J Comput High Educ (2018) 30:489–509
https://doi.org/10.1007/s12528-018-9180-6

Facilitating critical thinking in asynchronous online discussion: comparison between peer- and instructor-redirection

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Published online: 9 April 2018

Abstract The purpose of this paper is to explore and compare learners' critical thinking and interaction during an asynchronous online discussion when peer- or instructor-facilitation was provided. Current literature on online discussion reveals a controversy between peer facilitation and instructor facilitation regarding their strengths and weaknesses. However, the effect of peer-facilitation on critical thinking learning outcome has not been clearly discussed. Situated in a graduate-level program evaluation course, the learners engaged in a debate using a scenario-based case on ethical decision-making. A content analysis of discussion using the Cognitive Presence framework and a social network analysis revealed a significant difference between peer-redirected group and instructor-redirected group in their cognitive presence as well as in interaction dynamic upon receiving the redirection message. Based on findings regarding cognitive presence level, interaction dynamic and perspective change on the debate topic in each group, a peer-facilitation approach is more effective for fostering critical thinking and collaborative discourse.

Keywords Asynchronous online discussion · Critical thinking · Facilitation strategies · Interaction dynamic

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Introduction

For the past few decades, researchers and instructors have explored different instructional strategies to maximize the quality of online learning experiences for adult learners. Amongst various strategies, asynchronous online discussion is a commonly used approach. Asynchronous online discussion can resolve a potential interaction deficiency among learners and instructors due to physical separation as well as becomes an important means to facilitate the social construction of knowledge through peer interactions. Participating in asynchronous online discussions can encourage learners to engage more with the course content, seek various resources related to group discussions, and share diverse perspectives and expertise with peers. Also, discussion activities could facilitate a perceived sense of community in online learning environments.

One important pedagogical benefit of online discussion is promoting learners' critical thinking (Baran and Correria 2009). Regardless of discipline or industry, critical thinking is one of the most essential twenty first century skills to achieve professional success. Critical thinking skills involve reflective and purposive judgments (Facione et al. 2000), facilitating substantiated reasoning and effective problem-solving activities (Yang et al. 2011). Online discussion can serve as a platform where learners engage in critical discourse by demonstrating higher-order thinking skills such as analysis, synthesis, and evaluation.

However, neither all learners' participation and interaction spontaneously exhibit in-depth reflection and critical reasoning, nor does active interaction in asynchronous online discussion activities necessarily elicit a meaningful social construction of knowledge (Akyol and Garrison 2011; Darabi and Jin 2013; Dennen and Wieland 2007; Garrison et al. 2001; Hew et al. 2010). With conventional discussion methods (e.g., asking probing questions) students often engage in surface-level thinking in discussions by displaying agreement without substantiation, exchanging information, or exploring ideas without further synthesis (Darabi et al. 2013; Garrison et al. 2001; Garrison and Cleveland-Innes 2005; Garrison and Arbaugh 2007; Richardson and Ice 2010). Social construction of knowledge requires active learner engagement as well as a higher level of thinking skills beyond students' initial level of comfort in critical thinking (Dennen and Wieland 2007; Shea and Bidjerano 2009). In that sense, discussions should be structured in a way to allow learners to interact with each other and the course material "at deep (as opposed to surface) levels, which lead toward negotiation and internalization of knowledge" (Dennen and Wieland 2007, p. 283). An appropriate design of online discussion tasks and facilitation strategies is essential to encourage learners toward a more advanced level of critical thinking and learning in their discussions (Akyol et al. 2009).

Grounded in a cognitive presence framework, an essential component of the Community of Inquiry model (Garrison et al. 2000, 2001), this study compared the effect of different facilitation strategies for asynchronous online discussion activities to optimize the critical thinking of adult learners in higher education. Particularly, this study explored learners' critical thinking manifested in the level of

cognitive presence and their interactions in a graduate-level online course when peer or instructor re-direction was provided during asynchronous discussion.

The community of inquiry, cognitive presence and critical thinking

The Community of Inquiry framework developed by Garrison et al. (2000) has guided this study. The framework suggests that online educators should strive to create a quality community of inquiry for facilitating higher-order learning. Achieving such a community of inquiry requires interaction of three multidimensional and interdependent core elements: social presence, cognitive presence, and teaching presence. First, social presence is construed as learners' abilities "to project themselves socially and emotionally, as 'real' people" in an online environment and build relevant relationships within the community (p. 94). How participants effectively and comfortably express themselves, openly communicate with others, and establish cohesive groups are important indicators of social presence (Rourke et al. 1999). Second, cognitive presence is defined as "the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry" (Garrison et al. 2001, p. 9). Lastly, teaching presence is "the design, facilitation and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" (Anderson et al. 2001, p. 8). Understanding the nature and interaction of these three elements helps instructors design online learning environments aiming for deep and meaningful learning experiences.

