How Does Students’ Motivation Relate to Peer-Moderated Online Interactions?

Abstract: Motivation has been recognized as a crucial factor that influences learning success. However, little research has addressed students’ motivation in peer-moderated online interactions. This study conducted a content analysis of online discussions to discover how students’ motivation relates to their interaction and knowledge construction in peer-moderated online discussions. The results indicate that intrinsic motivation was significantly correlated with students’ elaboration processes and knowledge transfer. However, no significant correlation was observed between intrinsic motivation and students’ moderation behaviors. The findings suggest that instructional designers and teachers in online classes should integrate strategies to promote students’ motivation, and more importantly, they should scaffold student moderators to achieve meaningful learning in peer-moderated online discussions.

Introduction

Asynchronous online discussions have been integrated and are gaining popularity in distance learning. Asynchronous online discussions use networked computers to support the communication and interaction among learners and facilitate sharing and distributing knowledge and expertise in a learning community (Koschmann, Hall, & Miyake, 2002). Most contemporary course management systems, e.g., Blackboard, WebCT, Moodle, and Desired2Learn, have incorporated a component to facilitate asynchronous online discussions. However, Bromme, Hesse, & Spada (2005) noted that in order to achieve high-quality online discussions, students must overcome three barrier-presumptions including (1) the establishment and maintenance of motivation to cooperate and communicate, (2) the mutual construction of “meaning” and the exchange of information in groups, and (3) the establishment and maintenance of structure in social interaction. These three requirements pose an essential challenge to students that they must be willing to join in and invest considerable mental effort in collaborative learning activities and also persist in their motivation and cognitive engagement in online discussions over time. In many ways, newly designed environments that are adopted to achieve successful distance learning require students to be more motivated and self-regulated than do traditional environments due to the lack of face-to-face moderation of instruction (Blumenfeld et al., 1991). Therefore, the quality of online discussions heavily leans on learners’ motivational development toward computer-supported collaborative learning (CSCL) activities (Cheung, Hew, & Ling-Ng, 2008; Hakkarainen, et al, 1999; Author, DeBacker, Ferguson, 2006). Consequences directly related to students’ lack of motivation include low levels of participation (e.g., Mazzolini & Maddison, 2003), insufficient peer referencing (e.g., Hewitt, 2005), superficial interaction (e.g., Weinberger, 2003), and unwillingness for building joint efforts (e.g., Grasel, Fischer, Bruhn, & Mandl, 2002).

Motivation for online discussions

Motivation is the internal force that drives an individual to engage in a particular behavior. It is believed that motivation influences students’ learning decisively; that is, a learning behavior will not occur unless it is energized (Reeve, 2005). Student’s motivation is a continuum that ranges from intrinsic motivation where a student takes action for the fun or challenge involved in the task to extrinsic motivation where the drive for a student to take an action includes seeking external stimuli or rewards, or avoiding pressure or punishment (Deci & Ryan, 1985; Lepper, 1988; Ryan & Deci, 2000b). Intrinsic motivation emerges spontaneously from internal tendencies (e.g., enjoyment) and can motivate behavior even without the aid of extrinsic rewards or environmental controls. Students with high intrinsic motivation demonstrate greater persistence (Li, Lee, & Solmon, 2005), better ability to cope with failure (Ryan, Connell, & Grolnick, 1992), more positive self-perceptions (Ryan & Connell, 1989), and higher quality task engagement (Ryan & Deci, 2000a).

Often times, students’ school activities are driven by extrinsic motivation (e.g., grades, instructor’s requirement, etc.) (Rovai, 2007). Being extrinsically motivated might result in low-level of participation and cognitive engagement in CSCL events. Wan and Johnson (1994) found that university students contributed less than one message per week in online discussion forums due to the fulfillment of the course requirement. Author and his fellows examined the relationship of students’ intrinsic motivation and their participation in online discussions. They found that students’ intrinsic motivation was significantly correlated with their online discussion participation meaning students who had high-level of intrinsic motivation demonstrated higher participation rate than those with low-level of intrinsic motivation. Intrinsically motivated students demonstrated twice to three times higher
participation rate than those who are extrinsically motivated (Author, DeBacker, & Furgerson, 2006; Author & Durrington, 2007).

