# Developing Students' Critical Thinking through Asynchronous Online Discussions: A Literature Review

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## ABSTRACT

Critical thinking (CT) is being recognized as an essential skill for students to master in the 21st century. Previous studies have suggested that teaching CT through asynchronous online discussions (AODs) can be one of the effective ways to equip students with such 21st skill in the educational settings. The purpose of this article is to review of the empirical literature related to the use of AOD forums for the development of students' CT. Forty-seven articles published from 2000 to the present day are included in the review. The content of the individual study was analysed through the lens of revised Community of Inquiry framework in order to get an up-to-date understanding of the issues pertaining to using AODs as a method for developing students' CT. By drawing on the review of the existing literature, the research on how social presence could serve a critical role in affecting the development of students' CT is relatively few as compared to teaching presence. Therefore, the dearth of empirical evidence needs more research to make the social presence more dominant in the future studies. This article closes with a discussion on current research gaps and possible areas for future research in this field of study.

**Keywords:** Critical thinking, Asynchronous online discussions, Literature review

## INTRODUCTION

Critical thinking (CT) is being recognized as an essential skill for students to master in the 21st century (Partnership for 21st Century Skills, January, 2016). Most educators agree that fostering students' ability to think critically is one of the primary aims of formal schooling as it is integral to students' professional and lifelong learning (deNoyelles & Reyes-Foster, 2015; Piro & Anderson, 2015; Yang, Chuang, Li, & Tseng, 2013). Besides that, CT is particularly important in today's sophisticated technological environments as students must be able to analyse, synthesize, and evaluate or make judgments about electronic information (Alexander, Commander, Greenberg, & Ward, 2010; Liu, Wu, & Shieh, 2015; Schellens, Keer, Wever, & Valcke, 2009).

Additionally, CT also plays an important role in enhancing students' academic performance. This is because CT skills enable students to make connections across disciplines and to their own lives. By making knowledge useful and applicable to their daily life, their understanding to the content is deeper and more

lasting (Paul & Elder, 2014). Apart from that, students with CT skills are more likely to become independent and self-directed learners. This is because the skills developed in CT allow students to assess the strengths and weaknesses of their own learning styles and hence take ownership of their own learning (Alexander et al., 2010).

Moreover, the ability to think critically is also extremely important for students to survive and thrive in tomorrow's fast-changing work environments. Employers are not only looking for employees' highly specialized academic skills; increasing demands are also being placed on having good CT skills (Trilling & Fadel, 2009). Therefore, graduates are required to equip themselves with the abilities to analyse, evaluate, and integrate diverse sources of information to solve problems, as well as generate effective ideas for possible solutions (Richard & Rebecca, 2010).

Previous studies (Arend, 2009; Cheong & Cheung, 2008; Guiller, Durndell, & Ross, 2008; Jacob, 2012; McLoughlin & Mynard, 2009; Morrison, Watson, & Morrison, 2012; Pena & Almaguer, 2012; Szabo & Schwartz, 2011) have suggested that teaching CT through AODs can be one of the effective ways to equip students with such 21st skill in the educational settings. There are a few main reasons that motive to use of AOD forums to promote students' CT. First, the asynchronous nature of AOD forums allows learners to participate in the discussion without the limitations of place and time (Hew & Cheung, 2010; Hou, Chang, & Sung, 2008; Vonderwell, Liang, & Alderman, 2007); this flexibility offers students adequate time to review others' responses and refer to other resources before they contribute to the discussion (Arend, 2009; Hsieh & Tsai, 2012; McLoughlin & Mynard, 2009; Wang, 2008; Wang & Woo, 2010). Additionally, students might put more effort in formulating their thoughts before contributing them online as the posting are to be viewed and commented by others (Wang & Woo, 2010).

Second, the interaction for peer-to-peer learning afforded by the AOD provides opportunity for learners to exchange personal insight or experiences, comment or challenge others arguments or thinking by providing evidence to support their assertions, and enables the instructor to give feedback on their thinking processes (Greenlaw & DeLoach, 2003; Lim, Cheung, & Hew, 2011). Third, the impersonal nature of AOD encourages an equal level of participation as it provides a comfortable environment for reticent students to express their ideas and viewpoints (Williams & Lahman, 2011).

Fourth, the sustained nature of AOD may also lead to greater reflection (Bliuc, Ellis, Goodyear, & Piggott, 2011) as the messages which are kept in permanent record in AOD forums enables students to repeatedly review, refer, and weigh their own ideas and prior responses (Deloach & Greenlaw, 2005; Garrison, Anderson, & Archer, 2000; McLoughlin & Mynard, 2009). With this potential to prompt self-reflection, AODs can become an environment conducive for students to develop CT skills (Flores, Matkin, Burbach, Quinn, & Harding, 2012). Lastly, the text-based nature of AOD requires students to create their discussion contributions in the form of written text (Greenlaw & DeLoach, 2003). The process of expressing ideas into words and typing out messages in itself can facilitate the development of CT (Guiller et al., 2008; Lim et al., 2011). This is because the act of writing itself provides opportunity for deep reflection and revision of ideas (Klisc, McGill, & Hobbs, 2012).

In sum, even though the previously mentioned studies have highlighted that AODs can be a viable way to promote students' CT, it is considered to be the most challenging to study and develop in online learning environments (Arbaugh, 2008; Garrison & Arbaugh, 2007). Therefore, the purpose of this article is to further explore the existing literature that specifically relates how AODs can be effectively used to foster CT among students.

## REVIEW METHOD

This section first presents a detailed description of how the search for literature was conducted. Then, the details on how the publications to be included or excluded in the review are discussed. This is followed by a discussion on how the journal papers were coded and analysed by the researcher.

### Literature Search Strategies

In order to acquire a comprehensive picture of the trends, issues, and future directions regarding to the use of online discussion to develop students' CT, the literature searching process was completed in a series of steps. First, databases such as EBSCOhost, Eric, ProQuest, SAGE, ScienceDirect, Taylor & Francis, Web of Science and Wiley Online Library were searched mainly because these databases are usually considered as the most important channel to identify the educational literature (Hrastinski, 2008). Secondly, as Internet technology was only widely implemented in the field of education around 1999 (Tsai, Chuang, Liang, & Tsai, 2011), the search was restricted to articles published in year 2000 or later. During this stage of the literature review, the researcher used a set of keywords such as "critical thinking" AND "online discussion", "critical thinking" AND "asynchronous discussion", and "critical thinking" AND "discussion thread" to seek articles which are related to this area of study. In total, 72 papers were identified as at November, 2018. Finally, a further search was conducted by reviewing the references in the selected articles for additional papers. As a result, three more papers were found and were added in the current corpus.

### Inclusion and Exclusion Criteria

The corpus was further filtered according to the selection process as follows: (1) only empirical-based journal articles written in English that relate to the effect of online discussion or online threaded discussions on students' CT were retained; (2) studies that did not report sufficient details for the method section were removed. For example, some studies did not provide adequate information on some aspects of their research methodology such as sample size and research design or procedure in quantitative studies were excluded (Wu et al., 2012). On the other hand, qualitative studies that relied more on the author's experiences rather than provide a rich description of learning outcomes were eliminated (Wu et al., 2012). As a result, 47 articles that fulfilled the selection criteria were retained for further analysis.