Grounded in critical thinking literature, cognitive presence, particularly, serves as the core approach for the framework to design, facilitate, and assess the nature and quality of critical discourse in online learning environments (Garrison et al. 2001; Garrison 2003). Garrison et al. (2000, 2001) operationalize cognitive presence in four phases of the inquiry process: a triggering event, exploration, integration, and resolution. Within the community, when the *triggering event* (e.g., problem) regarding the content has been identified, learners begin experiencing a sense of puzzlement. Then, they start *exploring* the problem by searching for information and individually engaging in reflection and by exchanging information and brainstorming possible explanations with other members in the community. As learners engage in collaborative inquiry, they begin an *integration* of the ideas generated and perspectives shared from prior phases and constructions of meaning from substantiated justifications and various resources. In the final stage, learners reach a *resolution* of the question, or the problem explored and analyzed in prior stages, by selecting a solution. Such a solution can be vicariously and directly tested for the purpose of confirmation. In online learning environments, when learners engage in this cycle of practical inquiry, from encountering a triggering event through exploration, integration, and resolution, learners experience a higher level of critical discourse and reflective thinking. The framework has been useful in assessing levels of cognitive presence through a content analysis of online discussion messages.

Optimizing asynchronous online discussion

For learners to achieve deeper engagement and more active interaction with higher-level thinking and advanced stages of a cognitive presence, discussion activities should "demand cognitive collaboration" (Darabi et al. 2011, p. 217). To meet this goal, researchers have been exploring ways of structuring or facilitating asynchronous online discussions. The following sections synthesize such efforts into two categories: *discussion task design* and *discourse facilitation*.

Discussion task design

Online courses have been criticized for not using discussion strategies specifically designed for promoting learners' higher-level of cognitive presence and critical thinking. For example, early studies on cognitive presence report that a substantial portion of learners' cognitive presence remains at the exploration phase (e.g., Garrison et al. 2001; Garrison and Arbaugh 2007). That is, using a conventional method in which an instructor posts a set of question prompts for student thoughts may tend to trigger student interest and elicit their participation. However, such discussions can sometimes generate student responses based on insufficiently substantiated agreements or disagreements with each other's postings without meaningful collaborative discourse.

Findings of recent studies consistently argue the importance of the design of discussion tasks or good questions to promote an increased level of critical thinking. In a meta-analysis on the effectiveness of discussion strategies, Darabi et al. (2013) reported student performance was better when strategic discussion tasks included application scenarios, and emphasized using structured and well-designed discussion strategies. In another study, Darabi et al. (2011) explored the contribution of four scenario-based discussion strategies (i.e., structured, scaffolded, debate, and role play) on students' cognitive presence. They learned that different characteristics of discussion strategies allow learners to go through different cognitive processes; accordingly, each type of discussion strategy resulted in different levels of cognitive presence. Richardson and Ice (2010) discovered that discussion strategies that demand more cognitive effort, such as case studies and debate, elicit students' higher critical thinking achievement although they preferred simpler discussion tasks such as open-ended discussions. Richardson et al. (2012) explored relationships among nine types of initial question prompts (e.g., brainstorm, focal question, general invitation, and critical incident) and levels of critical thinking manifested in online discussion. They found that diverse types of initial question prompts facilitate different levels of critical thinking. Among nine types of question prompts, students achieved the highest level of critical thinking when they responded to a critical incident question prompt because it required them to engage in evaluative thinking to propose solutions to an authentic problem introduced in a scenario or a case (Richardson et al. 2012). In sum, the nature of discussion tasks influences students' cognitive processing. Moreover, it is important for online

instructors to design a relevant discussion task to require a deep and sustainable interaction conducive to higher-level thinking.

Discourse facilitation

Instructor-facilitated discussion

Facilitating discourse is considered to be an important task and responsibility of online instructors (Clarke and Bartholomew 2014; Hara et al. 2000; Phirangee et al. 2016). First, instructor facilitation can affect how students interact with each other in online discussions (Dennen and Wieland 2007; Phirangee et al. 2016). Instructor facilitation can further help students integrate their ideas and reduce the possibility of discussions ending prematurely or straying from the topic (Hewitt 2005). Students in the instructor-facilitated course had higher sense of community and exhibited more frequent activity patterns such as writing and editing more notes as well as rereading and responding to others' notes than students in peer-facilitated course (Phirangee et al. 2016). Moreover, students' perceptions of teaching presence can affect their perceptions of cognitive presence (Garrison et al. 2010) and their satisfaction with learning (Russo and Benson 2005). Students perceived that active instructor facilitation is a key element conducive to their deeper thinking (Hosler and Arend 2012). Clarke and Bartholomew (2014) also argued that an instructor's discussion facilitation style (e.g., use of cognitive, teaching and social messages) could affect students' perception of instructor's encouraging critical thinking on the topic and their own level of engagement in the class. Thus, the instructor's ability to push students to engage in reflection and discussion beyond the surface level is considered an important element for facilitation. However, the research on the role of instructors, the amount of the instructor's facilitation and types of facilitation to promote students' participation and actual learning outcome (e.g., critical thinking) is still inconclusive (Clarke and Bartholomew 2014).

On the other hand, there are researchers raising concerns regarding instructor-led or -facilitated discussion (An et al. 2009; Correia and Baran 2010; Hew 2015; Mazzolini and Maddison 2003, 2007). First, not all instructors are dedicating the extensive effort and time necessary to promote quality online discussions (Correia and Baran 2010; Seo 2007). Research on instructor's facilitation shows wide range in their frequency of postings and style of facilitation (An et al. 2009; Clarke and Bartholomew 2014) and what constitutes an effective instructor facilitation is still under development. Second, instructor-facilitation can possibly result in instructor-centered discussions if students perceive instructor facilitation as an "authoritarian presence" (Rourke and Anderson 2002, p. 4). Nevertheless, Hew (2015) found that 65% of student participants still preferred to see instructor facilitation. The highest ranked reason was the instructors' role as subject matter experts.

