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Higher-level knowledge construction in asynchronous online discussions: an analysis of group size, duration of online discussion, and student facilitation techniques

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Abstract This study is concerned with the challenge of understanding what factors may influence students' higher level knowledge construction. We defined higher level knowledge construction occurrences as the sum of the number of phases II to V measured using Gunawardena et al.'s (J Educ Comput Res 17(4):397–431, 1997) interaction analysis model. This paper is organized into two studies. In the first study, we examined the relationship between the frequency of higher level knowledge construction occurrences and group size, as well as the duration of the online discussion. Data were collected through online observations of 40 discussion forums. We found a significant positive relationship between group size and the frequency of higher level knowledge construction occurrences. However, there was no correlation between the duration of the online discussion and the frequency of such occurrences. In the second study, we examined the types of student facilitation techniques used. A further analysis of the data was conducted—of the 40 forums, 14 forums with higher incident rate of higher level knowledge construction occurrences were identified. Fourteen less frequent forums were then *randomly* chosen from the remaining forums. We found significant differences in the frequency of four student facilitation techniques employed between the more frequent group and the less frequent one. The results of this study suggest that using these four techniques more frequently may promote knowledge construction in asynchronous online discussions.

Keywords Asynchronous online discussion · Student facilitation · Knowledge construction · Group size

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Introduction

One of the many technological tools that have appeared in the educational landscape in recent years is the asynchronous online discussion forum. An asynchronous online discussion forum allows individuals to discuss issues or topics at any time and from any geographical locations. A discussion can provide the means for students to exchange ideas, explore dissonance of viewpoints, negotiate meanings, and construct knowledge with one another (De Laat and Lally 2003; Dunlap 2005).

In this paper, we adopted Gunawardena et al.'s (1997) interaction analysis model to code the levels of knowledge construction in an asynchronous online discussion environment. Lally (2001, p. 402) affirms that this particular model focuses on the "overall pattern of knowledge construction emerging from a conference, and is a relatively straightforward scheme." Knowledge construction, as espoused by Gunawardena et al. (1997) model, is based on the assumption that individuals engage in specific discourse activities and that these discourse activities are related to the *sharing* and *negotiation* of knowledge (Lally 2001; Schellens et al. 2005).

The kinds of knowledge being referred to by Gunawardena et al. (1997) include information, facts, specific examples or experiences, opinions, concepts, or ideas. Such a definition is consistent with the notion that emphasizes an applied, rather than a theoretical or philosophical orientation of knowledge (Hew and Hara 2007a, b); where knowledge is viewed as information possessed in the mind of individuals related to procedures, facts, concepts, ideas, or judgments that can help an individual take action (Alavi and Leidner 1999, 2001).

The types of discourse activities that individuals engage in may be represented by four phases (Gunawardena et al. 1997): phase I—sharing and comparing information (which includes observations, opinions, statements of agreement, and identifications of problems); phase II—discovering dissonance or inconsistency of ideas, concepts, or statements; phase III—negotiation of ideas, and suggesting new construction on issues where conflict exists; phase IV—testing of proposed synthesis or co-construction against existing cognitive schema, personal experiences, or literature; and phase V—statements of agreement or application of newly constructed meaning or ideas. This final phase might consist of summarizing agreements, applications of new knowledge, and students' self-reflective statement(s) that illustrate their knowledge or opinions have changed as a result of the online discussion interaction.

Past empirical research has found that students' discussions in online forums are often limited (Liu et al. 2008). Cheung and Hew (2005), for example, found that students were more interested in merely voicing their opinions to their classmates' queries—what Gunawardena et al. (1997) referred to as predominantly phase I level of knowledge construction (sharing of information). Consequently, the discussion appeared to resemble a mere question and answer session where students simply answered their course mates' online queries, rather than moving onto higher-level knowledge construction such as phases II–V (Cheung and Hew 2006).

Apparently, this is not an isolated phenomenon (Kanuka and Anderson 1998; McLoughlin and Luca 2000). For example, Gunawardena et al.'s (1997) study obtained a result of 93, 2.4, 1.9, 1, and 1.9% from phase I to V respectively. Chai and Khine (2006) also used Gunawardena et al.'s model and reported a distribution of 60, 20, 13, 4, and 3% from phase I to V respectively. Schellens and Valcke (2005) similarly found a distribution of 52, 14, 33, 1.2, and 0.4% from phase I to V respectively. The results of previous studies therefore suggested that higher levels of knowledge construction such as phases II–V are

difficult to achieve (Chai and Khine 2006; Cheung and Hew 2005; Gunawardena et al. 1997; Kanuka and Anderson 1998; McLoughlin and Luca 2000; Schellens and Valcke 2005).

This rest of the article is organized as follows. First, in the literature review section, we describe some of the past research on student knowledge construction in asynchronous online discussions, followed by an overview of several knowledge gaps. We then describe the methodology of the current study, including a description of how we selected the 40 discussion forums. This is followed by the discussions and conclusions of the study.