Blumenfeld, Kempler, and Krajcik (2006) suggested four determinants of motivation in CSCL. Their discussions, consistent with the Technology Acceptance Model and Self-Determination Theory, argued that perceived value, competence, relatedness, and autonomy are critical aspects that influence students’ motivation in CSCL. The Technology Acceptance Model, which was created to explain and predict users’ acceptance of new technology, suggests that the perceived value is one of the major determinants of users’ motivation to accept and use a technology (Davis, 1989). Perceived value is the degree to which a person believes that using a particular information system would enhance their learning or task performance. It directly impacts not only a person’s interactivity in online communication, but also his/her motivation toward using an information technology. Self-Determination Theory (SDT) identifies three innate psychological needs of intrinsic motivation – autonomy, competence, and relatedness (Ryan & Deci, 2000a). Autonomy refers to the need individuals have to determine their own behavior and to be free to act on their own volition (Baumeister & Leary, 1995; Reis, 1994). Competence refers to the need individuals have to feel successful in their attempts to understand and master their environment (Harter, 1978; White, 1963). Relatedness refers to the need individuals have to relate to others in ways that reinforce their feelings of emotional security and belonging (deCharms, 1968). Different effects on these three needs will result in different levels of intrinsic motivation. The groundwork for facilitating intrinsic motivation is supporting students so that they can improve their perceived value of CSCL and satisfy their needs for autonomy, competence, and relatedness.

Learning in online discussions
Social constructivists believe that human beings are unique and capable of constructing cognitive systems that interpret experiences with objects and other persons (Piaget, 1954), and learning is situated in a cultural context (Brown, Collins, & Duguid, 1989; Clancey, 1997; Lave & Wenger, 1991). This knowledge construction is a social and dialogical process in which different perspectives are incorporated (Pea, 1993). According to this view of knowledge construction, learning environments should encourage active participation, interaction and dialogue to provide students with opportunities to engage in a process of mutual knowledge construction. Therefore, many online classes have switched the major learning activities from reading Powerpoint slides to participating in asynchronous online discussions where students interact with one or more peers to solve a given problem or share experiences by reading and writing messages in a discussion board. Student online discussions provide the primary means for distance-learning students to exchange ideas, share multiple perspectives, and clarify understandings. However, researchers also raised some critical questions: Do students really learn in these online discussion activities? How do we know if learning really occurs (e.g., Dennen, 2008)?

A notion consistent with this social constructivist perspective believes that learning is thought to take place on two levels of interaction (Vygotsky, 1978): (1) an individual learner by interacting with others, and (2) in an interaction with self. At the first level, students interact with others to build social connections, form learning communities, and share information and experiences on a common topic or a problem (Weinberger & Fischer, 2006). Knowledge construction actually starts at this level, but does not stay here. In order to promote meaningful learning in CSCL, students have to integrate the knowledge into their own mental structures (e.g., schema). This knowledge integration is realized through elaboration processes. Two views of the elaboration processes are involved in CSCL. One focuses on reaffirming what students already understand by elaborating their prior knowledge and experiences, and the other focuses on adjusting participants’ mental models to accommodate new knowledge or different perspectives through synthesizing ideas and elaborations from the group (Vygotsky, 1978; Dennen, 2008). Therefore, besides social interaction and sharing information, learning in CSCL can also be manifested through two different elaboration processes, which in this article we define them as egocentric elaboration and allocentric elaboration. Egocentric elaboration is the process that a student elaborates on a concept or idea based on his or her own experiences. Allocentric elaboration, on the other hand, is the process that a student contributes to collaborative knowledge construction by synthesizing other individuals’ comments and collaboratively elaborating on a concept or an idea.

