser, R. (1989). Self-explanations: How students study and use example in learning to solve problem? *Cognitive Science, 13*, 145-181.

Chin, C., & Osborne, J. (2010). Supporting argumentation through students' questions: Case studies in science classrooms. *Journal of the Learning Sciences, 19*(2), 230-284.

Chinn, C. A. (2006). Learning to Argue. In A. M. O'Donnell, C. E. Hmelo-Silver, & G. Erkens (Eds.), *Collaborative learning, reasoning and technology* (pp. 355-383). NJ: Lawrence Erlbaum Associates.

Clark, H. H., & Brennan, S. E. (1991). Grounding in communication. In S. D. Teasley (Ed.), *Perspectives on socially shared cognition* (pp. 127-149). Washington: American Psychologist Association.

Clark, D. B., & Sampson, V. (2008). Assessing dialogic argumentation in online environments to relate structure, grounds, and conceptual quality. *Journal of Research in Science Teaching, 45*(3), 293-321.

Clark, D. B, Sampson, V., Weinberger, A., & Erkens, G. (2007). Analytic frameworks for assessing dialogic argumentation in online learning environments*. Educational Psychology Review, 19*, 343–374.

Cobb, P. (1994). Where is the mind? Constructivist and sociocultural perspectives on mathematical development. *Educational Researcher, 23*, 13-20.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement* 20(1), 37-46.

Darnon, C., Butera, F., & Harackiewicz, J. M. (2007). Achievement goals in social interactions: Learning with mastery vs. performance goals. *Motivation and Emotion, 31*, 61-70. DOI: 10.1007/s11031-006-9049-2.

Davis, J. H., Laughlin, P. R., & Komorita, S. S. (1976). The social psychology of small groups: Cooperative and mixed-motive interaction. *Annual Review of Psychology, 27*, 501-541.

De Dreu, C. K. W., & West, M. A. (2001). Minority dissent and team innovation. *Journal of Applied Psychology, 86*, 1191–1201.

del Valle, R. & Duffy, T. M. (2007). Online learning: Learner characteristics and their approaches to managing learning. *Instructional Science, 37*(2), 129-149.

Dennen, V. P. (2008). Pedagogical lurking: Student engagement in non-posting discussion behavior. *Computers in Human Behavior, 24*, 1624–1633.

Dennen, V. P. (2005). From message posting to learning dialogues: Factors affecting learner participation in asynchronous discussion. *Distance Education, 26*(1), 127–148.

Dennen, V. P & Wieland, K. (2008). Does task type impact participation? Interaction levels and learner orientation in online discussion activities. *Technology Instruction Cognition and Learning, 6*, 105-124.

Dennen, V. P & Wieland, K. (2007). From interaction to intersubjectivity: Facilitating online group discussion processes. *Distance Education, 28*(3), 281-297.

Dewey, J. (1938). *Logic: The theory of inquiry*. New York: Holt and Co.

Dillenbourg, P. (2002). Over-scripting CSCL: The risks of blending collaborative learning with instructional design. In P. A. Kirschner (Ed.), *Three worlds of CSCL. Can we support CSCL* (pp. 61-91). Heerlen, Open Universiteit Nederland.

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 170-198), NY: Simon and Schuster.

Duffy, T. M., Dueber, B., & Hawley, C. L. (1998). Critical thinking in a distributed evironment: A pedagogical base for the design of conferencing systems. *In C. J. Bonk, & K. S. King (Eds.). Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse*. Mahwah, NJ: Lawrence Erlbaum Associates.

Duncan, R. M. (1995). Piaget and Vygotsky revisited: Dialogue or assimilation? *Developmental Review, 15*, 458-472.

Duschl, R. A. (2008). Quality argumentation and epistemic criteria. In S. Erduran & M. P. Jimenez-Aleixandre (Eds.), *Argumentation in science education: Perspectives from classroom-based research* (pp. 159–175). The Netherlands: Springer.

Erduran, S., Simon, S., & Osborne, J. (2004). TAPping into argumentation: Developments in the application of Toulmin's argument pattern for studying science discourse. *Science Education, 88*, 915-933.

Farnham, S., Chesley, H. R., Mcghee, D. E., Kawal, R., & Landau, J. (2000). Structured online interactions: improving the decision-making of small discussion groups. *Proceedings of the 2000 ACM conference on Computer supported cooperative work*, 299-308.

Ferretti, R. P., Lewis, W. E., & Andrews-Wekerly, S. (2009). Do goals affect the structure of students' argumentative writing strategies? *Journal of Educational Psychology, 101*, 577-589.

Fox, S., & MacKeogh, K. (2003). Can eLearning promote higher-order learning without tutor overload? *Open Learning, 18*(2), 121-134.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education, 15*(1), 7-23.

Glassman, M. (1994). All things being equal: The two roads of Piaget and Vygotsky. *Developmental Review, 14*, 186-214.

Graetz, K. A., Boyle, E. S., Kimble, C. E., Thompson, P., & Garloch, J. L. (1998). Information sharing in face-to-face, teleconferencing, and electronic chat groups. *Small Group Research, 29,* 714-743.

Golanics, J. D., & Nussbaum, E. M. (2008). Enhancing collaborative online argumentation through question elaboration and goal instructions. *Journal of Computer Assisted Learning, 24*, 167–180.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*(4), 397-431.

Hackman, J. R. (1968). Effects of task characteristics on group products. *Journal of Experimental Social Psychology, 4*, 162-187.

Hackman, J. R., & Vidmar, N. (1970). Effects of size and task type on group performance and member reactions. *Sociometry, 33*(1), 37-54.

Hakkinen, P., & Jarvela, S. (2006). Sharing and constructing perspectives in web-based conferencing. *Computers & Education 47*, 433–447.

Hannafin, M. J., & Hill, J. (2007). Epistemology and the design of learning environments. In R. Reiser, & J. Dempsey (Eds.), *Trends and issues in instructional design and technology.* (2nd Ed., pp. 53-61). Upper Saddle River, NJ: Merrill/Prentice-Hall.

Hara, N., Bonk, C. J., & Angeli, C. (2000). Content analysis of online discussion in an applied educational psychology course. *Instructional Science, 28*, 115-152.

Harlow, S., Cummings, R., & Aberasturi, S. M. (2007). Karl Popper and Jean Piaget: A rationale for constructivism. *The Educational Forum, 71*(1), 41-48.

Hartung, J., Knapp, G., & Sinha, B. K. (2008). *Statistical meta-analysis with applications.* NY: Wiley.

Herring, S. (1999). Interactional coherence in CMC. *Journal of Computer-Mediated Communication, 4*(4).

Hew, K.F., & Cheung, W.S. (2011). Higher-level knowledge construction in asynchronous online discussions: An analysis of group size, duration of online discussion, and student facilitation techniques. *Instructional Science, 39*, 303–319.

Hew, K.F., Cheung, W.S., & Ng, C.S.L. (2010). Student contribution in asynchronous online discussion: a review of the research and empirical exploration. *Instructional Science, 38*(6), 571-606.

Hewitt, J. (2003). How habitual online practices affect the development of asynchronous discussion threads. *Journal of Educational Computing Research, 28*(1), 31-45.

Hewitt. J. (2001). Beyond threaded discourse. *International Journal of Educational Telecommunications, 7*(3), 207-221.

Hewitt, J., Brett, C., & Peters, V. (2007). Scan rate: A new metric for the analysis of reading behaviors in asynchronous computer conferencing environments. *AJDE, 21*(4), 215-231.