Literature review

Past research conducted to understand what factors may influence student knowledge construction, specifically in promoting higher levels of construction (i.e., phases II–V), has taken a number of different paths. These paths may be parsimoniously classified into one of the following three different categories: (a) students' learning styles, (b) the design of the discussion task or activity, and (c) facilitation roles or techniques. One strand of research focuses on the effects of students' learning styles on their levels of knowledge construction. For example, Schellens et al. (2005) used the Approaches and Study Skills Inventory for students to gather information about their learning styles (Entwistle et al. 2000). The researchers found that students with deep or strategic learning styles (e.g., seeking meaning, relating ideas, use of evidence, interest in ideas) did not obtain significantly higher levels of knowledge construction (measured using Gunawardena et al.'s (1997) interaction analysis model) as compared to students with surface approaches (e.g., lack of purpose, unrelated memorizing, syllabus-boundness, fear of failure).

The design of the discussion task or assignment that students have to complete may also influence the levels of knowledge construction. Schellens et al. (2005) found that when the discussion tasks were too complex, the levels of knowledge construction were significantly lower. The researchers posit that too much complexity (e.g., when the conceptual base of a particular topic or issue is not completely available or made clear to students, or using a foreign language such as English to present information to students who are unfamiliar with the language) could make students feel insecure and lose track of the objective of the discussion. To circumvent this, Schellens et al. (2005) suggested that the task or assignment should be matched to the available knowledge and skills of students. In addition, the researchers suggested that it is important to design tasks which leave enough room for discussion.

Other researchers suggest that facilitation may also be viewed as another plausible factor that could affect students' knowledge construction in an asynchronous online discussion forum, as facilitators are instrumental in shaping or influencing the discourse. Previous research studies on facilitation in asynchronous online discussions have largely focused on the techniques used by tutors or instructors. For example, students were assigned certain roles as determined by the instructor such as theoretician, summarizer, and source searcher (Schellens et al. 2005). The theoretician had to make sure that all appropriate theories were considered when tackling a task, and to indicate which theoretical knowledge was lacking. The role of the summarizer was to summarize participants' contributions in the discussion groups, indicate different points of view and to make some provisional conclusions. The source searcher, on the other hand, looked for additional sources and information so that participants were prompted to look further than the content of the available course. While the results of the study indicated that there was no significant

overall difference in participants' mean levels of knowledge construction between the role and no role condition, additional analyses revealed that assigning students the role of summarizer resulted in higher levels of knowledge construction. In another study, Lu and Jeng (2006) noted that some of the facilitation techniques used by instructors which are useful in enhancing knowledge construction include identifying areas of agreement/disagreement, seeking to reach consensus/understanding, encouraging, acknowledging, or reinforcing student contributions, focusing the discussion on specific issues, confirming understanding through assessment and explanatory feedback, and diagnosing misconceptions.

Knowledge gap

Thanks to the aforementioned research studies, instructors and researchers now have a better sense of how knowledge construction may be influenced by factors such as students' learning styles, students' epistemological beliefs, the design of the discussion activity, and instructors' facilitation techniques. Yet, some gaps still remain.

First, it is important to note that not all researchers agree that an instructor should facilitate the online discussion. Fauske and Wade (2003–2004), for example, found that some students did not want the instructor to be involved in the online discussion. Students felt that the instructor's involvement could be oppressive to certain students and ideas. Mazzolini and Maddison (2003) similarly noted that some facilitation techniques used by the instructor, such as questioning, is more likely viewed by students as a form of assessment, which makes students hesitant in voicing their opinions. As a result, some researchers (e.g., Poole 2000) have suggested the possibility that students should facilitate their own discussions. Hew et al. (2009) posited that student-facilitation is different from instructor-facilitation. Specifically, student-facilitation is based on lateral relationships (peer-to-peer) while instructor-facilitation is typically seen as a hierarchical relationship (e.g., expert-novice). Due to this expert-novice relationship, an instructor's postings can prevent students from engaging in further debate or negotiation of ideas as students think that the instructor's note must be the final authoritative one (Zhao and McDougall 2005).

This study is concerned with the challenge of understanding what may influence higher levels of student knowledge construction, but it explores the problem from a different angle. Rather than looking at the problem from the perspective of an instructor's facilitation techniques, the current study focuses on how and why student facilitation may influence knowledge construction in online discussion forums. In our current study, each discussion forum was completely student facilitated. The instructor merely created the empty forum shells; how the discussion started and evolved in the forums depended on the student facilitators. Each discussion forum was facilitated by one student facilitator. The student facilitators were largely instrumental in shaping or influencing the online discourse.

Hitherto, not many studies have investigated student facilitation in online discussion (Hew and Cheung 2008). Furthermore, the extant research on student facilitation is limited in two ways. First, the exact facilitation techniques were typically not delineated clearly (Hew and Cheung 2008). For example, in Cifuentes et al. (1997) study, students facilitated online discussions by employing intellectual, social, and organizational roles or techniques; however these roles were not clearly described. Second, although Hew and Cheung (2008) examined student facilitation techniques in online discussions, their investigation was limited to depth of discussion threads (i.e., threads that had six or more levels of

message postings). The influence of student facilitation techniques (if any) upon knowledge construction in online discussions was not explored.

Second, what relationships (if any) might exist between the frequency of higher level knowledge construction occurrences and group size, as well as the duration of the online discussions? Previous studies have examined possible factors, such as task design, and the amount of facilitator involvement. As far as we know, factors such as the duration of the discussion, and group size were not explored. The current study is significant because it uses a large data set to empirically examine these relationships.