### Coding Method and Analysis

In an effort to determine the efficacy of online discussions for promoting students' CT, the content of a selected article was analysed and synthesized through the lens of Community of Inquiry (CoI) as revised by Shea and Bidjerano (2010). This framework is considered the most appropriate model to illustrate the use of AOD forums for facilitating students' CT because an effective learning in AOD requires moving students toward higher levels of cognitive processing. The occurrence of higher order thinking in AOD is not only dependent on teaching presence but also high degrees of participation accompanying with high quality interactions among students. A slightly modified version of Shea and Bidjerano's (2010) revised CoI framework is illustrated in Figure 1.

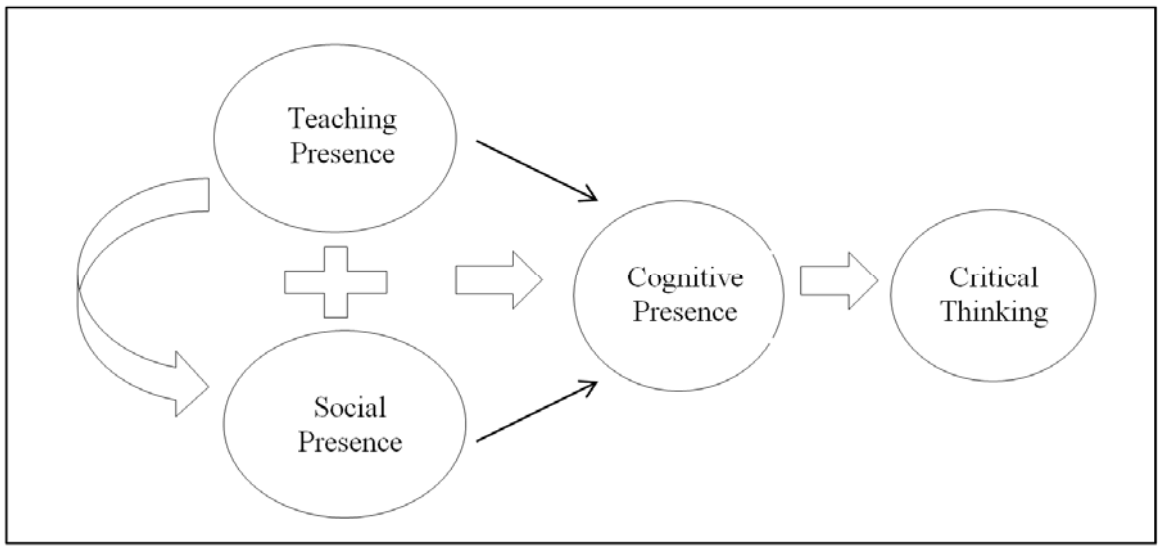


**Figure 1.** Relationships between teaching, social, cognitive presence, and critical thinking

Modifed from Shea and Bidjerano's (2010) revised CoI model (p. 1723)

Cognitive presence is the core concept and desired learning outcome in this model. The development of cognitive presence is mutually reliant on teaching and social presence within an online discussion. Cognitive presence refers to the extent to which learners are able to construct meaning and confirm understanding within a community of learners through sustained reflection and communication (Garrison, Anderson, & Archer, 2001). Cognitive presence leads to CT as achieving cognitive presence requires students engage in higher-order processing of information (Breivik, 2016; Costley & Lange, 2016; Garrison et al., 2001). Since the manifestation of cognitive presence is referred to as CT, CT should be added as an outcome variable which is closely associated with the cognitive presence construct.

The element of teaching presence typically requires teacher educators perform two general functions to support the development of cognitive presence: (1) directly affect cognitive presence through designing and organizing of the online discussion task, facilitation of online discussion, and providing subject matter expertise (direct instruction) during the process of discussion (Anderson, Rourke, Garrison, & Archer, 2001); and (2) indirectly affect cognitive presence through its mediating effect on social presence (Annand, 2011). For instance, teacher educators structure the social environment for learners by assigning roles to them to conduct their own group discussion. Such social structures provide an effective means for learners to reciprocally exchange ideas with each other and constructively critique others' contributions during the process of discussion, thereby encouraging them to practice of higher level of thinking skills. As such, the teachers are instrumental in forming the social space and engaging the participants cognitively.

The function of social presence is considered to have important effects on the development of cognitive presence (Garrison et al., 2000). This is because the effectiveness of online discussion is dependent on the quality of interactions that occur in the discussion forum. The quality of interaction is in turn dependent on how willing the participants are in sharing their deepest insights and working with others on issues. This constitutes the social dimension of learning in the online discussion. In addition, the quality of posted interactions is also dependent on the depth of the individual cognitive processing of the issue discussed, which constitute the cognitive dimension of learning. Thus, the social presence in turn contributes towards the development of cognitive presence.

## FINDINGS OF THE REVIEWED STUDIES

The revised CoI model is used to frame the key findings of this review. The two broad themes (teaching and social presences) that influence CT are discussed in the following sections.

### Teaching Presence

There are three major categories that directly define the role of teaching presence in supporting the development of student's CT in online discussions: *designing and organizing of the online discussion task*, *scaffolding* discussion activities, and *providing direct instruction* during the discussion process (Anderson et al., 2001). Each category is discussed in greater detail in the next sections.

### Designing and organizing of the online discussion task

Teaching presence begins before discussion activities even commence as the instructor is required to act as an instructional designer who plans and designs online discussion. Deloach and Greenlaw (2005) highlighted several key factors that should be taken into account when designing the online discussion for facilitating students' CT skills. These factors include *the choice of topics*, *the nature of the discussion task or strategies*, *the stipulation of group size*, and *duration of the discussion*.

#### *The topic of the discussion*

The first consideration is the topic for discussion. Two characteristics of a potentially strong topic for the promotion of CT have been identified. First, topics must be challenging and yet the information and related knowledge to the discussed issue ought to be readily available and accessible for students. Second, the topic should be open-ended rather than explicitly stated in the textbook as the nature of open-ended discussion topic is able to trigger different perspectives, suggestions and argumentation from students (see also Wang & Woo, 2010). Most importantly, the nature of the discussion task and/or strategies should be designed with the intention to direct and assist learners to think more deeply about their responses (McLoughlin & Mynard, 2009; Rusdia & Umara, 2015). Examples of these strategies include projects, problem solving, and case studies as well as debate and role play approaches (Schindler & Burkholder, 2014). A detailed discussion on how these tasks are designed to promote students' CT is thus presented in the section that follows.

#### *The nature of the discussion task or strategies*

The available literature indicates that the nature of the discussion task or strategies such as debate, case-based, role play, and also a combination of these strategies are employed by a number of researchers (Darabi, Arrastia, Nelson, Cornille, & Liang, 2011; Kalelioğlu & Gülbahar, 2014; Kanuka, Rourke, & Laflamme, 2007; Lee, 2007; Liu et al., 2015; Richardson & Ice, 2010) to promote students' CT in online discussions.