Student-facilitated discussion

Other than discussions facilitated by the instructors, students could also play roles in maintaining momentums in online discussion forum. Poole (2000) examined student

postings in terms of length and quantity and found that students made longer and more frequent postings when they were playing a role of a peer moderator during discussion. Similarly, Thormann et al. (2013)' study revealed that non-moderating students participated more actively in a discussion group with three moderators compared to discussion groups with one or two moderators. An et al. (2009) compared different instructor facilitation approaches and reported students with minimal instructor facilitation were more expressive with their thoughts and ideas. Hew (2015) found that although students in Singapore may prefer their instructor's strong presence in discussion, they also reported that they felt more at ease in expressing their own ideas in a peer-facilitation approach. Interestingly, other studies report different findings with regard to student preference when studied in a US context. For example, Correia and Baran (2010) conducted research on peer-facilitation with graduate students in two online courses at a large university in the US. They found that the students preferred a small group discussion facilitated by their peers rather than a discussion led by their instructors. When peers in small groups facilitated discussions, students tended to share more innovative ideas and demonstrated a more actively engaged participation in comparison to instructor-facilitated discussions. Hew and Cheung (2008) suggested that student facilitators at college level might effectively attract peers' participation with seven discussion facilitation strategies: "(a) giving own opinions or experiences, (b) questioning, (c) showing appreciation, (d) establishing ground rules, (e) suggesting new direction, (f) personally inviting people to contribute, and (g) summarizing" (p. 1117). Xie and Ke (2011) reported that students' moderation can be important for initiating online discussion and low-level knowledge construction with peers rather than high-level knowledge construction. They also argued that intrinsic motivation of students can play an important role in their moderation. To enhance contribution from peer moderation, it is essential to promote students' intrinsic motivation such as perceived competence in learning activities and the relatedness to their peers as well as to develop moderation skills. Most recently, Ghadirian and Ayub (2017) explored peer moderation behaviors of undergraduate students in online discussion in a blended course and classified them into low-level, mid-level and high-level moderation. Examining the overall students' moderating behaviors, over 64% of students were in mid-level and high-level moderation categories which exhibited information exchange and knowledge constructions as their primary moderating behaviors.

In summary, there is less research addressing effects of peer-facilitation as opposed to instructor-facilitation. Recent research has suggested that peer-facilitated approach could promote students' active participation in (An et al. 2009) and potentially stronger satisfaction with online discussion (Correia and Baran 2010). And students' perception of online discussion (Ghadirian and Ayub 2017) or intrinsic motivation (Xie and Ke 2011) are associated with their moderating behaviors. Prior research revealed how peers facilitate online discussion (Hew and Cheung 2008), yet the effect of specific kinds of peer-facilitation such as suggesting new direction (e.g. redirection message) in asynchronous online discussion has been unknown. Also, whether a peer-facilitation approach can impact critical learning

outcomes in online learning has not been explored (Correia and Baran 2010; Hew and Cheung 2008).

Research questions

In order to promote critical thinking as manifested by the degree of cognitive presence in asynchronous online discussion spaces, both the discussion task design and the specific facilitation strategies are important. Nevertheless, the current literature remains insufficient in articulating how to integrate both components for advancing adult learners' cognitive presence in asynchronous online learning settings. Based on literature review, using a scenario-based open-ended debate as discussion task and redirection as a facilitation strategy, this study, therefore, responded to the following questions:

(1) How is the cognitive presence of graduate students in an online course characterized when designing the discussion task as a scenario-based debate?
(2) How do peer and instructor redirection messages respectively affect learners' level of cognitive presence upon receiving the message?
(3) How do peer and instructor redirection messages respectively affect learners' interaction dynamic upon receiving the message?

Methods

Research setting

This study explored learners' level of critical thinking in a graduate-level online Program Evaluation course when peer and instructor re-direction was provided. The course is an integral part of an online Master's degree program with a concentration on human resource development. The online degree program is offered by a land-grant institution in the Midwestern U.S. Students in the program are adult learners with substantial professional experiences prior to joining the program.

The Program Evaluation course is a popular elective course focused on developing students' knowledge, skills, and abilities to evaluate various types of training and education programs across organizations. The course is eight weeks long with 100% online delivery and consists of both synchronous and asynchronous components. Students are required to attend synchronous sessions for two hours in the evening once every week. These weekly synchronous events enable students to interact with peer learners and the instructor for collaborative learning activities. For asynchronous activities, students need to complete weekly online discussion assignments and a major evaluation project.

Online discussion assignment

In this course, ethical thinking is a critical element, and promoting critical thinking leading to ethical thinking is an important pedagogical goal. The online discussion assignment, therefore, was focused on increasing students' abilities to recognize whether or not a realistic on-the-job scenario might require ethical thinking. In this eight-week long course, students had five weeks (from Week 3 to Week 7) to participate in the discussion. Considering the first research question, the discussion was designed as a debate for students to argue for their selected stances based on the scenario provided by the instructor in Week 3. Students were required to post their original thought per the scenario and respond to three other students' postings within the five-week discussion period, which accounted for 28% of the total possible points from the course.