Third, prior studies that examined student knowledge construction in online discussions have by and large represented experiences in western countries (e.g., Gunawardena et al. 1997; Kanuka and Anderson 1998; McLoughlin and Luca 2000; Schellens and Valcke 2005). Studies that involved participants from other countries were few in comparison. There is a need to investigate other contexts in order to better understand and appreciate the different possible factors that may influence higher levels of knowledge construction in online discussions.

Research questions

The current study attempts to redress the aforementioned gaps. The questions studied were:

(1) Is there a relationship between group size and the frequency of higher level knowledge construction occurrences? (Please refer to page 12 on how we defined group size and the frequency of higher level knowledge construction occurrences).
(2) Is there a relationship between the duration of the online discussion and the frequency of higher level knowledge construction occurrences? (Please refer to page 12 on how we defined duration of online discussion).
(3) Are there any differences between forums that have more higher levels of knowledge construction occurrences and those that do not in terms of the types of facilitation techniques used, as well as the frequency in which the techniques were employed?

Study one: examining plausible relationships

To investigate the plausible relationships between the frequency higher level knowledge construction occurrences and group size, as well as the duration of the online discussions, a total of 40 discussion forums were selected for the study. These forums came from three courses conducted at an Asia-Pacific university: course A (January 2007 semester, graduate level such as students pursuing a Master or doctoral degree) with 12 forums, course B (January 2006 semester, non-graduate level such as students pursuing a diploma certification) with 12 forums, and course C (July 2005 semester, non-graduate level) with 16 forums. There were a total of 50 students in these three courses. All courses involved both face-to-face and asynchronous online discussion sections, and dealt with the study of using technology in education. Although the 40 forums came from different courses, they met the following five criteria, as employed by Hew and Cheung (2009).

First, as previously mentioned, each discussion forum was completely student facilitated. Each discussion forum was facilitated by one student facilitator. The student facilitators were largely instrumental in shaping or influencing the discourse.

Second, each discussion forum used the same software—which, in this case, was BlackBoard™ as its discussion environment. All the students were familiar with the features of BlackBoard™. BlackBoard™ offers a threaded asynchronous online discussion tool that keeps logs of student activity. Our decision to use a threaded tool was informed by the literature. Kear (2001), for example, investigated students' discussion in two different conferencing systems; one with messages shown as a list of message headers, the other a graphical display with threading links (somewhat similar to that in BlackBoard™). The results of the study indicated that it is important to have a threaded discussion tool which offers a good visual representation of the relationships between messages. Such a graphical thread display helps users to see how different messages fit together and which messages are linked (Kear 2001). This allows participants of the asynchronous online discussion to easier concentrate on the content of the messages. BlackBoard™ was used in this study because it met this technical requirement of having a graphical thread display.

Third, the same instructor was overall responsible for the 40 forums. This was to minimize the risk of confounding variables due to the possibility of different online participation guidelines employed by different instructors. Prior to the actual discussions, the instructor shared certain expectations of desired online behavior such as no posting of personal insults or remarks, and no vulgarities in the discussions.

Fourth, all participants in the online discussions, including the student facilitators, were education major students. This was to minimize the risk of possible confounding variable due to the involvement of students from other disciplines areas (e.g., non-education type class). For example, the contribution rate of non-education major (e.g., math) students may be different than that of education major students.

Finally, the selected discussion forums were ones that had an ill-structured problem solving, specifically design task, as their discussion activities. The purpose of this criterion was to ensure that all forums shared a similar activity or task, so that the influence of group size and duration of the online discussion on knowledge construction (if any) would be easier to identify. The conceptual knowledge base of the design topic (e.g., principles of instructional design) was made clear to students prior to the actual online discussion. Students in these forums were engaged in designing instructional materials for use in the schools or training institutes (e.g., a web-based instructional activity on the subtraction of whole numbers for grade two children). Students utilized the discussion forums to identify and determine the nature of the problems or issues related to their peers' projects, give comments or develop viable solutions for improvements, and respond (e.g., agree or disagree accompanied by justifications or reasons) to the comments raised. This setting might be described as a problem based learning environment (Savin-Baden and Gibbon 2006).

Our decision to incorporate ill-structured problem solving into the online discussions was also informed by the literature. Ill-structured problem tasks or situations are complex, poorly defined, and open-ended with no right answer (Savin-Baden and Gibbon 2006; Jonassen 1997). The goals associated with addressing these tasks can change from circumstance to circumstance and they are often vague or unstated (Voss 1988; Voss and Post 1988). Ill-structured tasks may have multiple solutions or no solution at all, and may possess multiple criteria in evaluating their outcome (Kitchner 1983). They usually require learners to negotiate issues and meanings (Jonassen 1997; Meacham and Emont 1989), unlike well-defined tasks. There is therefore a need to incorporate ill-structured problem solving tasks in asynchronous discussion because well-defined ones do not satisfy the need for discussion. This is because well-defined tasks such as text-book exercises are problems that called only for a single, fact-based answer; hence after one student responds correctly there is really no need for further discussion (Dennen 2005).