In terms of the debate strategy, students are generally assigned to proposition and opposition teams. Students in the proponent role are required to develop and defend their reasoned arguments; meanwhile, they also need to examine, compare, and argue over the differences perspectives of their counterparts (Darabi et al., 2011; Kanuka et al., 2007; Richardson & Ice, 2010). Despite strong evidence that the use of debates positively influences CT in asynchronous online discussions (AODs), prior studies that examine the efficacy of debate discussion for CT are sparse, with only three studies found in this review.

For example, Liu et al. (2015) investigated the effect of debate on freshmen and sophomores' CT skills in an English course. By requiring participants to take turns being in the conventional and debate conditions, the researchers found that participants' CT skills in the debate condition improved significantly as compared to their counterparts in the conventional condition. This is because of the conflicting nature of

debate that helped students understand how supporting evidence plays a crucial role in making their arguments persuasive may have an important influence on the facilitation of CT.

In another study, Darabi et al. (2011) compared the influence of four scenario-based online discussion strategies (structured, debate, role play, and scaffolded) on students' level of cognitive presence in a course on stress and resilience in children and families. They reported that the debate strategy demonstrated a strong association with the higher level of cognitive presence (exploration and integration phases). This could be due to the fact that the debate strategy that requires students to articulate, justify, and clarify their positions on the debate issue and convince others of their justification are key elements to moving students to the higher levels of cognitive presence.

In another example, Kanuka et al. (2007) conducted a study to examine whether the five groups of communication activities (nominal group technique, debate, invited expert, WebQuest and reflective deliberation) can affect the quality of students' postings (as operationalized by the cognitive presence) in an education course. They found that the number of students' discussion postings or responses categorised in the highest level of cognitive presence (resolution) was highest during the debate activities. The reason attributed was that debate is more confrontational and requires students to actively defend their position and confront their peers' different points of view, hence requiring the students to exercise CT directly.

With regard to the case-based strategy, it commonly presents a discipline-related and authentic scenario, requires students to analyse the case, explore the relevant information, and exchange opinions and ideas with each other (Darabi et al., 2011; Richardson & Ice, 2010). Some previous studies on case based discussion show that it can be effectively used for enhancing CT skills in AODs. There were two studies in the refined corpus discussing the efficacy of case-based discussions for CT.

For example, Richardson and Ice (2010) conducted a study to analyse the impact of three different discussion strategies (open-ended, debate, and case-based) on 196 undergraduates' CT level in an educational technology course. Across the three discussion strategies, case-based discussion, which requires students to analyse the information in a typical case and explore the relevant information to solve the real-life problems, generated the most number of coded responses at the highest stage of cognitive presence (integration and resolution).

Similar findings was also reported by Lee's (2007) study, which compares the effects of individual and collaborative case-based learning on undergraduates' CT skills in a learning frameworks course via experimental design. Although the outcome of the study does not support the hypothesis that students perform better in collaborative case study analysis than individual case study analysis, the researcher found that participation in both individual and collaborative case studies had significantly improved students' CT scores. In this respect, the author claims that the analytical processes (such as apply and synthesize the concepts and theories from the course materials) involved in analyzing the cases can be an effective strategy to engage students to think deeply and more critically.

With respect to the role play strategy, students are appointed to a specific role which requires them to perform the discussion task from the perspectives according to the roles they are assigned (Darabi et al., 2011; Kalelioğlu & Gülbahar, 2014). Despite the potential advantages and applicability of role-playing, existing research on the efficacy of role play strategy in ensuring that CT occurs in AODs is considered few. A recent search yielded only two studies that examine the efficacy of role play strategy for the promotion of CT.

For example, Darabi et al. (2011) conducted a study which empirically explored the influence of four discussion strategies (structured, scaffolded, debate and role play) on 73 undergraduates' cognitive presence. They reported that the role-play strategy was highly associated with the higher levels of cognitive presence (exploration and integration) during the online discussion. This is because the discussion strategy

that demands students integrate and discern ideas from different perspectives in real-life situations, leading them to higher phase of cognitive presence.

Kalelioğlu and Gülbahar (2014) investigated the impact of various discussion strategies (comprising Six thinking hats, Brainstorming, Role playing, Socratic seminar, Anyone here an expert) on pre-service teachers' CT in a "distance education" course via triangulation design. The results indicate that the *Anyone here an expert*, which is slightly different from the role play discussion, seems to be efficient in influencing students' CT. The explanation for this finding is that the participants who are granted to different specialties in the *Anyone here an expert* group are expected to generate ideas from the perspective of expertise in a particular field, thereby requiring them to exercise CT.

### *Group size*

Other than the choice of the topic, it has been highlighted that instructor need to determine the group size for an online discussion. Prior research (Deloach & Greenlaw, 2005) suggests that discussions within small groups tend to increase CT as larger discussion groups tend to be unmanageable and unproductive. The participants also might experience reduced individual responsibility to further contribute in the online discussion forum as they are not able to respond to every comment (Meyer, 2003; Yeo & Quek, 2011). Furthermore, a small number of participants within a discussion group can make the discussion more sustainable on a single topic as a larger discussion group may elicit too many responses for the members to effectively manage (Garrison et al., 2000). Although group size is an important consideration in designing an online discussion, there is no empirical study has been done to determine the possible optimal group size in influencing students' CT development. Besides the size of discussion group, there are still other possible factors that may influence the development of students' CT. These factors include the complexity of the discussion task as well as the duration of the discussion (Leng, Dolmans, Jöbsis, Muijtjens, & Vleuten, 2009).

### *Duration*

In terms of duration, some researchers have posited that a single topic discussion should be conducted within a week or two at the most of introducing the topic. That is when students' ideas are still fresh and the discussion topic can sustain momentum, while giving students enough time to think about or reflect on their own responses and the comments of others (Deloach & Greenlaw, 2005; McLoughlin & Mynard, 2009; Meyer, 2003). Furthermore, restricting the duration of discussion between 10 to 14 days could also avoid the build-up of an excessive numbers of postings on the same topic (Garrison et al., 2000). Unfortunately, no empirical evidence has been found to support such claims or suggestions thus far. Neither is there a causal relationship between duration of discussion and the improvement of students' CT. In addition, discussions comprising only one session, regardless of topic, typically does not seem to be sufficient for the development of CT skills (Pisutova-Gerber & Malovicova, 2009; Richardson & Ice, 2010; Yang, 2008). This could be because the improvement of CT skills might only emerge or occur after several sessions (each of which lasts 1–2 weeks) and not just one (Joiner & Jones, 2003; Liu et al., 2015).