Researchers agreed that content analysis is a powerful approach to provide evidences of students’ learning in online discussion activities. It can unveil the dynamic patterns of interactions in the actual discussion discourse (e.g., Gunawardena, et al., 1997; Hara et al., 2000; Henri, 1992). Henri (1992) and Hara et al. (2000) developed an analytical framework based cognitive information processing model. They focused on students’ social, cognitive and metacognitive perspective and categorized the online discussion contents based on Bloom’s taxonomy, which involves different levels cognitive activities from elementary clarification, in-depth clarification, to inferencing, judgment, and application of strategies. Gunawardena et al’s (1997) analytical framework, on the other hand,
focused on the process of knowledge construction. She believes that the knowledge construction in online discussion context involves five phases of development: (1) Sharing and comparing of information; (2) the discovery and exploration of dissonance or inconsistency among ideas, concepts or statements; (3) negotiation of meaning and co-construction of knowledge; (4) testing and modification of proposed synthesis or co-construction; and (5) agreement statements and applications of newly constructed meaning. Later on, Salmon (2000) further developed this model into a 5-step e-moderating model aiming to help training student tutors to effectively facilitate discussion groups. His model involves (1) access and motivation, which centers on welcoming participants and offering them technical support, (2) online socialization, which helps to establish a feeling of community, (3) information exchange, where learning is becoming the more prominent objective, (4) knowledge construction, where social negotiation and task-related engagement occurs, and (5) development, where participants reassess their own thinking and explore the social learning processes. In this study, we developed the Online Learning Interaction model that integrates the concepts from these previous analytical frameworks. It holds the social constructivist view of learning but also keeps students’ cognitive perspective in consideration. This model is illustrated in the data analysis section. We hope through the content analysis students’ interaction and learning patterns will emerge from the discussion corpus.

Peer-moderation in online discussions
In a successful online collaboration, the guidance of the instructor and the moderation of students are two key interventions that facilitate online learning discussions (Rovai, 2007). A peer-moderator can be defined as “people from similar social groups who are not professional teachers, helping each other to learn, and learning themselves by teaching” (Topping, 1996, p322). This moderator may start or participate in discussions, provide timely feedback to difficult questions, identify the key issues remaining to be addressed, or make explicit suggestions for further development. Vygotsky (1978) suggests that a student’s cognitive development can be explained by the concept of ‘zone of proximal development’, which is the difference between what a learner can do without help and what he or she can do with help. Research has documented that peer-moderation is an effective strategy to support cognitive development in online discussion activities (Smet, Keer, & Valcke, 2008). With support provided by peer-moderators, students progress from zone to zone of their cognitive development (Jaramillo, 1996). Moreover, implementing the strategy of peers supporting one another as compared to staff support entails beneficial effects on students’ motivation (Neville, 1999). With peer support, students may perceive that online discussion as a useful and valuable way to communicate and get information, which may lead more willingness to continue to participate in this type of discussion (Author, DeBacker, & Ferguson, 2006). However, the body of research mainly focused on how peer-moderation can influence students’ motivation and learning. Little research examined how moderators’ motivation levels can impact their moderation performance, and consequently influence their peers’ online interaction and learning.

Method

Purpose of the study
Studies indicated that students’ motivation, especially intrinsic motivation impacts their participation rate in online discussions. However, in order to examine if motivation really impacts learning, two critical issues need to be addressed: whether learning occurs in online discussions and how students’ motivation impacts their learning behavior. This study conducted a content analysis of online discussions aiming to understand the nature of CSCL and discover how students’ motivation impacts their interaction and knowledge construction in peer-moderated online discussions. This study used SDT as the theoretical framework and was guided by the following questions: (1) What are the patterns of students’ interaction and knowledge construction? (2) Does students’ motivation have a relationship with these interaction patterns? (3) Does students’ motivation have a relationship with student moderation? How does moderation impact their peers’ knowledge construction?