Students in the discussion forums were given course credits for their participation in the online discussions, since the discussions were an integral part of the courses. Credits were given on the number of postings made in the discussions. Although students were given some credits for participation, they had the freedom of choice to contribute in whichever discussion forum they wished. No number of posting quota and discussion deadline were imposed. Group sizes, excluding the student facilitators, ranged from 2 to 10. The duration of the online discussions ranged from 6 to 41 days.

Data collection and analysis

Data were collected through online observations of the 40 discussion forums. According to Foster (1996), the advantages of observation are that (a) information about behavior is recorded directly without having to rely on retrospective or anticipatory accounts of others; (b) patterns and regularities in the environment can be recorded and analyzed over time; and (c) access to information can be obtained about people who are busy, deviant or hostile to taking part in research (p. 58). In this study, online observation was suitable because the students' discussions took place online. The term "online observation" is adapted from the works of Mann and Stewart (2000), who argued that qualitative researchers can observe participants' behavior in various types of computer-mediated communication usage, including both asynchronous and synchronous environments. In this study, the online discussions of student facilitators and participants were observed in order to examine the exhibited levels of knowledge construction (i.e., phases I, II, III, IV, V) (Gunawardena et al. 1997), group sizes, and the duration of the online discussions.

The unit of analysis was the individual idea or theme communicated by the participants (including student facilitators). Using this unit is consistent with Lincoln and Guba's (1985) suggestion that a unit of analysis should be heuristic and able to stand by itself, as well as Merriam's (2001) recommendation that communication of meaning should be a unit's main focus. An independent coder coded the entire participants' postings for knowledge construction using Gunawardena et al.'s (1997) scheme independently. The independent coder was not involved in the study and did not know the identity of the student facilitators. In order to determine the consistency of the analysis, the first author independently coded approximately 10% (randomly selected) of the participants' postings. The inter-coder reliability of the coding was 93%. The following paragraphs illustrate the various phases with one or more representative excerpts from the raw data:

(a) Phase I—for example, "The rewards are based on a list of rubrics in the XXX leadership competency model; in this case, the conceptual thinking competency, development competency, and social competency."
(b) Phase II—for example, "One way as you have suggested is through before-and-after surveys. However, I disagree with this idea. I personally prefer the idea of reflection through journaling and for each participant to share their reflections in a weekly sharing due to the following reasons…"
(c) Phase III—for example, "After hearing from you, I am re-considering my choice of the color of the text and background. You are correct to say that the text color for the left frame [consisting of navigation links] does not stand out from the blue background. I'm thinking one way is to have the text in white as you have suggested, while upon mouse over, to have the text color change to yellow."

(d) Phase IV—for example, "Your proposed idea of assessing whether students change their thinking after a short duration of discussion may not hold water. In a study conducted by Goh et al. (2006), students were introduced to a 10-h moral philosophy course with the purpose of developing critical thinking ability. But there was no significant improvement in this ability after the course. The researchers postulated that critical thinking skills do not come overnight."
(e) Phase V—for example, "I have certainly learned a lot more in these past two weeks about assessing critical thinking than I had over the previous year. From what we have discussed, it now seemed clearer to me that online discussion is a very useful platform for learning especially for an adult (read *–mature*) learning environment. And that online discussion comes with inherent limitations. From here, I can perhaps conclude that using online discussion as part of the overall strategy which includes a face-to-face approach would be really ideal…"

To answer the two questions—Is there a relationship between group size and the frequency of higher level knowledge construction occurrences? Also, is there a relationship between the duration of the online discussion and the frequency of such occurrences?—we used the Pearson product-moment correlation coefficient. We referred the group size of an online discussion to the number of students (excluding the student facilitator) who made postings in the discussion. We referred the duration of the online discussion to the period (in number of days) between the first and the final messages posted in the discussion. For example, we deemed the duration of an online discussion to be 19 days if the first and final postings were made on October 1, 2007 and October 20, 2007 respectively. We referred the frequency of higher level knowledge construction occurrences to the sum of the number of phases II, III, IV, and V occurrences. For example, if a forum had the following distribution of knowledge construction occurrences: 12, 3, 1, 3 from phase II to V respectively, the frequency of higher level knowledge construction occurrences would be 19.

Results

Table 1 displays the results of the relationship analyses. We observe from Table 1, a significant positive correlation ($r = 0.473$, $P = 0.002$) between group size and the frequency of higher level knowledge construction occurrences. This suggests that more higher-level knowledge constructions (phases II–V) tend to occur in forums that have larger number of participants who made postings in the discussion. Incidentally, we observe a significant positive correlation ($r = 0.422$, $P = 0.007$) between group size and the duration of the online discussion. On the other hand, a comparison of the duration of the online discussion and the frequency of higher level knowledge construction occurrences failed to find a significant correlation ($r = 0.192$, $P = 0.235$).

Table 1 Summary of relationship analyses ($n = 40$ forums)

	Number of phases II–V	Group size	Duration of discussion
Number of phases II–V	–	0.473**	0.192
Group size		–	0.422*

** Correlation is significant at the 0.01 level (2-tailed)

Study two: examining facilitation techniques

In Study One, we held constant a number of variables in our investigation of plausible relationships. These variables included the use of the same discussion software (i.e., BlackBoard^{TM}), same instructor, same discipline of study (i.e., education), discussions that were student facilitated, and same discussion activity (i.e., ill-structured design task). We found a significant positive relationship between group size and the number of higher level knowledge construction occurrences. However, there was no relationship between the duration of the online discussion and the frequency of such occurrences.