In conclusion, it would seem that well-designed online discussion activities contribute to students' achievement of higher levels of thinking skills. Although the scenario-based discussions like debate, case-based, and role play approaches have been found to be significant for the promotion of CT in a wide variety of academic disciplines, (Darabi et al., 2011; Lee, 2007; Liu et al., 2015; Richardson & Ice, 2010), there is comparatively few studies using AOD as an instructional strategy replicated the research in K-12 classrooms and in Malaysia. Furthermore, there is limited research reported on designing student discussion activities in specific subject matters such as economics, accounting, geography, history, etc. Additionally, what is currently not clear seems to be the optimal size of discussion group and the duration of the discussion in influencing students' CT within online discussions. Hence, these issues could be the focus of future studies.

## Scaffolding

Teaching presence continues through scaffolding during the discussion activities (Anderson et al., 2001). Scaffolding is the provision of instructional support by the instructor to guide the student to accomplish a given task. The support will be gradually withdrawn or fades away until the students are able to completely master the assigned tasks (Sawyer, 2006). Therefore, providing scaffolding to students on how to develop constructive or insightful responses could increase the quality of discussion and the level of thinking in students. Existing research (Bai, 2009; Schellens et al., 2009; Yang, 2008; Yang, Newby, & Bill, 2005) shows that there are several scaffolding strategies that can be effectively used to support students in properly generating postings that meet the instructor's expectations. These support strategies include offering students the *initial prompt* and *directive information* at the beginning of discussion, *questioning*, and *scripting*.

### *Initial prompt and directive information*

Past studies (Meyer, 2003; Yang, Newby, & Bill, 2008) suggest that the initial prompt and specific or directive information (Klisc et al., 2012; Pisutova-Gerber & Malovicova, 2009) which is explicitly described to students prior to the commencement of the discussion can make a significant difference in the facilitation of students' CT. For instance, Yang, Newby and Bill's (2008) study indicate that if the instructor provides a very clear prompt at the beginning of discussion, the discussion seems to be more dynamic and interactive because students tend to be more motivated to participate when they know the direction to formulate their ideas and arguments when responding to others' postings.

In another study that required 10 graduate students taking a course on gifted education to start a discussion with a prompt related to the assigned chapter they read, Christopher et al. (2004) finds that providing students with high-level prompts at the commencement of the discussion does not necessarily lead to high-level thinking responses in the subsequent discussion. In other words, there is no relationship between the level of the prompts and the thinking level exhibited in students' responses. One possible explanation for this finding is that students were not informed about the criteria that were used by the instructors to determine their thinking levels in online discussion forums. Therefore, the study suggests that clearly defining the scoring criteria before students participate in the online discussion can make a significant difference in facilitating CT in students.

A similar result is also found in a study conducted by Klisc et al. (2012) among 79 instructors who used AOD forums as a major element of their teaching courses. The purpose of Klisc et al.'s (2012) study was to examine whether providing students with three different types of information (information relating to the purpose of the discussion activity, information on how discussion postings are graded, and examples of graded postings) at the onset of the discussion would facilitate CT in the online discussion. The study reveals that providing students with *information relating to the purpose of the discussion* and *information on how discussion postings are graded* have an important influence on the facilitation of CT. This outcome probably occurs because students have a clear idea of what is expected of them when the objectives of the discussion and the grading criteria are clearly communicated to them at the commencement of the discussion. Nonetheless, no conclusive result is found to determine the effect of providing *graded posting examples* on the facilitation of CT in AODs. Thus, this issue can be investigated further in future research.

To conclude, providing students with *initial prompts* and *specific information* in terms of the purpose of the discussion and how discussion contributions are graded at the beginning of the discussion may guide students to demonstrate higher levels of thinking in online discussions. Unfortunately, research on the exact wording of instructor prompts that can be used to guide students to generate responses that reflect higher levels of thinking were not found in recent search thus far. Therefore, additional study is needed to investigate whether initial prompt can be one of the significant factors for promoting CT. Moreover, no conclusive result is found to determine the effect of providing *graded posting examples* on the facilitation of CT in AODs. Furthermore, exactly how much and what kinds of information about grading can be given to students and their impact on CT was not elaborated in detail in previous studies. Hence, future research can be carried out to further investigate these issues.

### *Questioning*

Scaffolding students by asking a series of thoughtful questions is crucial throughout the process of developing students' CT during the forum discussions (Arend, 2009; Cheong & Cheung, 2008). Questioning plays an important role in inducing students to think more in-depth before contributing their messages online. Besides that, the use of effective questioning techniques can also help students to generate insightful responses during the critical discussion. There are five empirical studies that examine the effectiveness of using the questioning technique to enhance students' CT in online discussion forums.

Some researchers (Cheong & Cheung, 2008; Yang, 2008; Yang et al., 2013; Yang et al., 2005) indicate that Socratic questioning is one of the most popular approaches that lead to higher levels of CT. In a highly cited paper, Yang et al. (2005) conducted an experimental study investigating the effectiveness of using Socratic questioning to stimulate CT among 16 undergraduates in a veterinary distance learning programme. The researchers examined students' CT in two separate structured asynchronous discussion forums (ADFs). One forum was modelled and facilitated by the teaching assistants (TAs) using Socratic questioning while the other was not. The findings reveal that students who participated in ADF with the facilitation of Socratic questioning demonstrate higher level of CT skills than their counterparts who were not facilitated by Socratic questioning.

This finding is in line with the research of Yang (2008) and Gokhale and Machina (2018), although the latter study was conducted in a different learning environment. For instance, the findings of Yang's (2008) study reveal that students' CT skills can be successfully developed after they participated in Socratic dialogues during small-group online discussions in a large lecture class in Taiwanese university settings. There are three reasons why Socratic questioning can be effectively used to promote CT. Firstly, Socratic questioning is able to guide the students in exploring their ideas in depth and breadth. Secondly, questions can stimulate students' thinking to articulate their ideas and evaluate their understanding of the course material by being critically challenged by others. Thirdly, Socratic questioning helps to stimulate original thought from the students through probing and thought-provoking questions.

Similarly, Bradley, Thom, Hayes, and Hay (2008), conducted a study to investigate whether the six question types (Direct link, Course link, Brainstorm, Limited focal, Open focal, Application), as proposed by Andrews (1980), can affect the level of higher order thinking in undergraduate students from Child Development course. Students' online contributions were evaluated based on two dimensions, namely "answers" to the discussion question or "responses" to group members' postings. The study shows that the *course link*, *brainstorm* and *direct link* question types emerged as the most effect at facilitating students' higher levels of thinking. These three types of questions require students to justify their solutions by providing additional support from outside resources and bringing in their prior knowledge or personal experiences. They generally generated the highest percentage of higher order thinking for both "answers" and "responses". A similar result is also found in a study conducted by Rusdia and Umara (2015) among 41 postgraduate students in an educational technology course in a public university in Malaysia. They report that *course link* and *brainstorm* question types were the most frequently applied in the online discussion forum.

In another study, Alexander et al. (2010) carried out a study to determine whether a four-questions technique (analysing, reflecting, relating, and questioning), as created by Dietz-Uhler and Lanter (2009), can effectively improve 24 educational psychology graduates' CT through asynchronous discussions. The authors report that participants in the online discussion that included the four-questions technique exhibit higher CT scores compared to participants in the online discussion that did not include the four-questions technique. Therefore, the authors propose that the four-questions technique seems to be efficient in scaffolding students to generate insightful responses regardless of their age or experiences of participation in online discussion activities. However, the authors claim that this study might not generalizable since it was constricted to small sample size and participants were not randomly assigned to different conditions.