Participants
The participants were 18 graduate and 6 undergraduate students from two sections of an online instructional technology course at a large Southeast University. The main goal of this course is to promote students’ understanding of different educational theories and methods, and different approaches of integrating technologies for meaningful learning. The instructional activities were designed to promote students’ higher-order thinking (e.g., knowledge transfer and application). Students were also desired to collaborate with peers and pursue collaborative knowledge construction. Students participated in weekly online discussions, which was a significant portion of the class and accounted for 30% of students’ final grade in the course. Students were assigned into smaller groups of 6
to 8. Each student moderated a chapter discussion for a designated week within his or her own group. During the course, students joined in the discussions to share information and contribute to knowledge construction. The instructor observed students’ discussion activities and supported the discussion when needed. Participants completed survey questionnaires measuring demographic information, attitudes toward the class and the instructor, and intrinsic motivation related to participating in online discussions at the end of the semester. All the online discussion activities in this course were archived in a WebCT system where the instructor created discussion topics and forums at the beginning of the semester. The survey questions were delivered through an online survey system designed and developed for this research.

**Measures**

The survey questionnaires included instruments measuring motivation and students’ attitude toward the class. Students’ motivation is measured by Deci and Ryan’s Intrinsic Motivation Inventory (IMI), which is a multidimensional measurement device intended to assess participants’ subjective experience related to a target activity (Self-Determination Theory). The IMI was modified to specifically address students’ motivation in participating in the online discussions in this study. The revised IMI measured 5 variables related to students’ intrinsic motivation including (a) 8 questions measuring enjoyment in online discussion, (b) 7 questions measuring perceived value of the online discussion, (c) 8 questions measuring feelings of autonomy in regard to the online discussion, (d) 6 questions measuring feelings of competence in regard to the online discussion, and (e) 8 questions measuring feelings of relatedness to student peers in the online discussion. As suggested by the IMI scale description, the enjoyment subscale of IMI is considered the self-report measure of Intrinsic Motivation. Since the primary goal of students’ participation in the online discussion board is content specific, and students were not encouraged to discuss non-content related topics, this study did not differentiate student motivation for discussion from their motivation related to the content area. Students’ attitude toward the class in general was measured by 6 Likert style items created for this study. Means, standard deviations, internal consistency coefficients, and sample items for all scales used in the study can be found in Table 1.

### Table 1: Means and Standard Deviation of Motivation and Attitude Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>α</th>
<th>Sample Item</th>
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<tbody>
<tr>
<td>Enjoyment</td>
<td>4.64 (1.56)</td>
<td>.94</td>
<td>If I participate in this online discussion, I will be thinking about how much I enjoy it.</td>
</tr>
<tr>
<td>Perceived Value</td>
<td>5.14 (1.61)</td>
<td>.95</td>
<td>I believe that participating in this online discussion can be of some value for me.</td>
</tr>
<tr>
<td>Autonomy</td>
<td>3.48 (1.70)</td>
<td>.89</td>
<td>I believe I have some choice about participating in this online discussion.</td>
</tr>
<tr>
<td>Competence</td>
<td>5.11 (1.21)</td>
<td>.76</td>
<td>I believe I am pretty skilled in the online discussions that allow me to share my knowledge and experiences.</td>
</tr>
<tr>
<td>Relatedness</td>
<td>4.06 (1.31)</td>
<td>.86</td>
<td>I'd like a chance to interact with the people in the online discussions more often.</td>
</tr>
<tr>
<td>Course Attitude</td>
<td>5.58 (1.07)</td>
<td>.81</td>
<td>How do you believe you will like the instructor in this class that you are taking?</td>
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</table>

* The enjoyment is considered the self-report measure of Intrinsic Motivation.

### Data collection and analysis

Data for this study included the transcripts of the electronic discussions and the self-reported survey results. The transcripts were organized and transformed to text files with all the identity information being removed. The transcripts were collected to provide information about the patterns of online learning interactions.