Treatment and procedure

Based on literature on discussion task (Darabi et al. 2011; Richardson et al. 2012), an evaluation scenario eliciting debates was developed by the instructor and provided to students. The entire class was randomly assigned to two discussion groups (P and I). In Week 3, the instructor posted the scenario presenting two views (ethical/operational issue); students were invited to voluntarily select a side and justify their selections. In Week 6, a "redirection" message representing the third view (cultural issue) was developed and posted by a peer student to group P (peer-redirected group). The same message, however, was posted by the instructor to

The Scenario
You have been contacted to evaluate a customer service training program in an organization. You are now meeting with the associate director of the Sales department. He is interested in collecting data from some of stakeholders including the trainees, supervisors, and Human Resource Development (HRD) department personnel. You believe for a good evaluation you need to collect data from customers as well and share this concern with the associate director. The associate director believes that they already have done several customer satisfaction surveys and it is not necessary for their purpose of evaluation. In his view, it is not the place for including customers' views. You are not sure about the validity of the measures used for customer satisfaction but you are sure that it is not easy to persuade the associate director to add the component related to customer satisfaction. Based on what he says, your evaluation plan would be in serious problem if it includes customers' views and probably would be rejected. You start wondering…

1. *Do you consider this scenario an **ethical issue** or an **operational issue**? Please state your stance first and then explain why.*
2. *If you were the evaluator, what would you do? And why?*

Fig. 1 The scenario

group I (instructor-redirected group). In Week 7, the instructor asked all the students to state their final positions regarding on the scenario (Figs. 1, 2).

Participants

Twenty-nine of 37 students (n = 15 in Group P and n = 14 in Group I) participated in the study. Only 27 students completed the demographic information survey (Table 1).

Data collection and analysis

Upon the conclusion of the course, the researchers extracted postings in Moodle discussion forum. For data analysis, the researchers used (1) a content analysis and (2) a social network analysis (SNA).

Regarding content analysis, two of the authors analyzed the discussion postings at the message level (unit of analysis) using the four phases of the Cognitive Presence Framework: Triggering Event, Exploration, Integration and Resolution. First, each author individually analyzed a small set of sample discussion data for practice and compared his or her analysis with the other author's analysis in a face-to-face meeting. The authors explicitly discussed any disagreement and built a shared understanding of the coding categories (Schreier 2012). Then, the authors completed all the discussion data individually and met again to compare their coding. As were in the first meeting, the authors compared the coding, discussed any disagreements and have achieved full agreement on their coding. Inter-rater reliability (Cohen's Kappa) between two coders was 0.86, considered as very good strength of agreement (Landis and Koch 1977).

For the SNA, the researchers used UCINET 6 for Windows. The data was recorded from the Moodle discussion forum and network matrixes were constructed on MS Excel. Then, the social networks and the network structures were visualized with Netdraw. Density and Average Degree were examined to identify the cohesiveness of the networks in each group; Density shows the number of ties in the

Redirection Message created by Student
To me, considering the situation as ***cultural issue*** *seems more relevant instead of viewing it as either ethical or operational issue. Cultural issues are inevitable for evaluation. Every program evaluation is situated in existing organizational culture and it will generate consequences for the status of those who are part of or related to the evaluand.*
Decisions on what data to use and how to collect the data will definitely affect the findings of evaluation, which are basically judgmental and would probably influence the staff, the evaluation participants, or managers in either negative or positive ways. Therefore, it is natural that people want to be compliant with existing organizational practices on certain data collection approach. Nobody wants to be an outlier.

Fig. 2 The redirection message

Table 1 Demographic

Characteristics	No. (%) of individuals (n = 27)
Gender	
Female	22 (81.5)
Male	5 (18.5)
Years in current profession	
Less than a year	1(3.7)
1-3 years	5(18.5)
4-6 years	7(25.9)
7-9 years	5(18.5)
More than 9 years	9(33.3)
Years of program evaluation experience	
None	3(11.1)
Less than a year	14(51.9)
1-3 years	4(14.8)
4-6 years	3(11.1)
7-9 years	1(3.7)
More than 9 years	2(7.4)
Current involvement in program evaluation	
Yes	11(40.7)
No	16(59.3)
Level of comfortableness with asynchronous online discussion	
5: Very comfortable	$M = 4.3$, $SD = 0.65$
1: Very uncomfortable	
Level of comfortableness with sharing honest perspectives	
5: Very comfortable	$M = 4.2$, $SD = 0.58$
1: Very uncomfortable	
Number of online courses taken prior to this course	
This is the first course	1(3.7)
1	5(18.5)
2	4(14.8)
3	4(14.8)
More than 3	13(48.1)

network, indicating its general connectedness and closeness of the network, while Average Degree shows the number of ties of a node (Borgatti et al. 2013). Centrality was also examined, as it is related to a node's position in a network by assigning values to all nodes according to their structural importance (Borgatti et al. 2013). For Centrality, In-degrees and Out-degrees were identified to indicate the participants' expansions of the nodes and interactions in the online discussion forum (Tirado et al. 2015). Out-degrees are the outgoing ties indicating influence of the actors, whereas in-degrees are the incoming ones indicating prestige of actors

(Borgatti et al. 2013). Lastly, the density comparison was conducted to reveal any change in each group after the redirection message.