Hitlz, S. R., Johnson, K., & Turoff, M. (1986). Experiments in group decision making: Communication process and outcome in face-to-face versus computerized conferences. *Human Communication Research, 13*(2), 225-252.

Hollingshead, A. B., McGrath, J. E., & O'Connor, K. M. (1993). Group task performance and communication technology: A longitudinal study of computer-mediated versus face-to-face work groups. *Small Group Research, 24*(3), 307-333.

Jeong, A. C. (2003). The sequential analysis of group interaction and critical thinking in online threaded discussions. *AJDE, 17*(1), 25–43.

Jonassen, D. H. (1991). Objectivism versus constructivism: Do we need a new philosophical paradigm? *ETR&D, 39*(3), 5-14.

Jonassen, D. H., & Kwon, H. I. (2001). Communication patterns in computer mediated versus face-to-face group problem solving. *ETR&D, 49(*1), 35-51.

Kanuka, H., & Anderson, T. (1998). Online social interchange, discord, and knowledge construction. *Journal of Distance Education 13*(1), 57-75.

Kaye, A. (1989). Computer-mediated communication and distance education. In R. Mason & A. Kaye (Eds.), *Mindweave: Communication, computers and distance education* (pp. 1–21). Oxford: Pergamon Press.

Keefer, M. W., Zeitz, C. M., & Resnick, L. B. (2000). Judging the quality of peer-led student dialogues. *Cognition and Instruction, 18*(1), 53–81.

Kirschner, F., Paas, F., & Kirschner, P. A. (2009). A cognitive-load approach to collaborative learning: United brains for complex tasks. *Educational Psychology Review, 21*, 31-42.

Knowlton, D. S. (2005). Taxonomy of learning through asynchronous discussion. *Journal of Interactive Learning Research, 16*(2), 155-177.

Koschmann, T. (2003). CSCL, argumentation, and Deweyan inquiry: Argumentation is learning. In J. Andriessen, M. Baker, & D. Suthers (Eds.), *Arguing to learn: Confronting cognitions in computer-supported collaborative learning environments* (pp. 261–269). Boston: Kluwer.

Kuhn, D. (1991). *The skills of argument*. New York: Cambridge University Press.

Levi, D. (2011). *Group dynamics for teams* (3rd ed.). Sage Publication, Inc.

Mao, L. (2009). *The effects of argumentation goals on recall, causal understanding and reasoning.* (Master thesis). Retrieved from http://summit.sfu.ca/item/9560.

McGrath, J. E. (1984). *Groups: Interaction and performance.* NJ: Prentice Hall.

Morris, C. G. (1966). Task effects on group interaction. *Journal of Personality and Social Psychology. 4*(5), 545-554.

Nemeth, C. J., & Chiles, C. (1988). Modeling courage: The role of dissent in fostering independence. *European Journal of Psychology, 18*, 275–280.

Nemeth, C. J., & Rogers, J. (1996). Dissent and the search for information. *British Journal of Social Psychology, 35*, 67–76.

Nussbaum, E. M. (2011). Argumentation, dialogue theory, and probability modeling: Alternative frameworks for argumentation research in education. *Educational Psychologist, 46*(2), 84-106.

Nussbaum, E. M. (2008). Collaborative discourse, argumentation, and learning: Preface and literature review. *Contemporary Educational Psychology, 33*, 345-359.

Nussbaum, E. M. (2005). The effect of goal instructions and need for cognition on interactive argumentation. *Contemporary Educational Psychology, 30*, 286–313.

Nussbaum, E. M. & Edwards, O. V. (2011). Critical questions and argument stratagems: A framework for enhancing and analyzing students' reasoning practices, *Journal of the Learning Sciences, 20*(3), 443-488.

Nussbaum, E. M., & Sinatra, G. M. (2003). Argument and conceptual engagement. *Contemporary Educational Psychology, 28*, 384–395.

O'Keefe, D. J. (1982). The concept of argument and arguing. In J. R. Cox & C. A. Willard (Eds.), *Advances in argumentation theory and research* (pp. 3–23). Carbondale, IL: Southern Illinois University Press.

Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49*, 345-375.

Palmer, S., Holt, D., & Bray, S. (2008). Does the discussion help? The impact of a formally assessed online discussion on final student results. *British Journal of Educational Technology, 39*(5), 847-858.

Paulus, P. B. (2000). Groups, teams, and creativity. *Applied Psychology, 49*, 237–262.

Paulus, T. M. (2005). Collaborative and cooperative approaches to online group work: The impact of task type. *Distance Education, 26*(1), 111-125.

Piaget, J. (1970). Piaget's theory. In P. H. Mussen (Ed.), *Carmichael's manual of child psychology* (Vol. 1, pp. 703-732). New York: Wiley.

Pintrich, P. R. (2000). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology, 92*(3), 544-555.

Pollock, P. H., Hamann, K., & Wilson, B. M. (2011). Learning through discussions: Comparing the benefits of small-group and large-class settings. *Journal of Political Science Education, 7*(1), 48-64.

Price, V., Cappella, J. N., & Nir, L. (2002). Does disagreement contribute to more deliberative opinion? *Political Communication, 19*(1), 95-112.

Priem, R. L., Harrison, D. A., & Muir, N. K. (1995). Structured conflict and consensus outcomes in group decision making. *Journal of Management, 21*(4), 691-710.

Renkl, A. (2009). Why constructivists should not talk about constructivist learning environments: a commentary on Loyens and Gijbels (2008). *Instructional Science, 37*(6), 495-498.

Rummel, N. E. (2004). Improving computer-mediated collaboration. Development and empirical evaluation of two instructional support methods. (Doctoral dissertation) Retrieved from http://www.freidok.uni-freiburg.de/volltexte/1427/pdf/Diss_Rummel.pdf.

Savery, J. R., & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. *Educational Technology, 35*, 31-38.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *The Journal of the Learning Sciences, 3*(3), 265-283.

Schellens,. T. , van Keer, H. , Valcke, M., & de Wever, B. (2007). Learning in asynchronous discussion groups: a multilevel approach to study the influence of student, group and task characteristics. *Behaviour & Information Technology, 26*(1), 55-71.

Schellens, T., & Valcke, M. (2006). Fostering knowledge construction in university students through asynchronous discussion groups. *Computers and Education, 46*(4), 349–370.

Schellens, T., & Valcke, M. (2005). Collaborative learning in asynchronous discussion groups: What about the impact on cognitive processing? *Computers in Human Behaviour, 21*(6), 957-976.

Schrage, M. (1990). *Shared minds: The new technologies of collaboration*. NY: Random House.

Seo, K. K. (2007). Utilizing peer moderating in online discussions: Addressing the controversy between teacher moderation and nonmoderation. *AJDE, 21*(1), 21–36.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L., (1991). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. *Educational Technology, 31*, 24-33.

Stahl, G. (2006). *Group cognition: Computer support for building collaborative knowledge*. Cambridge, MA: MIT Press.

Stahl, G. (2003). Building collaborative knowing: Elements of a social theory of learning. In J.-W. Strijbos, P. Kirschner & R. Martens (Eds.), *What we know about CSCL in higher education,* (pp. 53-85). Amsterdam, NL: Kluwer.

Stahl, G. (2000). A model of collaborative knowledge-building. In B. Fishman, & S. O'Connor-Divelbiss (Eds.). *Fourth International Conference of Learning Sciences* (pp. 70-77). Mahwah. NJ: Erlbaum.