In agreement with Beers, Boshuizen, Kirschner, and Gijselaers (2007), the authors of this study held the belief that a new online collaborative learning research project, when focusing on a different theoretical framework...
or a different research purpose, will generally require new coding themes for analysis. Therefore, rather than using an existing content coding themes, we analyzed the online interaction transcripts using a self-developed analysis schemes - *Online Learning Interaction Model*. This model synthesized the three representative content analysis schemes in the distance education literature: the model of Henri (1992) that analyzes the transcripts of discussions based on a cognitive approach to learning, and the model of Gunawardena et al. (1997) and Salmon (2000) that examines the transcripts of online interactions from a social constructivism perspective. In this model, the unit of analysis is “thematic unit” (Henri, 1992). Each unit was then classified into one of the eight analytic categories under three dimensions, outlined as the following:

Table 2: Online Learning Interaction Model

<table>
<thead>
<tr>
<th>Code</th>
<th>Interaction Category</th>
<th>Definition</th>
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<tr>
<td>S</td>
<td>Social Interaction</td>
<td>Having the indicators of greetings, comments without elaboration (e.g., “I agree with you”), personal life, and emotional expressions.</td>
</tr>
<tr>
<td>K1</td>
<td>Sharing information</td>
<td>Simply adding facts, opinions, or questions without elaboration</td>
</tr>
<tr>
<td>K2</td>
<td>Egocentric elaboration</td>
<td>Elaborating one’s own arguments/concepts/problem solutions</td>
</tr>
<tr>
<td>K3</td>
<td>Allocentric elaboration</td>
<td>Comparing and synthesizing peers’ multiple perspectives</td>
</tr>
<tr>
<td>K4</td>
<td>Application and Transfer</td>
<td>Planning future application of new knowledge or proposing in-field application strategies</td>
</tr>
<tr>
<td>L1</td>
<td>Coordination</td>
<td>Teamwork planning and coordinating for cooperation and/or collaboration</td>
</tr>
<tr>
<td>L2</td>
<td>Reflection</td>
<td>Self-evaluation and self-regulation on learning process</td>
</tr>
<tr>
<td>L3</td>
<td>Technical issues</td>
<td>Questioning and answering on technological problems or assignment clarification</td>
</tr>
</tbody>
</table>

* Codes will be used in the following discussions to indicate Interaction Categories.

All the discussion contents were exported from WebCT system along with all the meta information (e.g., timestamps, authors, and etc.). The two researchers scheduled and met in a 4-hour training session in which they together studied the analytical framework, coded two training data sets, and discussed the differences until reached a 100% agreement. Then the researchers blind-coded all discussion transcripts independently. Inter-rater reliability was calculated (*Kappa* = .92). The researchers also discussed the coding differences and reached a 100% agreement.

**Results**

**Online learning interaction patterns**

During the 16-week semester, students participated in 10 chapter discussions and generated a total number of 1462 thematic units. Among them, 44% were identified as K1 category (*n* = 645); 20% as K2 category (*n* = 294); 19% as S category (*n* = 279); 12% as K3 category (*n* = 182); only about 2% were identified as L2 category (*n* = 29), 2% as L3 category (*n* = 27), and 1% as K4 category (*n* = 9); and only 3 thematic units were identified as L1 category. These results indicated that a significant proportion of students’ interactions for knowledge construction were at a superficial level by simply adding facts, opinions, or asking questions. Students were heavily involved in individualistic elaborations on concepts and opinions from personal experience and theoretical references. There were relatively less efforts put in collaborative elaborations. In addition, students performed online interactions for social purpose in which they greeted each other, built social relations, or expressed their personal emotions. Little efforts were observed for knowledge application and transfer, collaboration coordination, reflection, or resolving technical issues.

A series of correlation analyses was performed among the learning interaction variables. The results indicated that S was significantly correlated with K1 (*r* = .89, *p* < .01) and K3 (*r* = .62, *p* < .01). K1 was significantly correlated with K2 (*r* = .37, *p* < .05) and K3 (*r* = .58, *p* < .01). L2 was significantly correlated with K3 (*r* = .38, *p* < .05) and K4 (*r* = .62, *p* < .01). L3 was significantly correlated with S (*r* = .55, *p* < .01), K1 (*r* = .52, *p* < .01), and K2 (*r* = .42, *p* < .05). No significant correlations were found between L1 and any variables of interest. The results indicated that students with more social interaction were more likely to share information and were more
likely to compare and synthesize others’ comments and involve in collaborative elaboration process. Students who performed higher-level cognitive engagement (e.g., K2 and K3) were also likely to share facts and opinions. In addition, students who performed reflection activities were also likely to engage in the highest levels of cognitive activities (e.g., allocentric elaboration and application).