Results

Overall discussion participation

As mentioned earlier, the discussion lasted for five weeks from week 3 to 7. The redirection message proposing a third view written by a peer student was posted by the same peer in Group P and posted by the instructor in Group I in week 6. Lastly, in week 7, students were asked to post their final position on the case scenario.

For the five weeks, weeks 3 through 7, participants made 216 discussion postings (n = 128 in Group P and n = 88 in Group I). On average, Group P students posted 8.5 messages per person and Group I students posted 6.8 messages per person. Students made approximately 89% of the discussion postings in weeks 3, 6, and 7 as those weeks stimulated the most student activity (Table 2).

Cognitive presence and perspectives on discussion topic

Both groups exhibited a substantial number of messages at the higher level (integration and resolution) of cognitive presence. Particularly, over 50% of the postings were in integration phases. In Group P, 75 of the 128 messages (58.6%) students had posted were at the integration level. In Group I, 47 out of 88 messages (53.4%) were at the integration level.

A between-group comparison of the patterns of cognitive presence in the two groups reveals similarities and differences (Fig. 3). For example, when a redirection message was posted in week 6, the messages in the integration phase were the highest percentage of the total messages posted in that week. Those at the integration level were greater than 55% in Group P, whereas those at the integration level were at approximately 44% in Group I. The second largest percentage of messages was at exploration level in Group P (45%) and Group I (40%) respectively. Messages at the triggering event were 11% in Group I, yet there was no phase other than exploration and integration identified in Group P in week 6.

Table 2 Overall discussion participation

	Group P		Group I		Total	
	Count	%	Count	%	Count	%
W3	63	49.2	42	47.7	107	49.6
W4	9	7	14	15.9	23	10.6
W5	4	3.1	3	3.4	7	3.2
W6	31	24.2	18	20.5	50	23.1
W7	21	16.4	11	12.5	35	16.2
Total	128	100	88	100	216	100

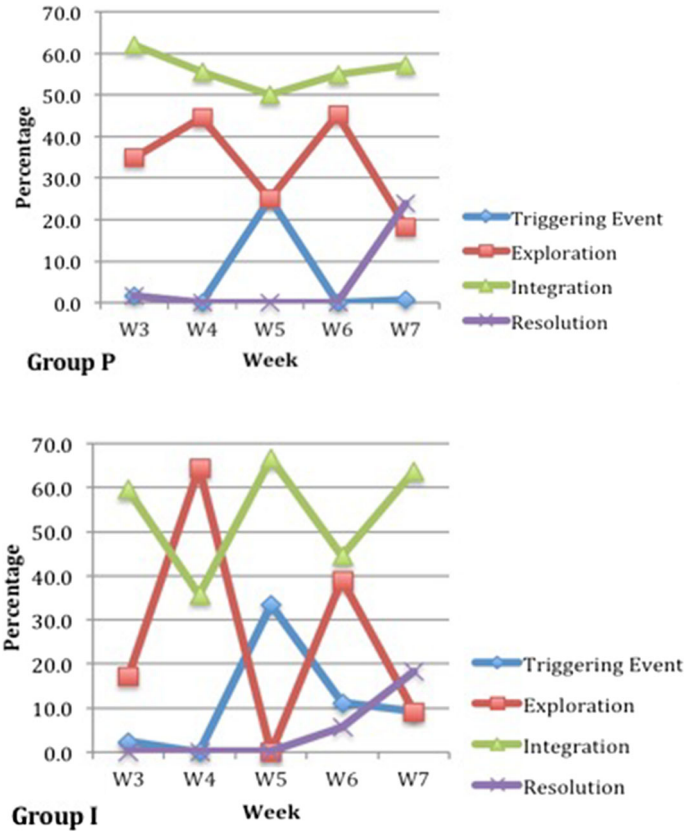

Fig. 3 Weekly cognitive presence in Groups P and I

Additionally, no statistically significant difference of cognitive presence between the two groups was found.

When examining differences within-group over five weeks, however, the peer-redirected group (P) exhibited a significant change after the treatment (Weeks 3-5 vs. Week 6) regarding the cognitive thinking level, X^2 (1, $N = 34$) = 5.86, $p < 0.05$). Additionally, looking into cognitive presence in week 6 in each group further, excluding the peer facilitator message, students in group P made 30 discussion postings in week 6. 20 (67%) out of 30 messages were posted to the peer-redirected message as either response postings or new postings to follow-up the re-directed discussion. Among twenty postings, 9 postings (45%) were at exploration level and 11 postings (55%) were at integration level. 10 postings were made as reply postings to earlier week's peers' postings. On the contrary, in group I, students made 18 discussion postings, yet only three (16.7%) discussion postings were made after the instructor's re-direction message. The three messages exhibited the triggering event, exploration and integration level respectively.