Steiner, I. D. (1972). *Group processes and productivity*. New York: Academic Press.

Straus, S. G. (1999). Testing a typology of tasks: An empirical validation of McGrath's (1984) Group Task Circumplex. *Small Group Research, 30*, 166-187.

Straus, S. G., & McGrath, J. E. (1994). Does the medium matter? The interaction of task type and technology on group performance and member reactions. *Journal of Applied Psychology, 79*(1), 87-97.

Suthers, D. D., Dwyer, N., Medina, R., & Vatrapu, R. (2010). A framework for conceptualizing, representing, and analyzing distributed interaction. *International Journal of Computer Supported Collaborative Learning, 5*(1), 5-42.

Thomas, M. J. W. (2002). Learning within incoherent structures: the space of online discussion forums. *Journal of Computer Assisted Learning, 18*, 351-366.

Toulmin, S. (1958). *The uses of argument.* New York, NY: Cambridge University Press.

Veerman, A. L. (2003). Constructive discussions through electronic dialogue. In J. Andriessen, M. Baker, & D. Suthers (Eds.), *Arguing to learn: Confronting cognitions in computer-supported collaborative learning environments* (pp. 117–143). Boston, MA: Kluwer Academic.

Veerman, A. L., Andriessen, J., & Kanselaar, G. (2002). Collaborative argumentation in academic education. *Instructional Science, 30*, 155–186.

Vygotsky, L. S. (1986). *Thought and language.* Cambridge, MA: MIT Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher mental process.* Cambridge, MA: Harvard University Press.

Walton, D. N. (1998). *The new dialectic: Conversational contexts of argument*. Buffalo, NY: University of Toronto Press.

Webb, E., Jones, A., Barker, P., & van Schaik, P. (2004). Using e-learning dialogues in higher education. *Innovations in Education & Teaching International, 41*(1), 93-103.

Weinberger, A., & Fischer, F. (2006). A framework to analyze argumentative knowledge construction in computer-supported collaborative learning. *Computers & Education, 46*, 71-95.

Wise, A. F., & Chiu, M. M. (2011). Analyzing temporal patterns of knowledge construction in a role-based online discussion. *International Journal of Computer-Supported Collaborative Learning*. Advance online publication DOI:10.1007/809 s11412-011-9120-1.

Wise. A. F., Speer, J., Marbouti, F. & Hsiao, Y. T. (2012). Broadening the notion of participation in online discussions: Examining patterns in learners' online listening behaviors. Advance online publication. *Instructional Science*. DOI 10.1007/s11251-012-9230-9.

Wise, A. F., Hsiao, Y. T., Marbouti, F. & Zhao, Y. (2012, July). *Tracing ideas and participation in an asynchronous online discussion across individual and group levels over time*. Proceedings of the International Conference of the Learning Sciences 2012, Sydney, Australia.

Wise, A. F., Hsiao, Y. T., Speer, J., Marbouti, F. & Perera, N. (2012, July). *Initial validation of "listening" behavior typologies for online discussions using microanalytic case studies.* Proceedings of the International Conference of the Learning Sciences 2012, Sydney, Australia.

Wise, A. F., Perera, N., Hsiao, Y., Speer, J., & Marbouti, F. (2011). Microanalytic case studies of individual participation patterns in an asynchronous online discussion in an undergraduate blended course. *The Internet & Higher Education, 15*(2), 108-117.

Woolfolk, A. E., Winnie, P. H., Perry, N. E., & Shapka, J. (2009). *Educational psychology* (4th Canadian Ed.). Toronto, ON: Pearson Canada.

Yun, G. W., & Park, S. Y. (2011). Selective posting: Willingness to post a message online. *Journal of Computer-Mediated Communication, 16*, 201-227.

Zigurs, I., Buckland, B. K., Connolly, J. R., & Wilson, E. V. (1999). A test of task-technology fit theory for group support systems. *The Advances in Information Systems, 30*(3,4). DOI: 10.1145/344241.344244.

Appendices

Appendix A.

Clark and Sampson's coding scheme for assessing dialogic argumentation in online environments

Step 1: Code posts for evidence of discourse move by following Table 1.

Step 2: Code the ground of the individual post by following Figure 1.

Step 3: Code the conceptual quality of individual posts by referencing Table 3.

Step 4: Determine the conceptual normality of a post based on results from Step 3.

Step 5: Parse posts in a discussion into episodes (subpart of a discussion).

Step 6: Determine the quality of discussion based on episodes by following Table 4.

Note: From "Assessing dialogic argumentation in online environments to relate structure, grounds, and conceptual quality," by D. B. Clark and V. Sampson, 2008, *Journal of Research in Science Teaching, 45*(3), p. 293-321. DOI 10.1002/tea.20216. Copyright 2007 by Wiley Periodicals, Inc. Reprinted with permission.

Table 1
Coding scheme for the discourse move of individual comments

Discourse Move	Definition
Claim	The seed-comment principle or an assertion made by a pair of students.
Counterclaim	An assertion made by a pair of students that is different from (and does not attack) the seed claim or parent comment made by another pair of students. This code is only assigned when a comment does not focus on any aspect of the thesis of the comment it replies to; instead it offers an entirely new interpretation of the phenomena.
Change of Claim	A comment made by a pair of students indicating that: (1) they have changed their original claim; or (2) changed their viewpoint; or (3) have made a concession in response to comments (claims or rebuttals) made by another pair of students.
Rebuttal Against Grounds	An attack on, or disagreement with, the grounds (evidence, explanations, qualifiers, or backing) used by another pair of students to support or justify their comment.
Rebuttal Against Thesis	An attack on or disagreement with the thesis (or a specific part of the thesis) of another pair of students' comment (claim or rebuttal) that does not attack the grounds.
Clarification in response to a Rebuttal	This code is assigned to comments that are used to strengthen a position (in terms of accuracy or validity) in response to a rebuttal without attacking the rebuttal or grounds made by another pair of students.
Support of a Comment	A statement used to support the truth or accuracy of the previous claim or rebuttal. This category includes statements that: (1) voice agreement with a comment; (2) rewords the previous comment; (3) adds additional grounds in support; or (4) expands on the comment.

Query about Meaning	A comment that asks for clarification of an earlier comment (e.g., "What do you mean when you say. . .?" or "I don't understand what you are saying?"). These comments question the meaning of a statement rather than the accuracy of the statement.
Clarification of Meaning	A comment made by a pair of students to clarify (restate in a new way) a previous comment. The purpose of these comments is to clarify the meaning of a statement in response to a query (about meaning) rather than supporting the accuracy of a statement.
Organization of Participants	A comment that: (1) reminds other participants to participate; (2) asks others for feedback; (3) has a meta-organizational aspect (e.g., "Do we all agree?"); or (4) attempts to change the way someone else in the discussion is participating.
Off-task	Comments that are not about the topic (e.g., "Nice haircut, John!").