In sum, there is strong evidence that questioning can be one of the best ways to solicit deeper responses from students through online discussion forums. While prior research (Yang et al., 2005) highly suggests that Socratic questioning promotes CT, further studies should be conducted to replicate the findings with another group or population such as K-12 levels. Moreover, additional research could be considered to determine which types of questions are most effective and suit the ability of the students from primary and secondary education.

### *Scripting*

On the other hand, the use of scripting tools can be another strategy to facilitate CT. Scripts can be considered as a kind of guideline provided by the instructor to scaffold students construct their responses in critical way online (Bernstein & Isaac, 2018; Wever, Keer, Schellens, & Valcke, 2010). Three papers in the refined corpus were related to the use of scripts to facilitate students' CT in an online discussion.

For example, Schellens et al. (2009) investigated how tagging the six different colour of thinking hats (De Bono, 1991) on participants' postings can influence students' in-depth level of thinking in online discussion. Using an experimental design, the participants were assigned into two research conditions. Students in the experimental group were required to label their messages according to the different colour of thinking hats whereas the participants in the control group did not. The researchers found that this strategy significantly promoted students' CT in experimental group, and attributed the improvement to the provision of guidelines on how to develop specific arguments. These guidelines stimulated students to think more in-depth and generate more focused contribution when they responded online. On the other hand, their peers from control group tended to restate or repeat the same issues. Therefore, it can be inferred that requiring students to categorize their contributions by means of the thinking hats as a scripting tool appears to be an effective method for fostering CT.

In another study, Bai (2009) examined whether the practical inquiry model (PIM) (Garrison et al., 2001) as a postings guide is able to facilitate students' CT in online discussion. In this model, the process of CT is defined in four consecutive phases, which are *triggering event*, *exploration*, *integration* and *resolution*. The author found that almost all the postings of the participants who were guided by the model were highly associated with the *integration* phase. In contrast, the postings of the control group of students who did not have knowledge of this model tended to aggregate in the exploration phase. However, no representation of *resolution* phase was found in this study. This is possibly because the discussion questions were not designed to promote students' thinking in the resolution phase. In this study, the researcher concludes that the PIM is useful in facilitating students' CT because the model as a discussion guideline is able to raise students' awareness of CT and the responses formulated by them tend to be more focused when replying their message online.

Similarly, Leng et al. (2009) conducted a quasi-experimental study to explore the effectiveness of their self-developed e-learning model, which is devised to foster a group of medical students' CT on pathophysiological concepts during work placements at different hospitals. In this study, CT was operationalized as cognitive presence. Students' discussions were based on the PIM. The findings show that the number of postings in higher phases of cognitive presence (integration and resolution) was relatively small. This could be related to the fact that students were required to synthesise and reflect on the integration message and consult other resources to support the resolution message prior to posting them in forum. The complexity of this task could have discouraged the students from contributing further towards the integration and resolution phases within a short time period (approximately one week). Despite the moderate display of CT by the students, the authors conclude that the PIM is effective in facilitating the students to engage in an on-topic discussion that engages CT at different workplaces.

To conclude, the aforementioned studies have provided strong evidence that the use of scripting tools is helpful in directing students on how to structure a critical idea or insightful argument in

online discussions. However, there is one limitation of scripting: by providing students with specific instructions or a controlled list of messages on how to structure their responses, students' thinking might be restricted in particular way. Perhaps one possible solution worth investigating is providing students with a script that includes a scoring rubric on CT-related criteria. For instance, points are awarded according to the level of thinking reflect in students' online postings, with more points for higher levels of thinking whereas the discussion posts with lower levels of thinking will be received fewer points. Offering students with clear expectations for CT in the discussion rubric not only encourages and guides students to construct quality postings, but also doubles as a self-assessment tool for students to use before submitting their postings online (Bernstein & Isaac, 2018). Thus, this is a gap that requires further attention.

### Providing direct instruction

Direct instruction refers to the use of explicit teaching strategies or techniques (Anderson et al., 2001) to teach students content or a specific skill. There are two forms of direct instruction that can be utilized to guide students perform and demonstrate CT skills in online discussions: *providing intellectual and scholarly leadership* and *demonstrating subject matter and pedagogical expertise* (Anderson et al., 2001). Four papers in the refined corpus were concerned with the use of direct instruction to facilitate students' CT in online discussions.

#### *Providing intellectual and scholarly leadership*

Past research has suggested that students' CT can be facilitated through direct instruction that involves instructors' provision of *intellectual and scholarly leadership* (Anderson et al., 2001). For example, Chiu (2009) investigated how the 'shepherd leadership' approach would help Asian students engage in CT discussions online. Asian students from a Confusion Heritage Culture (CHC) background generally prefer silence, respect for teachers' authority, and less likely to challenge others' ideas in class. The findings of the study show that the instructors who adopted the role of 'shepherd leader' successfully assisted the Asian students to publicly express their critical thoughts in online discussions. Therefore, the implication of this study is the use of shepherd leadership, which involves getting to know each student's affective needs (offering affective support), providing cognitive modelling (demonstrating the application of CT skills), training student leadership, and reaching out to reticent students to get involved in the discussion, is effective in facilitating Asian students' CT in online discussions.

#### *Demonstrating subject matter and pedagogical expertise*

Some studies (deNoyelles & Reyes-Foster, 2015; Hemphill & Hemphill, 2007; Mathesona, Wilkinson, & Gilhooly, 2012) have shown that the direct instruction that makes use of instructors' *subject matter knowledge* and *pedagogical expertise* (Anderson et al., 2001) were noted as effective in supporting the development of student's CT in online discussions. As a subject matter expert, the instructor is also expected to provide direct instruction by using various means of assessment and feedback (Garrison & Arbaugh, 2007), provide comments to students, and organize activities that allow students to achieve the learning outcomes of the course (Anderson et al., 2001).

Direct instruction that requires instructors' to share their *subject matter knowledge* with students (Anderson et al., 2001) appears to be significant for engaging students in CT discussions. For instance, Hemphill and Hemphill (2007) examined the effects of guest expert's (such as the subject matter experts or experienced instructors) postings in online discussions on learners' CT levels. The results of the study show that students' levels of CT were sustained at a high level throughout the entire length of threaded discussions despite speakers not extensively monitoring the discussion or comments on every posting. This was probably because the online discussions that provide greater opportunities for students to interact with the guest speaker in richer and more interactive ways appear to be best at encouraging CT among students.

Furthermore, the virtual guests can also encourage a wide range of CT responses and interest levels from the students by bringing in new perspectives, sharing relevant experiences, and offering their particular expertise in a specific content area. Hence, the findings support that the presence of invited expert in online discussions providing less frequent but high quality prompts and feedback do show promising results for fostering CT.