In Study Two, a further analysis of the data was carried out to examine the types of student facilitation techniques used. As previously mentioned, although students were given some credits for participation, they had the freedom of choice to contribute in whichever discussion forum they wished. Because facilitators are instrumental in shaping or influencing the discourse in a forum, we hypothesized that discussion forums which had *more* number of higher level knowledge construction occurrences might differ in the *types*, as well as the *frequency* of facilitation techniques employed by the student facilitators when compared to forums that had *less* number of such knowledge construction occurrences. As the mean number of phases II–V knowledge construction occurrences for the entire 40 forums was 7.86, we deemed forums with eight or more phases II–V as the more frequent groups. Fourteen such groups were found. Fourteen less frequent forums were then *randomly* chosen from the remaining forums. These were referred to as the less frequent groups.

Because of the relatively small samples sizes ($n = 14$ forums in each group), and the lack of homogeneity of variance, nonparametric statistical tests were used (Goldberg and Podell 2000). The differences in these two independent groups were analyzed using the Mann–Whitney (M–W) *U*-test (two-tailed). Results of a Mann–Whitney (M–W) *U*-test confirmed that the number of higher level knowledge construction occurrences was significantly higher in the more frequent group compared to the less frequent one with mean scores of $M = 14.50$; $SD = 7.552$ versus $M = 3.36$; $SD = 2.061$, respectively (M–W *U*-test $z = -4.545$, $P = 0.000$), with an effect size of 2.09 (Cohen, 1988).

Data collection and analysis

We used Hew and Cheung's (2008) framework of peer facilitation techniques to guide our initial analysis and coding. This particular framework was developed using the grounded approach or constant-comparative method (Lincoln and Guba 1985) to build emergent and initial data categories of facilitation techniques. Specifically, the framework consists of seven peer facilitation techniques: (a) giving or providing personal opinions about an issue or topic, (b) asking for other people's opinions about an issue, or for clarification of an idea or opinion, (c) setting ground rules or expectations of desired online behaviour, (d) showing appreciation to other people for their posting, (e) suggesting a new or different area for potential discussion, (f) encouraging specific people by name to post, and (g) summarizing what has been discussed so far (Hew and Cheung 2008).

Although Hew and Cheung's framework was used a priori, we did not forcefully impose any of the coding categories onto our data corpus. During the course of our analysis, we also allowed for new facilitation technique categories (if any) to emerge inductively during the coding process. We continued to move back and forth among our data sets to discover new codes until each type of facilitation technique category was saturated—that is, until

new data began to confirm rather than shed new light on the facilitation categories (Lincoln and Guba 1985).

Through this process of constant comparison, we found six main facilitation techniques employed by the student facilitators in our study. We also modified Hew and Cheung's category of "specifically encouraging particular people to post" (p. 1118) to "encouraging people to post" because we felt that the latter can include both particular individuals as well as other individuals at large to contribute in the discussions. The six main facilitation techniques are as follows:

(a) Giving comments or opinions about an issue or topic. For example, "120 members is the present class or course size. The CTM group size of 6 is based on the existing and recommended grouping for the execution of the Conceptual Thinking Methodology. The participants of each group are selected on a random basis".
(b) Asking questions. For example, "I personally like the idea of reflection through journaling and for each participant to share their reflections in a weekly sharing. I found this to be more effective than surveys in my previous two courses. What about the rest of you?" "Can you clarify what you mean by saying 'this web-based activity is just a small activity, there's no need for a parent's letter'?"
(c) Setting ground rules for online discussion. For example, "I just want to remind everyone of some ground rules during the discussion…[e.g.] no personal attacks (be gentle with your words), reply within 48 h."
(d) Showing appreciation for some action. For example, "Thanks for pointing out that part for me".
(e) Encouraging people to contribute. For example, "Right now, it's only a few hours before the discussion is closed. Do feel free to contribute suggestions, opinions before then."
(f) Summarizing what has been discussed so far. For example, "Here's a summary of the discussion so far…(1) inclusion of pre-activity before the actual one, (2) clarification of instructions…"

An independent coder coded the entire student facilitators' postings independently. In order to determine the consistency of the analysis, the first author independently coded approximately 10% (randomly selected) of the student facilitators' postings. The inter-coder reliability of the coding was 90%.

In addition, convenience sampling was used to obtain individuals from both the more frequent and less frequent groups to write their reflections at the end of the discussions. For instance, they were asked to provide general comments on the use of asynchronous online discussion (e.g., advantages and disadvantages), share what they had learned when they facilitated their own discussion forums, state the types of facilitation techniques they used in the discussions and why they applied them, or describe reasons as to why they chose to take part in the discussions. Sixteen individuals wrote their reflections.