With regard to students' perspectives toward the discussion scenario, the two groups differed from each other. In group P, initially seven students viewed the

discussion case as an operational issue and eight students viewed it as an ethical issue. After five weeks of discussion and the redirection message with the third view, students' final stance in week 7 indicated that six out of eight students whose initial stance was ethical switched their perspective to operational. However, none of the students changed to the third perspective presented by the peer. In group I, 10 students considered the case as an ethical issue, two students considered the case as an operational issue and one student did not address her stance. In week 7, students' final stance indicated only two students had changed their stance and they both changed their stance to the third view presented by the instructor. The instructor-redirected group, to some extent, complied with the redirection message while the peer-redirected group did not.

Influence of re-direction message on interaction dynamic

To examine the influence of the re-direction message, an SNA was used to analyze learners' interaction dynamic in each group. First, a comparison of the network density between weeks 3 to 5 and week 6 within each group was conducted using the Bootstrap Paired Sample *T* Test. Unlike Group P, there is a significant difference in social network density between weeks 3-5 and week 6 in Group I. Upon receiving the redirection message, the density of Group I has been changed from that of prior weeks (Table 3).

Next, the structural characteristics of each group's network in week 6 were analyzed (Table 4). Group P had a higher density (10.70) than Group I (7.10). The density of a large network is almost always lower than one of small network (Borgatti et al. 2013). However, although the size of Group P is larger (n = 15) than Group I (n = 13), its density is higher. Furthermore, Group P showed a higher group cohesiveness in week 6 in terms of the average degree of the network, 1.706, with Group I at 1.000. The more closed and stable networks are those with higher levels of cohesion and density (Tirado et al. 2015). From its higher density and average degree, *Group P is considered as a more closed and stable network than Group I.* In terms of the network ties of Groups P and R, Group P exhibits 29, and Group I, 15. If the number of ties is expressed as a percentage of the number of pairs (Borgatti et al. 2013), in week 6, Group P is a denser network than Group I. That is, Group P has more relationships among group members. With regard to the network centralization of each group, out-degrees refer to messages sent. Similar numbers of

Table 3 Network densities between Weeks 3 to 5 and Week 6

Bootstrap paired sample *T*-test	Group P	Group I
95% bootstrap CI for the difference paired samples	[− 0.0297, 0.1621]	[− 0.0053, 0.1577]
t-statistic	1.3528	1.8322*
Average bootstrap difference	0.0652	0.0627

*$p < 0.05$

Table 4 Structure of the networks (Week 6)

Group	Size	Density	Number of ties	Average degree	Network centralization (out-degrees)	Network centralization (in-degrees)
P	17	10.70	29	1.71	15.23	21.88
I	15	7.10	15	1.00	15.31	15.31

messages were received by the two groups in the forum network—15.23 for Group P and 15.31 for Group I. Another network centralization index of the group, in-degrees indicated received messages—21.88 in Group P and 15.3 in Group I.

Lastly, to examine the interaction in each group further in week 6, the researchers calculated the 'coreness' of the network using the *k*-core function in both groups, as depicted in Figs. 4 and 5. This function re-structures the network into a set of concentric subsets in which the inner ones are more connected than the outer ones. The value of *k* indicates how many ties exist between a particular node and the other members of the subset (Borgatti et al. 2013). Thus, the nodes in the 1-core form the outer fringe. Those in the 2-core are connected to at least 2 others. Figure 4

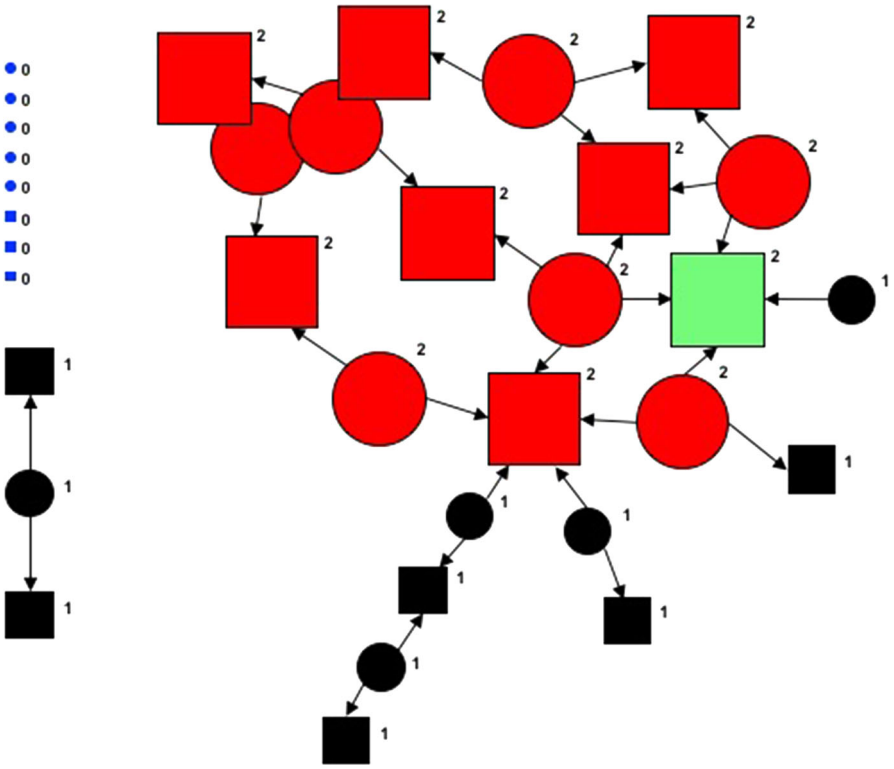

Fig. 4 *K*-core Visualized by SNA (Group P, Week 6)