Additionally, the instructor's comments as direct instruction are also crucial (Anderson et al., 2001) in influencing students' quality of thinking and online postings (Mandernach, Forrest, Babutzke, & Manker, 2009). According to Kong (2014), teacher's provision of direct and immediate feedback on the CT tasks could be regarded as one of the most effective ways to support students, especially at the secondary level, to develop their CT skills. This view also coincides with the suggestions of Cheong and Cheung's (2008) study, which claims that offering students with timely feedback or explanation in an online discussion environment could assist students to think and reflect further. However, there is no subsequent research has been carried out to confirm the efficacy of instructors' positive feedback or comments on the promotion of students' CT skills.

The direct instruction that makes use of the instructors' *pedagogical expertise* is inevitable for enhancing students' CT (Anderson et al., 2001). The results of the previous studies show that pedagogically *integrating the different forms of instructional techniques into online discussions* (deNoyelles & Reyes-Foster, 2015; Mathesona et al., 2012) in general can lead students to achieve a significant improvement in CT skills. For example, Mathesona et al. (2012) investigated whether combining patchwork text with online discussions could provide a good opportunity for the development of CT skills in students taking the course of Business and Management Studies and Marketing degree programmes. The authors reported that the use of patchwork text as an assessment method associated with online discussions can be a potential strategy to facilitate students' CT. The patchwork text, which consists of a variety of small sections of text, is made up gradually over a period of time (typically over a term or semester). The process of building up the patchwork text, which encourages learners to take charge of their own learning, helps to promote autonomous learning; the online discussion board, which provides a medium for promoting questioning and information sharing between instructor and students, appears to be important in fostering CT.

In another example, deNoyelles and Reyes-Foster (2015) conducted an exploratory study to look for the potential or applicability of integrating word clouds (as a pedagogical tool) into online discussions for stimulating students' CT. The researchers found that participants who analysed text in the word cloud condition achieved relatively high scores on CT as compared to their counterparts who analysed the text in a linear form. Thus, the authors suggest that word clouds—as a graphical representation of a given text, in which the size of every word shows its frequency or significance—can be integrated into online discussions as it can stimulate students to think about the topic or concept without being impeded by a great number of words. In addition, using the word clouds to analyse text appears to foster objective thinking, prompts the act of problem solving, and makes the task more thought-provoking. In turn, this increases students' engagement as they find that learning can be pleasant, intriguing, and inspiring. However, deNoyelles and Reyes-Foster (2015) further claim that the findings may have limited generalizability as this strategy is still in the initial stage of investigation.

To sum up, *direct instruction* that involves instructors' provision of *intellectual and scholarly leadership* and makes use of instructors' *subject matter knowledge* and *pedagogical expertise* appear to be significant in developing students' CT in online discussions. However, it is obvious that there is no specific type of *direct instruction* that evidence shows to be most effective at promoting CT. Therefore, additional studies in these areas deserve further attention and research. On the other hand, it is suggested that more research on how to effectively use of problem-based and project-based strategies to promote students' CT is desirable.

Finally, apart from teaching presence, the development of CT is also dependent on high levels of social presence within an online discussion. This is because using AODs to develop students' CT also rests in a high degrees of commitment and participation between learners (Hammond, 2005). Hence, a detailed

discussion on how social presence can be an important construct affecting the development of students' CT is presented in next sections.

## Social Presence

Social presence is regarded as the learners' capacity to express their individual personalities in a learning environment that supports learners in building social relationships with fellow students using a communication medium (Rourke, Anderson, Garrison, & Archer, 2001). This section first attempts to discuss the effects of the *quantity of peer facilitators* and *peer-interaction styles* on students' CT in online discussions. The researcher then provides a detailed discussion on how *peer facilitation* and *peer feedback* can influence the students' CT based on prior studies. There are seven papers in the refined corpus examine the extent to which social presence is able to influence students' CT in online discussions.

### *The number of peer facilitators*

The quantity of peer facilitators that should be employed for promoting students' CT in online discussions is rarely investigated by the researchers in prior studies. In a related study, Thormann, Gable, Fidalgo, and Blakeslee (2013) analyse the effect of a variable number of peer facilitators (1, 2, and 3) on K-12 educators' CT in an online course. The findings show non-moderator use of CT increased when there were more moderators employed. However, the authors claim that the instructor intervention as well as their contributions might also increase students' use of CT in their online posts. The authors conclude that there are several potential benefits and applicability of peer moderation as it supports students' in-depth thinking, giving students sense of ownership of the discussion and authority-sharing. Therefore, the authors further claim that additional research is required to identify the most effective use of peer facilitators for facilitating students' CT in online learning context.

### *Peer interaction styles*

Several studies suggest that the way of interaction can influence students' CT in online discussions. For instance, in a study that examined the patterns of group interaction and which interaction styles could promote students' CT using the Discussion Analysis Tool (DAT), Jeong (2003) reported that interaction style that involves conflicting viewpoints encouraged more discussion and promoted students' CT in online threaded discussions. However, the patterns of interaction do not necessarily lead to students' achievement of higher levels of thinking. This was corroborated by Zhu's (2006) study, who examined the relations between types of interaction and levels of student cognitive engagement in four AODs, she reported that no evidence of association between types of interaction and the cognitive quality of contributions students made in AODs.

Similarly, Wang and Woo (2010) conducted a study to investigate the extent the four forms of interaction (interaction with the whole class, interaction with the teacher, interaction in groups of four, writing online reflections individually and independently) influence students' CT through weblog discussions. They reported that all the interaction strategies, including writing individual reflections without any interaction with the teacher or peers had potential to promote CT. The reason for this finding could be related to the asynchronous nature of weblog, which provides participants more time to think, reflect, and consult other resources prior to posting their reflections online. In addition, students are encouraged to work harder in their writing as their posts will be read and commented on by others. The researchers further claim that the strategy of interaction with any peers in class was the best way to promote students' CT, whereas interaction with fixed members in group have been shown less effective in this study. However, they did not provide the possible reasons for this finding. Therefore, the researchers assert that future studies could be conducted to ascertain this result.

Xie, Ke, and Sharma (2010) examined the effects of two different starter styles (questioning and monologuing) as demonstrated by the discussion leader on students' cognitive thinking in blogs. The researchers conducted the study in two sections. The blog leader adopts a role of *questioning* starter in first section and *monologuing* starter in second section. As questioning starter, s/he needs to post questions on blogs, and group members provide answers to the questions; whereas *monologuing* starters post the writing on blogs, and the group members are required to comment on the post. The findings show that the *monologuing* starters exhibited a higher level of thinking as compared to *questioning* starters. In contrast, the respondents to *questioning* displayed higher levels of thinking as compared to the respondents to *monologuing*. The reason for this finding because the postings by *monologuing* starter were generally considered less thought-provoking and consequently yielded little arguments and negotiation from their peers. Conversely, the postings of *questioning* starters that commonly comprised controversial information encouraged students to think more deeply. In addition, they further claim that allowing students to conduct discussions that involve application of CT strategies such as summarization of group members' viewpoints and making sound conclusions from the discussion is effective in guiding students to demonstrate higher levels of thinking.