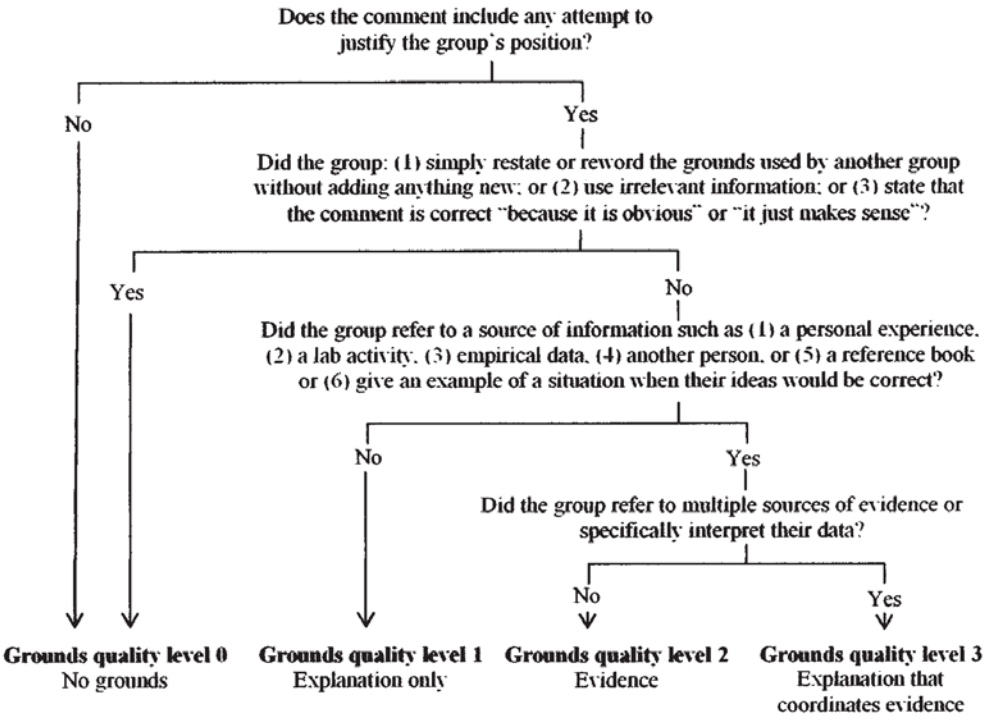

Figure 1. Flowchart for coding the grounds of an individual comment.

Table 3
Example facets for coding conceptual quality of comment

Non-normative facets
Metal objects are above/below ambient temperatures by a great difference
All objects are (end up) way above or way below ambient temperature
Objects have a "natural" temperature
Wool makes things warm
Cold energy travels from cool objects to warm object which cools them down
Thermal equilibrium does not happen to all objects/same room=different temperatures
Objects will take in heat until they "fill up," then they stop heating up
Circulating air within an object moves heat through a medium
Hot things can give off heat energy without cooling (and reverse)
Size/thickness affects final temperature
Objects keep getting hotter/colder past equilibrium temperature the longer they are in a hot/cold place
Objects will "overshoot" equilibrium temperatures as they warm up or cool down
Unless something is actively keeping an object cold, it will warm up
Conductors attract heat/take in a lot of heat/always take in heat
Materials with holes (porous/density) allow heat/cold energy to pass through (barrier model for insulation)
Good conductors/insulators keep heat on the surface versus keeping heat/cold inside
Thickness of a material alone determines insulating/conducting properties
Insulators store heat or cold energy and/or release it slowly
Wool warms things up/good insulators warm things up or cool them down
Metals insulate because they reflect heat away
Metals keep things cold because they feel cold
Metal conducts heat away from cold objects to keep them cold/metal gets cold from object and then keeps object cold
Only cold/hot things can keep objects cold/hot
Conductors heat or cool slowly/insulators heat or cool quickly
Wood/Styrofoam/plastic/glass only take in a little heat
Material that keep things cold cannot also keep things hot (and reverse)
Heat or cold energy cannot travel through metal
The conductivity of an object influences the object's *ability* to reach equilibrium
Transitional facets
All objects in the same room will reach close temperature (but not the same) as surroundings
Wood/wool/plastic/glass/metal will not reach equilibrium because they need more time
Insulators "block, trap, or allow a small amount of" heat or cold (act like barriers)
Heat comes in and out of metal quickly at a constant rate
Metals "adjust" temperature more quickly (without making a connection to conductivity)
Wood/wool/plastic/glass change temperature slower then metal (without making a connection to conductivity)
Styrofoam/wool is good for keeping cold objects cold (without making a connection to conductivity)
Metal is not good for keeping cold objects cold (without making a connection to conductivity)
Normative facets
Objects in the same room become the same temperature
If more heat flows into an object than out of it, its temperature rises (or reverse)
Heat energy flows from hot to cold objects
Heat flows until objects reach the same temperature
Objects do not go beyond equilibrium temperatures
Wood/wool/Styrofoam/plastic/metal objects reach temperature of surroundings
Same room/same temperature unless another heat source or it produces it own heat
Size and thickness do not affect final temperature
Metal conduct heat well
Wood/wool/Styrofoam/plastic are insulators (do not conduct heat well)
Conductors conduct heat energy quickly/insulators conduct heat energy slowly
Good conductors are poor insulators (and reverse)
Objects that keep cold things cold also keep hot things hot
Conductors heat up faster, insulators heat up slower
Rate of reaching equilibrium is dependent on conductivity
Appropriate connection of thickness/size to rate of heating/cooling

Note. Although there are four conceptual quality codes for comments (*non-normative, transitional, normative, nuanced*), there are not "nuanced" facets. A nuanced comment is defined in terms of the presence of multiple normative facets and the absence of non-normative and transitional facets. See Figure 2 for more details.

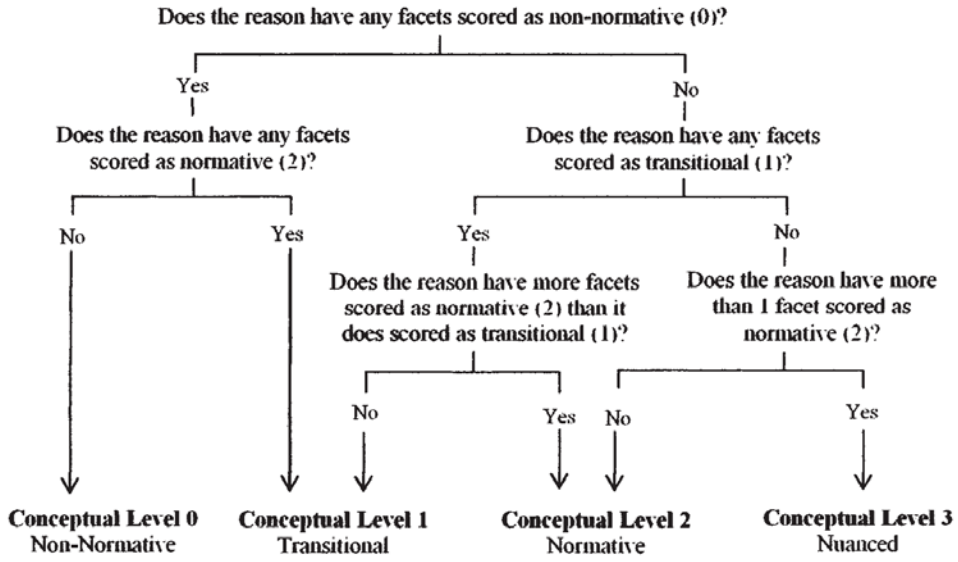

Figure 2. Flowchart for coding the conceptual normativity of an individual comment based on its facets.

Table 4

The overall quality of the argumentation that takes place within an episode determined using a hierarchy based on opposition

Quality	Characteristics of the Discourse
Level 5	Argumentation involving multiple rebuttals and at least one rebuttal that challenges the grounds used to support a claim
Level 4	Argumentation involving multiple rebuttals that challenge the thesis of a claim but does not include a rebuttal that challenges the grounds used to support a claim
Level 3	Argumentation involving claims or counterclaims with grounds but only a single rebuttal that challenges the thesis of a claim
Level 2	Argumentation involving claims or counterclaims with grounds but no rebuttals
Level 1	Argumentation involving a simple claim versus counterclaim with no grounds or rebuttals
Level 0	Non-oppositional

Appendix B.