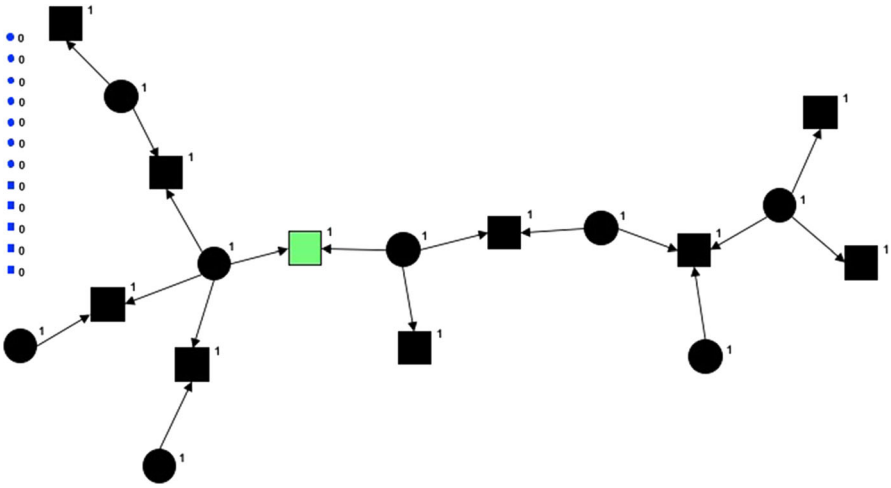

Fig. 5 *K*-core Visualized by SNA (Group I, Week 6)

conceptualizes K-core visualized by SNA in Group P and the nodes of 0, 1, and 2 exist in the group. The arrowheads indicate the direction of ties. The larger red nodes have a coreness of 2 and the green node is the student who posted the re-direction message. In fact, the discussion threads during week 6 from the peer-redirection message went to the fifth level in Group P. However, as seen in Fig. 5, only the nodes of 0 and 1 exist in group I. The small black nodes have a coreness of 1 and the green node is the instructor who posted the re-direction message. In summary, students in Group P were more connected and interacted with each other upon receiving the re-direction message compared to students in Group I.

Discussion

Cognitive presence of graduate students when the discussion task was a debate

The study results indicated cognitive presence between two groups had no significant differences. Both groups exhibited over 55 percent of higher level of cognitive presence although each group presented a different composition of the four phases of cognitive presence on a weekly basis. In the Community of Inquiry framework, cognitive presence is perceived as the most challenging and difficult element to establish in online courses (Garrison and Cleveland-Innes 2005; Garrison and Arbaugh 2007). In fact, many studies which examined cognitive presence in online discussions reported that many characteristics of exploration such as information exchange, brainstorming, presentation of divergent ideas without relevant substantiation and so forth were demonstrated in students' inquiry in online discussion (e.g., Celestin 2007; Garrison et al. 2001). As the cognitive presence progresses as students engage in the problem and questions given, integration and

resolution levels require more time and effort devoted to careful monitoring and deep reflection on on-going discussion as well as articulation and synthesis of ideas. Although researchers discuss both the importance of facilitating discourse and the design of the discussion task for cognitive presence to progress to integration and resolution phases (Garrison and Arbaugh 2007), based on the study findings, we argue that the task design seems to play a more critical role in promoting higher levels of cognitive presence. This claim confirms the findings of prior studies that the different discussion strategies result in different levels of cognitive presence and critical thinking (Darabi et al. 2011, 2013; Richardson and Ice 2010). It is important to note that, in this study, the instructor's facilitation was limited to the initial posting introducing the discussion task in week 3, the redirection message in Group I and the invitation for students to their final stance. However, the debate activity situated in a case-based scenario specifically required students' selecting one perspective initially and at the end and articulating their choice each time. The question given in the scenario was regarding an ethical dilemma, which is ambiguous in nature and invites high-level thinking of students when engaging in a debate (Liu and Yang 2012). Given that over 80 percent of participants had program evaluation experience at their work, the scenario was also easily applicable in their workplace setting. Such structure and design of the discussion task probably demanded much cognitive effort of students beyond exploration and exchanging their ideas and helped them actively engage in reflection, synthesis and resolution.

Influence of peer and instructor re-direction on learners' level of cognitive presence and perspective change

The results showed two major differences in the groups upon receiving the redirection messages. First, there was a significant difference in cognitive presence in Group P after a peer-redirection message was posted. Examining the result further revealed the differences in quantity of postings, levels of cognitive presence and response posting behaviors. Second, the number of students who changed their final stance and the direction that their stance changed was different. Summarizing the overall discussion process, learners in Group P were more willing to respond to the third view posted by a peer, but they were less likely to agree with that perspective from the re-direction message. Interestingly, at the end, more students had changed their perspective to one of the initial stances that the discussion topic asked them to choose. In contrast, students in Group I were less willing to respond to the third view, but students who changed their perspectives were more willing to agree with the new perspective posted by the instructor although the content of the posting had been developed by a peer. Perspective change after a discussion activity is an indicator of a learning outcome from collaborative discourse. Without actively reading resources and peers' postings, and deeply reflecting on their own thoughts as well as the overall discussion, changing one's perspective on an open-ended topic such as an ethical dilemma is not possible. That is, students can only decide to change their perspective after they experience cognitive dissonance on the topic and wrestle with it during the discussion.