In conclusion, despite prior research (Jeong, 2003) suggesting that peer interaction style can positively influence students' CT in online discussions, it is not clear which peer interaction styles are the most effective ways to support the development of CT (Wang & Woo, 2010). Thus, additional studies should be considered to determine which interaction strategy is most effective for promoting CT.

### *Peer facilitation*

There is one paper in the reviewed literature that specifically focuses on facilitation techniques used by peer facilitators for developing CT. Lim et al. (2011), for example, conducted an exploratory case study to identify the types of facilitation techniques displayed by peer facilitators in online discussions and examined the effects of these techniques on the level of students' CT. The results show that the facilitation techniques such as *providing opinions or explanations*, *expressing agreements*, *showing appreciation* and *questioning* were extensively used by the peer facilitators in discussion threads that contain higher level of CT.

Lim et al. (2011) posit that the reason in using *providing opinions or explanations* was to allow the students to see things in a clearer way through their own experiences. When clarification about their own opinions and assumptions they made, this in turn help students to assess the accuracy of their thinking too, thereby helping students hone their CT. Although sharing of a variety of ideas or perspectives might not necessary lead to higher levels of responses, it was essential to function as a starting point to support students moving to the higher levels of thinking. In terms of *expressing agreements* technique, Lim et al. (2011) claim that the use of the technique is not only to ensure the discussion is kept focused on the discussion topic, but also helps students to gain a common understanding and consensus on a particular issue before they can use this common ground to move on further to explore their differences and engage in more-in-depth discussions, and this consequently allow them to practice of CT skills.

The researchers further claim that although *showing appreciation* does not necessarily result in CT, the technique can play a supporting role in promoting students' higher levels of CT. This is probably because this technique is able to create a respectful learning environment in which students feel more at ease to contribute or express their ideas in the online discussion. Hence, it is considered as an important step to help students moving toward a higher level of thinking. With regard to the *questioning* technique, *questions for clarification* and *questions that probe viewpoints or perspectives* were usually applied by the peer facilitators to seek more elaboration or information about group members' ideas in forums that achieve higher level of CT.

To sum it up, there are few major aspects that are lacking in the extant research. Additional studies are needed to address the gaps in certain areas. First, although *showing appreciation* technique makes students feel appreciated for their contributions, past research indicate that it might become less effective if

the peer facilitators do not request further elaboration and justification for the contributions they make. Additionally, the facilitation technique *expressing agreement* might not be appropriate for the discussions structured in debates condition and could also discourage students from exploring conflicting points of view. Therefore, merely *showing appreciation* or *expressing agreement* for individuals' contributions in AOD forums are seen as inadequate to trigger CT.

Moreover, this study was concentrated on examining the frequencies of the facilitation techniques used by peer facilitators in the forums with higher levels of CT, the effectiveness of using such techniques in developing students' CT remained uncertainty. Therefore, it would be worth exploring this issue in future research. Furthermore, additional research could also be conducted to replicate the findings involving participants from other disciplines and educational contexts (e.g., in primary or secondary school level).

### *Peer feedback and comment*

Peer feedback and comments can be incorporated into online discussions where feedback is given by one student to another in order to provide students more opportunities to learn from each other. Therefore, peer feedback can be another way to foster high-level thinking as they will need to provide reasons when they either agree or disagree with others' responses (Ertmer et al., 2007). Besides, peer feedback also provokes students to put more effort in their writing and encourages them to reconsider, revise, and reassess their responses before putting them online since their postings will be viewed by their peers as well as teachers. There are three studies that focus on the use of peer feedback or comments to develop students' CT.

In a study by Szabo and Schwartz (2011), using a true experimental design, the students were required to submit their reflections, with and without use of discussion forums to critique or comment on each other's reflections, and compared. They found that students in the experimental group, who were provided the opportunity to read and comment on others' reflections via discussion forums, had significantly improved their CT skills as compared to the control group, who wrote their reflections through the homework assignment and were not able to view and respond to their peers' reflections online. Therefore, the researchers conclude that the use of online discussion forums which enables students to read others' ideas or descriptions and reciprocal comments on their peers' reflections was the main factor that helped them to think critically and use higher order thinking.

In another study, Ertmer et al. (2007) conducted a study to gauge the effect of a peer feedback strategy on students' CT skills in AODs. The results showed that peer responses are valuable components in improving students' learning process as well as helping them to achieve a better understanding of the content; however, the results did not show a significant improvement in the participants' CT skills. In addition, the research participants were also found to be heavily reliant on instructor comments over peer feedback. Based on these results, the researchers recommend more research on how peer feedback can be effectively used to improve students' quality of postings that reflect the higher level of thinking is needed.

However, Ertmer et al.'s (2007) findings seem to contrast with the following study. In Ekahitanond (2013) examination of the effects of peer feedback strategy on the promotion of sophomores' CT skills in an online discussion forum, the results reveal that the participants' CT skills, as measured by the Bloom's taxonomy, were significantly increased through the application of peer feedback strategy. This could be related to the fact that the peer feedback strategy such as enabling them to learn with each other, exchange their ideas, and compare their responses with peers helped students understand the content better and subsequently assist them in organizing and synthesising a response to their given tasks. Furthermore, the process of providing feedback that require students to express their opinions with logical, clear, and specific reasons or examples, or using well-supported commentary, or statistics to convince the other students allow for the occurrence of higher order learning opportunities.

To sum it up, prior studies have yielded inconsistent results in terms of the effects of peer feedback to cultivate students' capability for CT. Furthermore, the empirical studies also do not consider whether the types of feedback that students respond to peers can be another factor to foster students' CT. Additionally, there is no subsequent research has been carried out to determine whether students' educational levels as well as their academic maturity are significant factors that influence the quality of peer feedback. Therefore, these issues could be the focus of future studies.

## CONCLUSION AND SUGGESTIONS

By drawing on the review of the existing literature, there are three major categories that directly define the role of teaching presence in supporting the development of students' CT in online discussions: *designing* and *organizing* discussion task, *scaffolding* discussion activities, and *providing direct instruction* during the discussion process (Anderson et al., 2001).

Teaching presence begins before discussion activities even commence as there are number of dimensions that instructor needs to consider when designing an online discussion to foster CT. This is because clearly described of the topic of discussion (Deloach & Greenlaw, 2005; Wang & Woo, 2010), the duration of discussions (Deloach & Greenlaw, 2005; Meyer, 2003), clear guidelines and detailed information for participation and time parameters (Klisc et al., 2012; Pisutova-Gerber & Malovicova, 2009) are the first step for moving students to higher levels of thinking and critical discussion. Most importantly, the online discussion activities should be designed with the intention to direct and assist learners to think more deeply about their responses.

Although the available literature provides strong evidence that the use of the scenario-based discussions like debate, case-based, and role play approaches have been found to be significant for the promotion of CT in a wide variety of academic disciplines, (Darabi et al., 2011; Lee, 2007; Liu et al., 2015; Richardson & Ice, 2010), there is comparatively few studies using AOD as an instructional strategy replicated the research in K-12 classrooms and in Malaysia. Furthermore, there is limited research reported on designing student discussion activities in specific subject matters such as economics, accounting, geography, history, etc. In addition, what is currently not clear seems to be the optimal size of discussion group and the duration of the discussion in influencing students' CT within online discussions. Therefore, these issues could be the focus of future studies.