Sample of discussion prompts in the OT and AT Conditions

Note: Sentences in brackets [ ] are case-dependent.

Week 4: Motivation

Video Case: Reaching Generation Y

OT Discussion Prompt:

Now that you're all experts in Organizational Behaviour, people are turning to you for advice! Please access the challenge your client is facing in the following link:

http://tinyurl.com/bus272motivation

You only need to watch the first segment – Background and Challenge. Your discussion should only be based on this segment.

As a group, your goal is to come to an agreement on the best solution to the situation with reasons supporting your choice (e.g. using evidence/theories learned from the **[Motivation]** chapters). What should **[Dave Kaval]** (the interviewee) do with this individual? If different viewpoints arise, try to explore the underlying assumptions of each and do not be afraid to state and defend your opinion. We learn from each other through these conversations!

After watching the video, you can use the following guiding suggestions to help your group process.

- Summarize the context and discuss the implications of this challenge.

- If you've been in a similar situation, tell us what happened and what did you learn from it.

- Think about possible solutions that **[Dave Kaval]** could try in this situation. Discuss with your group members, decide a concrete/preferred solution based on **group consensus** and explain why you think it is the best solution for **[Dave Kaval]**. That is, at the end of the discussion, your group has to agree on one best solution.

At the end of the week, after fully analyzing and discussing the challenge, your group will lead a discussion on this case in the tutorial, so you can use what you learn here to support your discussion leading. You will be assessed based on the quantity and the quality of your contributions in the discussion forum as well as tutorial discussion, see grading schemes in the syllabus for more details.

Tips:

- Good contributors will

  - post multiple times in the discussion
  - make comments that move the discussion forward
  - using course theory to analyze the situation in depth
  - avoid re-iterating points that have already been said.

- A good length for posts is usually somewhere between three sentences and a paragraph.

AT Discussion Prompt:

Now that you're all experts in Organizational Behaviour, people are turning to you for advice! Please access the challenge your client is facing in the following link:

http://tinyurl.com/bus272motivation

You only need to watch the first segment – Background and Challenge. Your discussion should only be based on this segment.

As a group, your goal is to come to an agreement on the best solution to the situation with reasons supporting your choice (e.g. using evidence/theories learned from **[Motivation]** chapters). What should **[Dave Kaval]** (the interviewee) do with this individual? If different viewpoints arise, try to explore the underlying assumptions of each and do not be afraid to state and defend your opinion. We learn from each other through these conversations!

After watching the video, you can use the following guiding suggestions to help your group process.

- Summarize the context and discuss the implications of this challenge.

- If you've been in a similar situation, tell us what happened and what did you learn from it.

-Think about the following two possible solutions **[Dave Kaval]** could try:

[1. If this guy follows instructions next time, give him incentives; if not, give him punishment.]

[2. Set up clear goals with this guy next time when giving him assignments, and help him to accomplish each goal.]

Discuss with your group members, decide a concrete/preferred solution based on group consensus and explain why you think it is the best solution for **Dave Kaval**. That is, at the end of the discussion, your group has to agree on one best solution. If neither solution is good enough, explain why and propose your own solution (make sure to tell us why you think it is better).

At the end of the week, after fully analyzing and discussing the challenge, your group will lead a discussion on this case in the tutorial, so try to use what you learn here as preparation to your discussion leading. You will be assessed based on the quantity and the quality of your contributions in the discussion forum as well as tutorial discussion, see grading schemes in the syllabus for more details.

Tips:

- Good contributors will

- post multiple times in the discussion
- make comments that move the discussion forward
- using course theory to analyze the situation in depth
- avoid re-iterating points that have already been said.

- A good length for posts is usually somewhere between three sentences and a paragraph.

Appendix C.

The modified coding scheme used in the study

Coding Scheme for Discourse Function

Discourse Function	Code	Description	Example
Problems *Issues related to the business challenge shown in the video*	0 No problems	No problems mentioned	-
	1 Problem Summary	A comment that summarizes or repeats details from the video without elaboration / analysis.	*"In the video, she got negative feedback and didn't know how to react."*
	2 Problem Analysis	A comment that elaborates on the details from the video to analyze the situations and/or identify specific aspects of the problem(s)	*"I think the problem in this situation is that she had taken the comments too personally."*
	0 No contest to previous problem	No comment disagrees with the problem mentioned. Assign this code as default.	-
	1 Contesting previous problem	A comment that contests a previously mentioned problem analysis/summary.	*"I disagree with the problem you identified. It's not Lisa's problem, it's the boss."*
Solutions *Ideas proposed for the purpose to solve the problems*	0 No solutions	No solutions mentioned	-
	+ Positive position	A comment that proposes or supports a proposed idea as a way to solve the given problem	*"I think that she should email them back to defend herself."*
	- Negative position	A comment that opposes or disagrees with a proposed idea as a way to solve the given problem	*"I don't think that sending emails is a good solution."*

Note: Please note down the title of the corresponding solution from the pre-determined solution list according to its order on the list.

Discourse Function	Code	Description	Example
Supporting reasons *Reasons used to support a solution position* *(the position can be either + or -)*	0 No reasons	No reasons provided to support a position	-
	1 Single reason	Only one reason provided to support a position	*"I would accept the advice because it's coming from her employer."*
	2 Multiple reasons	More than one reason provided to support a position (including implications or direction of how to do it). When reasons are discussed as consequence, count all	*"Having in person meeting was better than other methods because it allows her to 1) reduce job insecurity and 2) communicate with her boss."* *"It's better to use email, so they can reach each other efficiently, then it will open room for discussion"[count as two reasons]*
Note: *If a post has more than one solution / position, code for the one with the maximum number of supporting reasons.*			
Qualifiers *Statements that illustrate the problems or limit the validity of a position*	0 No qualifiers	No qualifiers mentioned	-
	1 Single qualifier	Only one qualifier offered (saying when a position might have different result)	*"I disagree with the emailing method because it increases misunderstanding. However, if done with caution, one could have an effective communication and avoid miscommunication (qualifier)"*
	2 Multiple qualifiers	More than one qualifier provided (saying when a position might have different result)	*"I agree that face-to-face meeting is a better way as emails can be misread at times. But, in big corporations, it would be hard for senior executives to arrange a meeting just for an individual. Additionally, when the senior executive only used downward communication, having meetings would not solve the problem."*
Note: *If a post has more than one solution / position, code for the one with the maximum number of qualifiers.*			

Discourse Function	Code	Description	Example
Evidence for reasons *The breadth of sources used to support reasons*	0 No evidences	No justification to the reasons offered, justifications with irrelevant information, or simply repeating previous ideas in quotes.	*"It just makes sense." "Because it's obvious."*
	1 Explanation only	Simply explains/elaborates on the reasons provided. If a question is proposed with underlying assumptions, code as explanation.	*"This is a good solution because it gives Lisa more time to prepare"*
	2 Explanation + Single source of evidence	Offers explanation and/or refers to a source of information in supporting reasons such as (1) a personal experience, (2) specific details from video, (3) input from instructor, (4) textbooks, and (5) give an example of a situation when their ideas would be correct (transfer situations to other specific contexts).	*"There are drawbacks about having in person meeting. In most cases, managers try to avoid confrontation in person (p.10)."*
	3 Explanation + Multiple sources of evidences	Offer explanation and/or refers to more than one type of source listed above.	*"The video presented two potential benefits for our solution :job satisfaction and authority establishment (p.11)[connecting information from video with textbook theories]"*

Note: Assign this code based on all evidence used in the entire post.