Convenience sampling was also used to obtain interviewees for the interviews. Eleven individuals volunteered to be interviewed. The interviews were conducted face-to-face and took about 30 min for each person. During the interviews, the interviewees were asked to elaborate on the facilitation techniques used, and how these techniques might influence the online discussions. After the interviews were completed, member checking was conducted to check the validity of the data. The interviewees were asked to review the interview data, and indicate any places where they disagreed. Corrections to the data were then made. This served to provide descriptive validity, ensuring that the interviewees agreed that the interview data accurately capture their opinions (Maxwell 1992).

Results

Table 2 shows the types of facilitation techniques used in both the more frequent and less frequent groups. Overall, our investigation showed that all six types of facilitation techniques were employed in both groups. It can be seen that many student facilitators, both in the more frequent group and the less frequent group, used *multiple* rather than single techniques to facilitate their discussions. By multiple, we mean the different possible *combinations* of techniques that may be employed by the facilitators. It is, of course, not unusual for individuals to have more than one single technique to facilitate the online discussion. Within the more frequent group, the most common combination of student facilitation techniques was providing own comments, asking questions, showing appreciation, and encouraging contribution. This particular combination was also found in the less frequent group.

The frequencies of the facilitation techniques used in these two independent groups were analyzed using the Mann–Whitney (M–W) *U*-test. We found statistical significant differences at the 0.05 level of significance in the frequency of four peer facilitation techniques between the more frequent group and the less frequent group (see Table 3).

(1) Providing own opinions or experiences (M–W *U*-test $z = -3.001$, $P = 0.003$, $d = 1.47$).
(2) Showing appreciation (M–W *U*-test $z = -2.920$, $P = 0.004$, $d = 1.39$).
(3) Encouraging people to contribute (M–W *U*-test $z = -2.215$, $P = 0.027$, $d = 0.75$).
(4) Summarizing (M–W *U*-test $z = -2.377$, $P = 0.017$, $d = 0.91$).

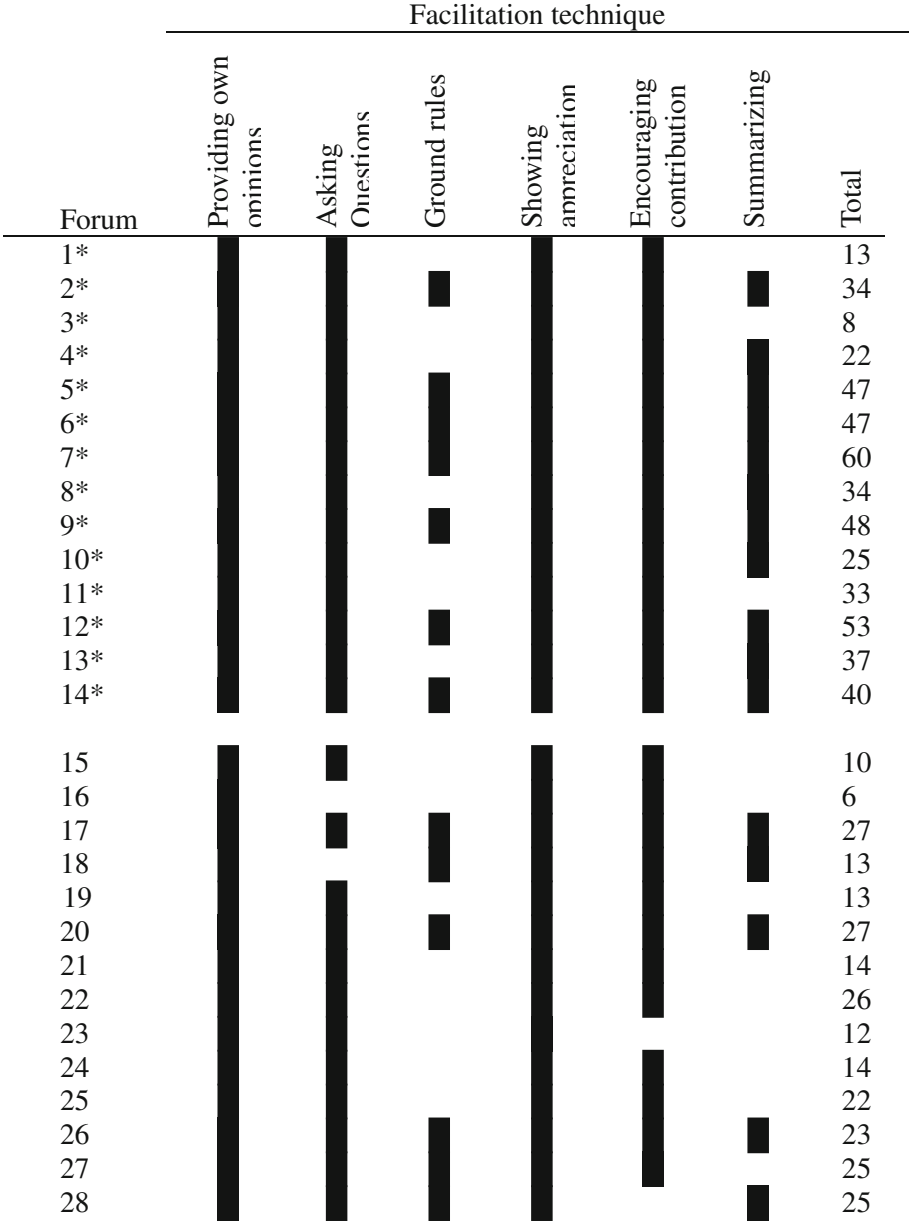
No significant differences were observed in the frequency of two techniques between the two groups: setting ground rules (M–W *U*-test $z = -0.372$, $P = 0.710$), and asking questions (M–W *U*-test $z = 1.846$, $P = 0.065$).