Relations between motivation and knowledge construction
A series of correlation analyses was performed between learning interaction variables and self-reported motivation and attitude variables. The results indicated that intrinsic motivation was significantly correlated with K2 ($r = .40, p < .05$), K3 ($r = .35, p < .05$), K4 ($r = .36, p < .05$), and L3 ($r = .42, p < .05$). Perceived value was significantly correlated with S ($r = .45, p < .05$), K1 ($r = .47, p < .05$), K2 ($r = .44, p < .05$), K3 ($r = .39, p < .05$), and L1 ($r = .35, p < .05$). Relatedness was significantly correlated with K3 ($r = .44, p < .05$). Competence was significantly correlated with S ($r = .56, p < .01$), K1 ($r = .57, p < .01$), K2 ($r = .45, p < .05$), K3 ($r = .51, p < .01$), and L3 ($r = .50, p < .01$). Course attitude was significantly correlated with S ($r = .42, p < .05$), K1 ($r = .44, p < .05$), K2 ($r = .50, p < .01$), K3 ($r = .47, p < .05$), K4 ($r = .36, p < .05$), and L3 ($r = .47, p < .05$). No significant correlations were found between perceived choice and any variables of interest. The results indicated that students’ intrinsic motivation predicted their knowledge construction, especially higher-level cognitive engagement (e.g., K2, K3, & K4). When students perceived the online discussion activities are valuable, and/or when students perceived themselves competent in the learning tasks, and/or when students had positive attitude toward the class and the instructor, they were more likely to engage in higher-level online discussions. In addition, if students had strong a sense of relatedness to the learning community, they were more likely to involve in collaborative elaboration processes.

Motivation and discussion moderations
In order to explore how students’ motivation was related to their online interaction when they were in a moderator position, a series of correlation analyses was performed between moderator’s motivation and attitude variables and their moderation activities. The results indicate that perceived value was significantly correlated with S ($r = .36, p < .05$). Relatedness was significantly correlated with S ($r = .36, p < .05$) and K3 ($r = .46, p < .05$). Perceived competence was significantly correlated with S ($r = .45, p < .05$), K1 ($r = .46, p < .05$), K3 ($r = .37, p < .05$), L2 ($r = .43, p < .05$) and L3 ($r = .38, p < .05$). Course attitude was significantly correlated with L3 ($r = .43, p < .05$). No significant correlations were found between perceived choice and any variables of interest. The results indicated that if a moderator perceived the online discussion activities were valuable, and/or perceived himself/herself to be competent in the learning tasks, and/or had strong relatedness to others, he/she was more likely to engage in social interactions. If a moderator had strong sense of relatedness and strong competence, he/she was more likely to involve in collaborative elaboration processes. In addition, the significant correlation of perceived competence with five of learning interaction variables indicates the importance of perceived competence for peer-modерators.