The instructor's redirection message in Group I did not result in an instructor-centered discussion. However, students might have still perceived the instructor re-direction message as an "authoritarian presence" (Rourke and Anderson 2002, p. 4). Accordingly, instead of examining all facets of the third view and critically discussing it, most students decided to respond to their peers' earlier postings. Prior studies on peer facilitation report increased participation of students when performing moderator roles (e.g., Xie et al. 2014), peer facilitation strategies and styles (e.g., Ghadirian and Ayub 2017; Hew and Cheung 2008) and students' preferences in peer facilitation (e.g., Correia and Baran 2010). However, the literature does not provide evidence regarding the effect of peer-facilitation on critical thinking learning outcome (Correia and Baran 2010; Hew and Cheung 2008; Xie et al. 2014). The findings contribute to the existing literature by suggesting peer facilitation by posting a new perspective on an open-ended topic during discussion can be conducive to students' critical thinking and collaborative discourse at graduate-level online courses. Making use of a peer-facilitation approach for adult learners can help them delineate complex and realistic discussion topics.

Influence of peer and instructor re-direction messages on learners' interaction dynamic

The study results highlight a difference between the effect of peer and instructor re-direction messages on learners' interaction dynamic. The peer re-direction message did not bring about a statistically significant difference in learners' interaction dynamic in Group P; however, the instructor's re-direction message brought a significant difference in Group I in its network density compared to prior weeks. Also, K-core value difference between groups shows that in week 6, students in Group P showed more connection with each other when the peer posted the third view. Students actively asked questions and argued with their peers to articulate their understanding of the new perspective shared by their peer. In Group I, the discussion thread to the instructor's redirection message became relatively inactive in week 6 as the re-direction message facilitated neither discussion among students nor discussion between instructor and the students. As prior studies reported, students might have felt intimidated by the instructor's posting, and accordingly they might have felt less comfortable or confident about sharing their perspective (Rourke and Anderson 2002). However, it is important to note that these adult learners are professionals who reported at the beginning that they felt comfortable sharing their honest perspectives during the discussion. Additionally, most of them have program evaluation experience. Despite these facts reported by students at the beginning of the semester, students' interaction dynamic was not as active as before. Prior studies report the importance of strong instructor presence because learners want it (Hew 2015), participated more (Phirangee et al. 2016), perceive that they have learned more (Hosler and Arend 2012), had higher sense of community (Phirangee et al. 2016) and are more satisfied (Russo and Benson 2005). However, the result of our study is contradictory to some extent, as students participated less in the discussion and connected less with each other after the instructor presence.

Conclusion

This study empirically examined the effect of peer and instructor redirection to facilitate asynchronous online discussion. The findings indicate a few suggestions. First, a scenario-based open-ended discussion task could be conducive for a high level of cognitive presence leading to ethical decision-making in graduate-level online courses. Although the study was conducted in a program evaluation course for learning ethical practice, this type of discussion task can be applicable not only in learning ethical practice in different professional disciplines, but also in discussing any open-ended issues such as wicked problems (Van Bruggen et al. 2003) in various courses. Second, for this type of open-ended discussion task, peer-facilitation approach is a more viable approach for promoting the critical thinking and collaborative discourse of adult learners. Based on the findings of this study, when setting up asynchronous discussion activities using peer-facilitation approach, instructors can guide a peer facilitator to use a redirection message as a facilitation strategy during the discussion in order to help the classmates to be exposed with a new perspective and promote their deeper reflective thinking as well as active collaborative discourse.

The study has some limitations, which can possibly lead to future research efforts. First, the study examined critical thinking manifested in the discussion postings using a Cognitive Presence framework. Assessing students' ethical thinking development using an ethical thinking- related framework could be useful to expand our discussion on critical thinking in relation to learning outcomes. Second, the redirection message was written by a peer and shared by the instructor and the peer in this study. An instructor-developed re-direction message with more substantiation may bring about an effect similar to or different from the peer-written re-direction message on the cognitive presence, perspective change on discussion topic and the interaction dynamic. Findings from such study can help further articulate our understanding of optimizing asynchronous online discussion with a peer or instructor facilitation approach. Third, examining non-participating behaviors (e.g., frequency and duration of login and reading of postings) in addition to participating behaviors also can help us to further understand what learners experience when facilitation is given by instructor or peers. Fourth, including data such as learners' perception or experience on the discussion activity using a survey or an interview also can further enrich our understanding of the findings. Finally, the study was conducted in one graduate-level online class, consisting of adult learners who are professionals and have online education experience. Future research efforts can include research settings beyond a program evaluation course and open-ended discussion topics beyond ethical thinking to further investigate the effect of peer and instructor facilitation. In addition, conducting a similar study in a fully asynchronous course where students can only establish social presence via online discussion can result additional insight on the effect of instructor and peer-redirection as a facilitation strategy.

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