Discussion and conclusion

Many instructors and facilitators of online learning desire their students to explore dissonance of ideas, and negotiate meaning in online discussions. However, this is easier said than done because student discussion in online forums often appears to be limited to the sharing of information (phase I of Gunawardena et al.'s 1997 model) which seems to merely resemble a question and answer session where students simply answered their classmates' questions. This study is concerned with the challenge of understanding what may promote higher level knowledge construction, specifically phases II to V in student-facilitated online discussion forums. In this section, we discuss some of the results that were surfaced in the study. We conclude by highlighting a limitation of the current study, and proposing several research directions that could help advance the knowledge base on knowledge construction in asynchronous online discussions.

Results of our investigation suggested that group size was positively related to the frequency of higher level knowledge construction occurrences. On the other hand, the correlation results between the duration of the online discussion and the number of higher level knowledge construction occurrences are somewhat counterintuitive. Originally, other scholars have posited that time is an important factor for higher level knowledge construction discourse to be formed (e.g., Chai and Khine 2006). However, our empirical results suggested otherwise. We found that a longer duration of online discussion did not necessary result in more number of phases II–V instances. Although the precise reason for

Table 2 Types of facilitation techniques



Note: * Forums having more higher-level (phases II–V) knowledge construction occurrences. A black box indicates that a particular facilitation technique was found at least once in the specific discussion forum

Table 3 Summary of statistical results

Facilitation technique	Less frequent group		More frequent group		Mann–Whitney *U z* scores	*P* (two-tailed)
	Mean	SD	Mean	SD		
Providing own opinions	7.14	2.852	13.14	5.275	−3.001	0.003*
Asking questions	4.29	3.292	6.93	3.912	−1.846	0.065
Setting ground rules	0.43	0.514	0.50	0.519	−0.372	0.710
Showing appreciation	4.43	2.563	9.14	4.258	−2.920	0.004*
Encouraging contribution	1.64	1.737	3.29	2.701	−2.215	0.027*
Summarizing	0.43	0.646	2.07	2.556	−2.377	0.017*

* $P < 0.05$

this is currently unclear, we posit that this disparity could be due to the complex interplay of other factors such as facilitation techniques.

We found that many student facilitators, both in the more frequent group and the less frequent group, used multiple, rather than singular techniques to facilitate their discussions. Overall, our investigation indicated that six types of student facilitation techniques were used in both groups. Moreover, the most common pattern of facilitation techniques employed was similar in both the more frequent and less frequent groups—providing own opinions or experiences, asking questions, and showing appreciation. Despite the fact that the *types* of facilitation techniques used were similar in both the more frequent and less frequent groups, the *frequency* in which they were employed were different. Results of the Mann–Whitney–Wilcoxon test revealed that four techniques were used significantly more in the more frequent group. These four techniques include giving comments or opinions, showing appreciation, encouraging people to contribute, and summarizing. Our finding thus infers that student facilitators who use these techniques more frequently may promote higher level knowledge construction in online discussions.

At this juncture, it is important to highlight one possible confounding variable in our examination of the more frequent and less frequent groups; which was the academic level of the participants in the discussion forums. Ten of the 28 discussion forums involved graduate students (e.g., students pursuing a Master degree), while the rest involved non-graduate students (e.g., students pursuing a diploma certification). Although all the participants were education major students, it was possible that graduate students were more likely to reach higher-levels of knowledge construction. To examine whether this was indeed true, we conducted an additional analysis of our data. Results of a Mann–Whitney (M–W) *U*-test suggested that there was no significant difference between forums involving graduate students and forums involving non-graduate students in terms of the number of phases II–V occurrences ($M = 9.00$; $SD = 8.576$ vs. $M = 8.89$; $SD = 7.684$ respectively, M–W *U*-test $z = -0.145$, $P = 0.885$).

This therefore brings us to the question: "Why does using these four facilitation techniques more frequently appear to promote students' higher-level knowledge construction?" First, we posit that the facilitation technique of "providing own comments or opinions" may help foster higher-level knowledge constructions in two specific ways. First, it helps keep the discussion alive as highlighted by the following remark found in a participant's reflection log:

Due to the lack of physical interactions [since the online discussion is based on text communication], members' participation may wane during the discussion. It is important

[for the student facilitator] to keep spirits up and encourage discussion from other students by agreeing or disagreeing with their points or sharing personal opinions.

Although we acknowledge that the activity of keeping a discussion going per se may not directly guarantee that higher-level knowledge constructions would occur, we believe that it is a necessary, if not sufficient, condition for higher-level constructions to take place. If students' participation in an online discussion wane and eventually cease, the results would be drastic: no higher-level constructions can occur at all.