More important is the examination on whether the moderation affected students’ learning. Although student moderated the discussions at most time, the instructor’s activities might have been influenced students’ interactions in the discussion activities. Therefore, correlation analyses were performed between student moderators’ (-M) and student peers’ (-P) interaction variables, and between instructor’ (-I) and student peers’ (-P) interaction variables. The student-student correlation matrix indicated that S-M was significantly correlated with S-P ($r = .86, p < .01$), K1-P ($r = .81, p < .01$) and K2-P ($r = .79, p < .01$). K1-M was significantly correlated with S-P ($r = .82, p < .01$), K1-P ($r = .79, p < .01$) and K2-P ($r = .77, p < .01$). K3-M was significantly correlated with S-P ($r = .80, p < .01$), K1-P ($r = .74, p < .01$) and K2-P ($r = .68, p < .01$). L2-M was significantly correlated with S-P ($r = .36, p < .01$), K3-P ($r = .40, p < .05$) and L2-P ($r = .47, p < .05$). L3-M was significantly correlated with S-P ($r = .51, p < .01$) and K1-P ($r = .45, p < .05$). The instructor-student correlation matrix indicated that K4-P was significantly correlated with S-I ($r = .61, p < .01$), K2-I ($r = .51, p < .01$), K3-I ($r = .51, p < .01$), K4-I ($r = .81, p < .01$) and L2-I ($r = .81, p < .01$). L2-P was significantly correlated with S-I ($r = .44, p < .05$), K2-I ($r = .51, p < .01$), K3-I ($r = .44, p < .05$), K4-I ($r = .83, p < .01$) and L2-I ($r = .83, p < .01$). The results indicated that peer-modерators’ knowledge constructions (S-M, K1-M, & K3-M) were positively associated with students’ lower-level knowledge constructions (S-P, K1-P, & K2-P). Student moderators’ reflective interactions were positively associated with student peers’ social interaction, collaborative elaboration, as well as their reflections. On the other hand, the instructor’s moderation (S-I, K2-I, K3-I, & K4-I) was positively associated with students’ higher-level knowledge constructions (K4-P) and their reflective interactions (L2-P).

1 S-M indicates student moderators’ (-M) social interaction (S). The same acronym method was used to indicate other categories of learning interaction.
Discussions and Conclusion
This study examined the relationship between students’ motivation and their online interactions in a distance learning class. Previous studies found that students’ motivation were significantly correlated with their participation rates (e.g., number of messages posted or number of times logged in), but failed to take the discussion content in consideration (e.g., Hew & Cheung, 2008; Author, DeBacker, & Ferguson, 2006). This study took the online discussion contents into account and revealed interesting patterns of students’ interaction for knowledge constructions. Through the semester, students performed online learning interactions that contribute to the knowledge construction at different levels from simply sharing facts, opinions, and experiences, to elaborating one’s own or others’ ideas, to applying and transferring knowledge in practices. However, the volume of these levels differed: the lower level categories had larger volumes than those of higher-level categories. This finding supports Salmon’s five-step model, which believes that the online interaction process starts from the lower-levels interactions, e.g., assess and motivation, and online socialization, builds upon them, and evolves gradually to the higher-levels, e.g., knowledge construction and development (Salmon, 2000; Smet, Keer, & Valcke, 2008).

The study results indicate that motivation played an important role in students’ online interaction. At the whole class level, intrinsic motivation and perceived value had significant correlations with both egocentric and allocentric elaboration processes of knowledge construction. The study also indicates that the inner psychological variables related to intrinsic motivation predict students’ knowledge construction. Specifically, perceived competence was positively associated with the volume of interactions for sharing information as well as elaborations. Relatedness was positively associated with collaborative elaborations. In addition, we found that highly motivated students demonstrated not only high cognitive engagement, but also persistence in their engagement throughout the semester, whereas low motivated students were the contrary. These results support Author et al. (2006, 2007) finding that intrinsic motivation predicted students’ participation rate manifested by the posting numbers. This study provided further evidences that intrinsic motivation predicts not only students’ participation rate, but also their learning processes as indicated by the content analysis of their online discussion scripts. The results indicate perceived value was associated to information sharing interactions, whereas intrinsic motivation was associated to application and transfer. One step further, looking into the moderated discussion sessions, we found that perceived value and relatedness were related to students’ moderation behaviors. Moderators’ perceived competence seemed to be an importance factor that may predict students’ moderation behaviors at all different knowledge construction levels.