- If none of the above code is assigned, put an X at Non-argumentative column.
- At the end of the discussion, see if this group has agreed on a consensus. Note down the agreed solution label on the excel sheet. If more than one solution is SELECTED, note down them all. If they didn't have any consensus, enter N/A.
- If a group specifically indicate how they reached consensus, note it down in the "Consensus medium" column (e.g. face-to-face meeting, online meeting, not mentioned). If not obvious, enter N/A.

Additional Notes for the Coding Scheme (Generated during calibration)

Discourse Function	Note	Example & Reference
Problems	If problem analysis is used as a supporting reason. Code it as both Problem analysis and supporting reasons. Do this only when explicit cues exist.	*Practice 3, Post 14* *"For the problem to reduce age difference, communication must be applied.*
	If they only disagree with the evidence/theories/details provided in problems, put 1 under "contesting prior problem analysis"	*"I don't think age difference is the problem, it's the value difference."*
Solutions	If both positive and negative positions were mentioned without explicit inclination, count the post with positive and negative positions. But if both sides are mentioned and one explicit position is chosen, count the chosen position, take its supporting reasons, and count the other side as a qualifier.	*Practice 3, Post 9* *"There are two options leading to different results: 1)do XXX, 2) don't do XXX…"*
	If different solutions were mentioned but only a few were commented, count only the ones discussed.	*There are 5 possible solutions. 1.....and I think only the third way will work. (count only solution 3).*
	When someone said "Solution A is better than B" without any more explanation on B but supporting reasons for A. Code +A, –B. Unless the author describe both pros& cons for A & B, then code +A, +B with qualifiers.	*A is better than B. (+A, -B)* *I think A is the best solution. B is better in dealing with short-term problem, but in long-term, A is still the best. (+A, +B).*
	If one agrees with the solution in general but disagree with the evidence/theories/details used in the argument, still treat the statement as agreement	*"I do not agree that contact him is only based on A theory. I think he should be promoted because of B theory."*
	When a group consensus is a combination of many solutions (i.e. proposed as different steps to solve the problem), code them as separately solutions but note them all in the consensus.	*"We as a group agreed that the reward system should be used with the punishment and goal setting methods."*
	Sometime a solution is a combination of two different other solutions, in this case, only code based on what was written.	*Practice 3, Post 18.* *"He should not be promoted, nor demoted." (It*

Discourse Function	Note	Example & Reference
		means to keep his current status, code – promote, -demote but do not code +keep).
	When multiple solutions are proposed, use the solution list to map the content. Use this strategy regardless whether participants stated them as the same/different solution. For example, when one proposed 3 different solutions, but it's under the same solution category, code it as one. If one proposed 1 solution which involved other solutions as steps, code them separately (as Point 3 here). This is done because participants may not view the entire discussion as the coders did. The categorization of solutions is done to reflect what the majority treats the solutions in the forum.	*When posted as the same category:* *"The manager can use these solutions to improve their communication: 1)have regular meeting, 2)ask boss before making actions , and 3)use reward to motivate." [code as communication, ask boss, reward]* *When posted as the different category:* *"The solutions are 1) regular meeting, 2)understand their need, and 3)improve relationship" [code only as communication]*
	When solution is proposed with some conditions, code it as a positive solution with a qualifier.	*"Forcing should only be used if there is no other better solutions."*
Supporting reasons	When supporting reasons are organized as consequence, count all (multiple reasons).	*"Using email leads to misunderstanding, so bad impression occurs. Then it's easy to lose motivation."*
Qualifiers	When qualifiers are organized as consequence, count all (multiple qualifiers).	*"I agree that he should be fired. But this decision will be harmful for his career. It might ruin his life too as he already had depression."*
Evidence for reasons	Evidence is divided into 4 codes. No evidence, explanation only, explanation + single source, and explanation + multiple source.	-
	If a short post doesn't contain any information, it should be 0.	*"I agreed that "whatever was mentioned in the previous post""*

Discourse Function	Note	Example & Reference
	If a short post only had questions about clarification or response, it should be a 0. However, when they stating their arguments in question form, we should account it as evidence.	*"Am I right?" [Code as 0]* *"How about her feeling after this, will it be affected?" [Code as explanation]*
	If details in video was mentioned to support arguments in solutions/ or specific situations mentioned in the video (even without explicit reference), it should be coded as "video."	
	When a certain term was used in analyzing the problem, we should treat it as "theory." However, if it's used a name for solution, we shouldn't treat it as "theory."	*"Compromising strategy is the best solution"[not a theory]* *"The situation could be solved because compromising strategy requires both parties to give up something valuable." [Theory]*

Appendix D.

Solution lists generated in this study

Summary Table

	# of Consented Groups	# of Unique Solutions
Case 1 – Week 4 (Motivation)	7	62
Case 2 – Week 5 (Communication)	6	43
Case 3 – Week 9 (Conflict & Negotiations)	7	64
Case 4 – Week 10 (Ethical Decision Making)	3	15

Group: 1 (12 solutions)

Case: 1

Sol'n	Label	Full title	Description (synonyms)
A	Training	Have training course	Training on "mandatory sanction" Follow orders
B	Ask	Ask the boss before taking actions	Discuss new method Take everybody's idea into accounts
C	Communication	Communication before/after mission	From Gen Y's perspective Ask their opinions Improve relationship
D	Personality	Arrange task based on their personality	Take personality test; Task & goal are assigned w/ working ability
E	Needs	Identify needs	
F	Motivation	Motivate employee's with rewards based on their goals/needs	Rewards, increase belief Satisfy their personal goal Trust employee
G	Backup	Set up a back-up plan	
H	Responsibility	Give employee the responsibility	Empowerment Let them decide what to do Let them create new things
I	Mastery	Enacted mastery	
J	Modeling	Vicarious modeling	Mention previous good examples
K	Praise	Verbal persuasion	Praise when succeed
L	Arousal	Arousal	Encourage when failed

Group: 2 (8 solutions)

Case: 1

Sol'n	Label	Full title	Description (synonyms)
A	Communication	Strengthen relationship	Meeting, events to close gap Provide chance for feedback Let them express opinions CEO should understand employee's motivation
B	Goal	Re-evaluate company's goals and values	Establish the same goals
C	Reward	Incorporate reward system	Motivate people to work together Reward for product/process
D	Freedom	Give younger staff space to demonstrate their ability	Let them decide how to finish the task
E	Ownership	Foster employee's ownership	Training staff sense of belongingness Giving them responsibility
F	Old method	Let them become familiar with old method before creating new	
G	Mentorship	Mentorship program	Pair up with seniors Strengthen the senior and Yers' cooperation
H	Strategies	Adapt attraction strategies	

Group: 3 (10 solutions)

Case: 1

Sol'n	Label	Full title	Description (synonyms)
A	Communication	Communication	Talk to them separately Acquaintance his employee more Understand the Generation Y
B	Dismiss	Dismiss employees when did wrong	
C	Ignore	Leave things as it is	
D	Reward	Reward system	Give them bonus upon completion. Apply performance-reward relationship
E	Punishment	Set Strict rules	
F	Training	Have training courses	Train them to act after asking boss