Second, providing own comments or opinions may serve as a starting point to help students in an online discussion move forward to higher-levels of knowledge construction. We concur with Schellens et al. (2005) who suggested that individuals need a certain amount of such postings before they can move forward to the higher levels of knowledge construction. Schellens et al. (2005) stressed that a certain number of comments or opinions-related postings are necessary in order to function as a starting point to ground the rest of the online discussion. However, what exactly this number is cannot be ascertained based on the current findings. Future research could be carried out to investigate this issue.

One barrier to higher-level knowledge construction is that participants are afraid or hesitant to question or challenge other people's ideas because it may be perceived as being confrontational (Chai and Khine 2006; Liu et al. 2008). Students who wish to challenge other participants' viewpoints may be afraid that their postings be taken negatively by the party that is being challenged which could lead to conflicts—hence they hold back their postings. We, therefore, posit that the use of the facilitation techniques "showing appreciation" and "encouraging people to contribute" can foster higher-level knowledge constructions because they could help potential student contributors overcome their fear of having their opinions being taken negatively by other students. Specifically, when facilitators showed appreciation or encouraged people to contribute, the other students felt that the facilitators were open to receiving their opinions (i.e., being open-minded), which may include accepting dissenting viewpoints. An open environment can help reduce the possibility that a contributor's personal self-image is being threatened because attacks on a contributor's comments or opinions, which are typically viewed as attacks on the individual itself and destroys further contribution, are minimized (Hew and Hara 2007a, b; Wasko and Faraj 2000). This makes contributors feel that they were worthy contributors. For example, one student wrote in her reflection log: "Acknowledging participants' contribution aids in encouraging discussions because it ensures that the participants of the forum obtain the satisfaction that their views have been taken note of and this encourages further contribution of opinions". One student remarked in the interview: "It [being open to receiving comments or opinions] definitely helps people discover dissonance and negotiate differing viewpoints. A facilitator who is open shows that he is willing to accept different viewpoints, hence making people less fearful in contributing their ideas."

Nevertheless, it is interesting to learn from the interviews with some students that although the technique of showing appreciation was a useful motivator for some students, it did not work for others; specifically, if the acknowledgement appeared to be insincere. For example, one student elaborated:

Some facilitators merely said 'thank you' or 'thank you for your postings' to every student who contributed. They did not further elaborate how and why the contributions were useful to them. Such forms of appreciation seemed to be a mere formality or lip service to me rather than a sincere gesture.

Another student explained, "To me, a mere thank you does not really convince me that the other person really reads my contributions. Hence, I'm reluctant to contribute [my viewpoints] further."

The technique of summarizing what has been discussed thus far may help achieve higher-levels of knowledge construction because the summarizers know that they have to identify the different opinions, describe which of the contributions hold similar points of view, as well as indicate contradictions and make some provisional conclusions (Schellens et al. 2005). Such tasks or activities directly relate to higher-levels phases such as phase II and III.

It may be useful to consider why the other two facilitation techniques, "asking questions", and "setting ground rules" were not surfaced as possible factors that may promote higher knowledge construction levels. We conducted an additional analysis of the types of questions used. We found two main types—questions of clarification and questions about viewpoints. Respective examples of clarification and viewpoints questions include "Can you clarify what you mean by saying 'this web-based activity is just a small activity, there's no need for a parent's letter'?" and "I personally like the idea of reflection through journaling and for each participant to share their reflections in a weekly sharing. What about the rest of you?" respectively. The responses to these questions tend to exemplify the types of discourse or statement typically seen in phase I level of knowledge construction (Gunawardena et al. 1997).

Setting ground rules for online discussion was not found to be a possible factor that may promote higher knowledge construction levels, probably because students were already familiar with the proper etiquettes of online communication. For example, one student explained, "I've already known that I should reply to someone as quick as possible, preferably within 24 h. Setting such ground rules therefore did not really motivate me [to voice my comments or opinions] as I'm already doing it."

Limitation and future research

While the current study examines factors such as group size, duration of online discussions, and student facilitation techniques that might contribute to higher-level knowledge construction (phases II–V), the transferability of the results is limited and should be viewed with caution. In this study, the research sample consisted of higher education students majoring in education courses in an Asia-Pacific country. Our use of convenience samples should not be seen as representing the entire population of students. It cannot be assumed that the discussion forums examined in the current study are representative of any other forum involving other students. Thus future research is needed to examine whether the present results can be confirmed when involving other types of students and when set up in different educational contexts (e.g., in elementary or primary school level).

Notwithstanding the reported limitation and the fact that further research is called for, we believed we have been able to contribute to a better understanding of what may influence higher level knowledge construction, specifically phases II to V which are beyond the mere phase of information sharing (phase I). Perhaps the overall strength of this study lies in the fact that student facilitation of online discussions was considered. Student facilitation of online discussions in terms of knowledge construction has, hitherto, received considerably less attention in previous studies as compared to tutor or instructor facilitation. Overall, our results suggest that student facilitators who use certain techniques (e.g., giving comments or opinions, showing appreciation, encouraging people to contribute, and summarizing) more frequently may promote higher level knowledge construction in online discussions. The current study is also significant because it empirically examined the relationships between the frequency of higher level knowledge construction occurrences

between the duration of the online discussion and group size. Given the importance of discussions in online learning contexts, we hope that our findings will be useful to other researchers and educators similarly engaged in efforts to enrich our collective understanding regarding student knowledge construction in online discussions.

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