The study findings suggest that facilitating intrinsic motivation and perceived value should be considered in instructional design for online collaborative learning. Teachers should find ways to promote students’ intrinsic motivation. Literature suggests that purposeful CSCL design interventions (such as, creating optimal challenging tasks, enhancing belongingness of learning community, etc.) may increase students’ intrinsic motivation for learning (Raffini, 1996). The study finding also suggests that in order to promote interactions for knowledge application and transfer, teachers should help students to understand the true value of the online collaborative learning in order to initiate online interactions. This suggestion is similar to what Hakkarainen et al (1999) stated in their study that teachers could have a positive influence on students’ learning when they emphasize the inherent importance and value of the learning materials. According to SDT, three innate psychological needs are keys to promote intrinsic motivation (Ryan & Deci, 2000a). The study findings suggest that perceived competence is a crucial factor that impacted students’ online learning interaction as well as their moderation behaviors in collaborative learning. Therefore, instructional design for CSCL should find ways to promote students’ perceived competence in the learning activities. With higher perceived competence, students will not only show more willingness to share information with their peers and collaborate with others to elaborate on instructional tasks, but also show better performance in moderating online discussion. The findings also provide evidences that students’ perceived relatedness to their peers correlates with their contribution in online discussions. It is consistent with previous research studies that recommend teachers should foster the development of trust relationships among individuals in online collaborative learning (e.g., Cheung, et al, 2008; Hew & Hara, 2007).

It is important to note that no significant correlations were found between students’ intrinsic motivation and their moderation behaviors, which indicates that highly motivated students did not necessarily provide a better-quality moderation. One possible reason might be that students might not have had the adequate skills to facilitate a successful online discussion even when they were highly motivated. Therefore, instructional design for peer-moderated online discussions should consider developing students’ moderation skills. Many research studies suggest that purposeful training sessions before moderation activities, moderation guidelines, instructor’s modeling of moderation, or job aids should be considered to ensure successful online discussions (e.g., Hew & Cheung, 2008; Smet, Keer, & Valcke, 2008).
Besides knowledge construction, students also performed social interactions and reflective behaviors. Interestingly, social interactions had significant correlations with information sharing and allocentric elaboration behaviors. This finding supports Rovai’s (2007) argument that the social component of online interaction is vital for the success of online collaborative learning. Social interactions enable students’ feeling of social presence and enhance self-awareness and awareness of others in the learning community (Cutler, 1995). Previous research suggests social interactions increase students’ willingness to participate in collaborative knowledge constructions, such as sharing information and allocentric elaborations (Garrison & Anderson, 2003; Gunawardena & Zittle, 1997). The study also found that reflective interactions influenced students’ higher-level knowledge constructions. Reflective interaction can be viewed as a type of metacognitive behavior, namely self-awareness. Self-awareness is the awareness students have over their own cognitive activities (Schraw & Moshman, 1995). Many studies have documented that self-awareness promotes higher-level learning (e.g., critical thinking, knowledge transfer, etc.)(King, 1991; Zellermayer, et al., 1991). Kauffman et al. (2008) found that prompting online students with reflection prompts could be an effective technique for improving problem solving and achievement. To sum up this point, our findings suggest that although content-related knowledge constructions are important, students’ social interaction and reflective activities should not be ignored and discouraged because these interactions will facilitate content-related knowledge construction processes. As such, instructional design for online collaborative learning activities needs to improve social presence and promote metacognitive activities.

Our findings indicate that student-moderations were positively associated with peers’ lower-level knowledge construction whereas instructor-moderations predicted peers’ higher-level knowledge construction. It seems to indicate that students’ moderation are important to the initiation of online discussions, but their moderation might not lead to high-quality discussions without support from the instructor. This finding supports Rovai’s (2007) argument that instructors’ presence promoted students’ cognitive engagement. The study seems to indicate that moderators’ reflective comments might have had been served as reflective prompts that prompted students’ metacognitive behaviors. It is similar to the findings in Hakkarainen et al. (1999) that suggest teachers’ metacognitive-like participation in asynchronous online discussions guided the students toward deepening inquiry.

**Limitations of the study**

The present study has a number of limitations. This study was conducted in a particular educational setting with a small sample size, which might have impacted the power of the statistical analyses. Future research should use a larger sample size to see if similar findings can be replicated. This study used mainly a quantitative approach. In order to increase the validity of interpretation of the results, follow-up research could consider including interview data with students and instructors to study their perceptions of their learning processes in online collaborative learning. Despite these limitations, the present study revealed interesting findings on the impacts of intrinsic motivation on students’ participations and moderations in online collaborative learning activities. These findings draw practical implications in designing and facilitating successful online learning.

**References**