			Train them to have responsibility
G	Reduce	Reduce power distance	Reduce concept of the order and degree
H	No Stereotype	Get rid of stereotypes	Through off stereotype
I	Value	Share organizational values and adjust accordingly	
J	Freedom	Increase independence	Give them freedom

Group: 4 (9 solutions)

Case: 1

Sol'n	Label	Full title	Description (synonyms)
A	Reward	Reward	Satisfy personal goals Verbal praise and recognition
B	Explain	Explain employer's vision	
C	Relationship	Create good relationship with employees	Bone with Yers to boost job satisfaction/organizational commitment Connect with employees Understand & appreciate different values
D	Workshop	Have team building workshops	
E	Rotate	Rotate job tasks	
F	Manager	Let employees be managers for a while	
G	Bad example	Give examples of wrong doings	Impress them with the importance of following commands
H	Meeting	Have regular meetings to set goals together	To let employee express themselves Get feedback from them Have employee involve in decision making
I	Expectation	Set difficult goals	

Group: 5 (6 solutions)

Case: 1

Sol'n	Label	Full title	Description (synonyms)
A	Goal	Set up goals	Goal setting Set goals using management by organization
B	Reward	Reward	Job performance based rewards Positive reinforcement
C	Punishment	Punishment	Make sure employees knows the

			consequence Negative reinforcement
D	Communication	Speak to employee to solve the problem	Informal communication in workplace Involve employees in decision making
E	Adapt	Adapt Gen Y's ideas	
F	Appreciate	Appreciate employee's performance	

* Treat one of the given alternatives separately as the participant indicated

Group: 6 (9 solutions)

Case: 1

Sol'n	Label	Full title	Description (synonyms)
A	Reward-punish	Reward-punishment system	Be kind and severe Blame & praise Give bonus/incentives for motivation Encourage & motivate Identify individual's need & reward them accordingly Check system for equity Make employee feel comfortable & equal Develop employee engagement Combination of rules
B	Goal	Set up clear goals	Give specific instruction Recognize individual differences and use goal & feedback to help them
C	Sustaining	Practice traditional way to catch the mission then exert their creativity	Follow order first and then start be independent
D	Communication	Disruptive	Figure out an approach together Build good relationship/connection Listen to what employees think Have meeting/feedback box
E	Environment	Provide fun & challenge workspace	
F	Generation-based	Assign different tasks to different generation	Assign the task based on their characters
G	Training	Have training courses	
H	Ask	Ask the boss before taking	Discuss new ideas with CEO

		action	
I	Accept	Company should accept failure when employee try new methods	Let them try their way and take the consequence

Group: 7 (8 solutions)

Case: 1

Sol'n	Label	Full title	Description (synonyms)
A	Identify	Identify needs and reward accordingly	Build a bridge to connect with each other Do a research to find needs Survey to learn their needs Find out the type of employee and their hierarchy to satisfy their interests
B	Y manager	Appoint a new manager who is Generation Y	Empower generation Y Let Gen Y lead the group
C	Goal	Set specific goals	Set effectively SMART goals Set goals & measure the efficiency
D	Common method	Use a common agreed method	Figure out the reason of inefficiency and solve the solution together
E	Communicate	Communicate frequently	Communicate to resolve difference via meeting, social events to improve relationship Talk with employee and know the gap
F	Punishment	Set strict rules if not followed, use punishment	Establish harsh rules & build power distance
G	Generation gap	Hire someone to fill the generation gap	
H	Training	Have training course	

Group: 8 (5 solutions)

Case: 2

Sol'n	Label	Full title	Description (synonyms)
A	Accept	Accept feedback	Understand what senior executives expect from her Take account of senior executive's perception & don't take it personally Take criticism and put aside personal feeling
B	Email	Email the senior executive	Tell exec. that she understands the feedback

			Explain why she spoke strongly
C	Talk	Talk to the executive in person	Buy him coffee/dinner Speak to the executive privately
D	Body lang.	Choose tone & body language carefully	
E	Respond	Treat the feedback positively & respond accordingly	

Group: 9 (6 solutions)*

Case: 2

Sol'n	Label	Title	Description (synonyms)
A	Accept feedback	Accept feedback	
B	Email	Email the executives	
C	Talk	Talk to the executives in person	
D	Control	Control her feelings	
E	Formative feedback	Executives should give formative feedback	
F	Company	The company should do something	

*The solutions were adapted from another study using this dataset (Wise, Hsiao, Marbouti & Zhao, 2012)

Group: 10 (9 solutions)

Case: 2

Sol'n	Label	Full title	Description (synonyms)
A	Meeting	Run more meetings	Meetings to get feedback & explain reasons for decision making
B	Creativity	Show her creativity	
C	Ask & confirm	Ask & confirm	Discuss more to understand their feeling, emotions
D	Talk	Talk to the executive(s)	Barriers to effective communication Talk with others at high position Make an appointment to see exec. Face-to-face interaction Request a meeting
E	Email	Email the executives	
F	Accept	Accept the feedback	Care more about the feedback Accept feedback & behave better next time

G	Videotape	Analyze her behaviour by watching video recording	
H	Preparation	Make more preparation for presentation	
I	Good feedback	Exec. should give feedback nicely	Exec. find a better manner to talk to Lisa

Group: 11 (8 solutions)

Case: 2

Sol'n	Label	Full title	Description (synonyms)
A	Time	Exec. give Lisa more time to prepare	
B	Stress	Team show know how to communicate better when they are stressed out	
C	Reality	Exec. learn more reality	Reality = the environment Lisa's team faced
D	Empathetic	Both Exec. and Lisa should be empathetic	Putting yourself in others' situation Put themselves in Lisa's shoes
E	Different	Both Exec. and Lisa understand difference	Both listen to each other to view situation from both perspectives Understand each other's situation Consider the different experience & expectations
F	Email Lisa	Exec. email negative feedback	Express her negative feedback in milder way than f2f
G	Meeting	Have meeting	Have fixed meeting Have a meeting after presentation and tell each other what they think Have meeting with neutral parties / third party Lisa's peers should give her feedback
H	Network	Have All channel small group network	

Group: 12 (9 solutions)

Case: 2

Sol'n	Label	Full title	Description (synonyms)
A	Accept	Accept feedback	Listen to all suggestions & give a new point later

			Think twice before talking back Get to know the senior executives before responding to the feedback Internal factor: think about the mistake and learn from it
B	Reflect	Reflect cognitively	Calm down and think cognitively of what happened Think in a critical way /in others' shoes Consider both sides
C	Talk	Talk to the executives	External: get a coffee with the exec. Re-communicate with the exec. Have a phone meeting
D	Private	Exec. give feedback in a private place	
E	Training	The exec. offers Lisa training	
F	Workshop	Workshop to identify stressful situation & how to deal with it	
G	Kind	Exec. give good feedback	Exec. talk more kindly Say good things about the presentation
H	Communication	Communicate with senior executives	Clear instruction Clear & well-explained
I	New idea	Exec. should be open to employee's ideas	Senior executives should allow junior executives to voice their logic Notice that there's a new generation of managers

Group: 13 (6 solutions)

Case: 2

Sol'n	Label	Full title	Description (synonyms)
A	Respect	Communicate with mutual respect	Acknowledge each other's effort for mutual respect Harmony communication Decode executives' messages in a positive attitude Executives be careful when they order staff More communication between boss & employee (boss respect what your employees do)

B	Two-way	Reinforcing upward & downward communication	Improve their communication skills Lisa reinforce upward communication skills Exec. improve downward communication skills Boss should give more positive feedback Explain reasons in feedback Exec. Filter information
C	Talk	Talk to the executive	Understand the feedback and have a conversation with the Exec. Have a conversation with the exec. Ask to clarify their feedback Discussion with exec. informally Meet with executives
D	Accept	Accept feedback	Admit defeat Learn from mistake Conform to what the Exec. said Be rational when accepting exec. advice
E	Stress	Learn to deal with stress	Understand the effects of communicating under stress
F	Authority	Acknowledging authority	Be aware of norms of communication

Group: 14 (6 solutions)

Case: 3

Sol'n	Label	Full title	Description (synonyms)
A	Compromise	Compromise while negotiating with the new peer	Negotiate with other team leaders Integrative bargaining Balance both concerns, give up some "fun" work Negotiate in small meeting to either trade some work or turn all tasks into a master list to redistribute them
B	ProblemSolving	Negotiate in order to solve problem & reach a mutually beneficial state	Give herself & the new peer equal standing and a chance to work out their differences Problem solving with mixed groups
C	Yielding	Yield and to give whatever the peer wants (no negotiation)	
D	Avoiding	Ignore the peer's concern	
E	Forcing	Dig in the heels	

F	Escalate	Escalating to the boss	Third party arbitration

Group: 15 (8 solutions)

Case: 3

Sol'n	Label	Full title	Description (synonyms)
A	Trade	Go with what the peer wants	Trade the fun work Solution 1
B	Dig	Dig in the heels	
C	Escalate	Escalate to the boss	
D	Meeting	Meeting face to face	Negotiation & compromise Face-to-face meeting with the peer
E	Goal	Use goal setting theory to motivate peers	Motivate & give peer feedback
F	Arbitrator	Utilize a mutually selected arbitrator	Arbitration
G	Fire	Fire the new peer	
H	Rotate	Rotate jobs	Alternating jobs in a cycled process

Group: 16 (12 solutions)

Case: 3

Sol'n	Label	Full title	Description (synonyms)
A	Problem solving	Problem solving in meeting	Face-to-face conversation Problem solving
B	Compromise		Give up something of value to reach an accord
C	Negotiation	Negotiation	Integrative bargaining
D	Forcing		
E	Avoiding		
F	Yielding		
G	Arbitration	Third party conflict resolution	Pass the issue to higher management Let supervisor to handle it Let someone to convince both sides
H	Escalate	Escalate to the boss	Authoritative command Manager evaluate the situation & make a decision for both
I	Rethink	Solution for Melissa, the peer &	Melissa, peer and the manager all rethink

		the manager	about the conflict
J	Goal	Develop overarching goals	
K	Smoothing	Smoothing	Play down the differences and emphasize the similarities
L	Cooperative	New peer to be cooperative	

Group: 17 (13 solutions)

Case: 3

Sol'n	Label	Full title	Description (synonyms)
A	Problem solving	Problem solving	Face-to-face meeting with co-workers Gain commitment through consensus & sit down to find out solution The company should talk to them directly
B	Compromise		Balance their concern Negotiate to balance the opinion Search for a middle ground Achieve temporary settlements to the issue Even out the work load Separate the work The company should talk to them to find the balance
C	Negotiation	Negotiation	[Whenever the group see it as a thing, except for negotiate to balance the opinion]
D	Consider	View the new peer from different point of view	
E	Explain	Explain to the new peer about the job distribution	
F	Trade	Trade the job temporarily	
G	Forcing	Give all the job to the new group	
H	Reward	Reward team members	Reward another teams for doing boring jobs Motivation
I	Questionnaire	Make questionnaire to ask their opinion	Ask for opinion from the members
J	Develop	Develop members' interests for the job	The other team should make their job interesting
K	Performance	Separate the job according to the performance	

L	Mediation	Mediation	Third party Involve the boss
M	Expectation	Consider company expectation	Avoid ineffective work environment

Group: 18 (9 solutions)

Case: 3

Sol'n	Label	Full title	Description (synonyms)
A	Communication	Problem solving	Face-to-face meeting Discuss with the peer and explain her expectation Sit down and talk
B	Escalate	Escalate to the boss	Authoritative command Involve the boss Take a stand Third party conflict resolution
C	Attitude	Change the attitude	Melissa change her attitude & the peer change his attitude
D	Avoiding	Avoidance	Run
E	Compromising	Exchange some works	Exchange the arraignment of works Agree with each other and each gives up something
F	Forcing	Dig into the heels	
G	Goal	Developing overarching goals	Create a shared goal
H	Smoothing	Smoothing	Play down differences and emphasize common interests
I	Think	Think before responding	

Group: 19 (9 solutions)

Case: 3

Sol'n	Label	Full title	Description (synonyms)
A	Confrontation	Confront each other	
B	Compromising	Go along with the peer	Split the "fun" work equally Trade work
C	Dig	Dig in the heels	
D	Escalate	Escalate to the boss	Bringing the decision to a higher ups
E	Arbitration	Third party mediation	HR rep

			Professional mediator
F	Goal	Set goals for her team	
G	Motivate	New peer should motivate his team	
H	Preference	Pool together two teams and split work based on their preference	Ask the new peer to list “fun” and “unfun” and ask her team members if they want to switch. Re-divide the group according to what they feel is fun
I	Divide	Assign people to what they are good at	Divide the people to do the job they are best at.

Group: 20 (7 solutions)

Case: 3

Sol’n	Label	Full title	Description (synonyms)
A	Forcing	Do whatever Melissa feel like to do	
B	Escalate	Escalate to the boss	Use third party conflict resolution Ask the boss to negotiate
C	Skill	Increase her skills to lead an effective team	
D	Problem solving	Problem solving	Integrative bargaining Negotiation Reach an agreement that satisfy both aspiration as much as possible
E	Compromising	Compromising strategy	Find middle ground Trade some fun works with the other team Communication
F	Avoiding	Avoid the interaction with the new peer	
G	Motivation		

Group: 21 (3 solutions)

Case: 4

Sol’n	Label	Full title	Description (synonyms)
A	Demote	Reduce Joe’s Rank to E1 (no rank)	Punishment
B	Promote	Make an exemption and promote Joe	Promote but with probation/ restriction

C	Delay	Delay promotion & investigate more	Have an interview and allow Joe to clarify Talk to Joe and find out more details before making a decision Delay promotion & have a second drug test and make decision accordingly

Group: 22 (5 solutions)

Case: 4

Sol'n	Label	Full title	Description (synonyms)
A	Demote	Reduce Joe's Rank to E1 (no rank)	Punishment
B	Demote a bit	Reduce Joe's Rank a little bit (not zero)	
C	Promote	Make an exemption and promote Joe	
D	De-promote	Demote Joe to zero first and then promote him immediately	
E	Discuss	Discuss with Joe and then make decision	

Group: 23 (7 solutions)

Case: 4

Sol'n	Label	Full title	Description (synonyms)
A	Demote	Reduce Joe's Rank to zero	Punishment
B	Promote	Make an exemption and promote Joe	
C	Attitude	Make decision not only based on Joe's performance but also his attitude & character	
D	Evidence	Make decision based on evidence but not personal emotions	Avoid self-interest thinking
E	Criteria	Set proper criteria & give priority	
F	Ethical	Build an ethical environment	Keep ethics in mind
G	Meeting	Gather group intelligence in decision making	Groupthinking