Teaching presence continues through *scaffolding* during the discussion activities (Anderson et al., 2001). There are several instructional support strategies such as offering students the *initial prompt* at the beginning of discussion, *questioning*, and *scripting* that have been found to be effective for guiding students to demonstrate higher levels of thinking within online discussions. The available literature suggests that providing students with *initial prompts* and *specific information* in terms of the purpose of the discussion and how discussion contributions are graded at the beginning of the discussion may guide students to demonstrate higher levels of thinking in online discussions. Unfortunately, research on the exact wording of instructor prompts that can be used to guide students to generate responses that reflect higher levels of thinking were not found in recent search thus far. Therefore, additional study is needed to investigate whether initial prompt can be one of the significant factors for promoting CT. Moreover, no conclusive result is found to determine the effect of providing *graded posting examples* on the facilitation of CT in AODs. Hence, future research can be carried out to further investigate these issues.

In addition, there is strong evidence that *questioning*, especially Socratic questioning can be one of the best ways to lead students toward higher levels of thinking (Cheong & Cheung, 2008; Yang, 2008; Yang et al., 2005). While prior research highly suggests that Socratic questioning promotes CT, further studies should be conducted to replicate the findings with another group or population such as K-12 levels. Moreover, additional research should be considered to determine which types of questions are most effective and suitable for the different ability levels of students from primary and secondary education.

On the other hand, the use of *scripting* tools can be another strategy to facilitate CT. Despite previous studies (Bai, 2009; Leng et al., 2009; Schellens et al., 2009) have provided strong evidence that the use of *scripting* tools is helpful in directing students on how to structure a critical idea or insightful argument in online discussions, it is possible that providing students with a script that includes the CT grading rubric could be another effective strategy to foster CT. Offering students with clear expectations for CT in the discussion rubric not only encourages and guides students to construct quality postings, but also doubles as a self-assessment tool for students to use before submitting their postings online. However, exactly how much and what kinds of information about grading can be given to students and their impact on CT was not elaborated in detail in previous studies. Therefore, additional studies in these areas deserve further attention and research.

The final category of teaching presence, *direct instruction*, involves instructors' *intellectual and scholarly leadership*, *subject matter knowledge*, and *pedagogical expertise* in promoting students' CT (Anderson et al., 2001). Previous studies suggest that *direct instruction* that involves invited expert and provision of instructor's *intellectual and scholarly leadership* appear to be significant for engaging students in CT discussions. Additionally, students' CT can also be facilitated through direct instruction that makes use of different instructional techniques such as combining patchwork text with online discussion activities (Mathesona et al., 2012) and including word cloud analysis in online discussions (deNoyelles & Reyes-Foster, 2015). However, it is obvious that there is no specific type of *direct instruction* presents conclusive evidence for being the most effective at promoting CT. Therefore, additional studies in these areas deserve further attention. Additionally, more research on how to effectively use problem-based and project-based strategies to promote students' CT is desirable.

Apart from teaching presence, social presence also plays a central role in affecting the development of students' CT. Based on the current literature, the research on how social presence could serve a critical role in affecting the development of students' CT is relatively few as compared to teaching presence. Therefore, the dearth of empirical evidence needs more research to make the social presence more dominant in the future studies.

Furthermore, the quantity of peer facilitators that should be employed for promoting students' CT is hardly attended to by prior studies. To date, there is only one study that has done so. For example, the prior research (Thormann et al., 2013) points out that students' use of CT would increase when there were more peer facilitators employed in online discussions. Therefore, additional research could consider investigating whether the number of peer facilitators can be one of the significant factors for promoting students' CT. In addition, future research could also include further investigation on the effects of the size of discussion group and diversity of group members on students' CT.

Additionally, instead of focusing solely on the impact of instructor intervention or facilitation on students' CT, peer facilitation is strategically important to consider as well. This is possibly because of peer facilitation might not only encourage peer facilitators to use CT strategies when they are leading the discussion (Xie et al., 2010), but also help their group members to generate higher-level responses in the discussion (Hew & Cheung, 2011). Even though peer facilitation contains great potential for ways to promote students' CT, prior research (Lim et al., 2011) may not be sufficient in providing evidence to address the gap in this area. Therefore, additional research is required to identify the most effective use of peer facilitators for facilitating students' CT in online learning context (Thormann et al., 2013).

Finally, while there are several studies (Jeong, 2003; Xie et al., 2010) suggest that peer interaction can positively influence students' CT in online discussions, it is not clear which peer interaction styles are the most effective ways to support the development of CT (Wang & Woo, 2010). Hence, this is a gap that could be the focus of future studies. Moreover, there is mixed support for the use of peer feedback to foster students' CT in previous studies (Ekahitanond, 2013; Ertmer et al., 2007; Szabo & Schwartz, 2011). Nevertheless, there is no empirical evidence indicating whether the quality of peer feedback can be another

possible factor to foster students' CT. Then, more research also needs to explore whether the different educational level of students as well as their academic maturity are significant factors that influence the quality of peer feedback.

## REFERENCES


Akyol, Z., & Garrison, D. R. (2011). Understanding cognitive presence in an online and blended community of inquiry: Assessing outcomes and processes for deep approaches to learning. *British Journal of Educational Technology, 42*(2), 233–250.

Alexander, M. E., Commander, N., Greenberg, D., & Ward, T. (2010). Using the four-questions technique to enhance critical thinking in online discussions. *Journal of Online Learning and Teaching, 6*(2), 409-415.

Anderson, T., Rourke, L., Garrison, D. R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks, 5*(2), 1-17.

Andrews, J. D. W. (1980). The verbal structure of teacher questions: Its impact on class discussion. *POD Quarterly: The Journal of the Professional and Organizational Development Network in Higher Education Technology Research Development, 2*(3 & 4), 129–163.

Annand, D. (2011). Social presence within the Community of Inquiry framework. *The International Review of Research in Open and Distributed Learning, 12*(5), 40-56.

Arbaugh, J. B. (2008). Does the Community of Inquiry Framework Predict Outcomes in Online MBA Courses? *International Review of Research in Open and Distance Learning, 9*(2), 1-21.

Arend, B. (2009). Encouraging critical thinking in online threaded discussions. *The Journal of Educators Online, 6*(1), 1-23.

Bai, H. (2009). Facilitating students' critical thinking in online discussion: An Instructor's experience. *Journal of Interactive Online Learning, 8*(2), 156-164.

Bernstein, A. G., & Isaac, C. (2018). Critical thinking criteria for evaluating online discussion. *International Journal for the Scholarship of Teaching and Learning, 12*(2), 1-8.

Bissell, A. N., & Lemons, P. P. (2006). A new method for assessing critical thinking in the classroom. *Bioscience, 56*(1), 66-72.

Bliuc, A.-M., Ellis, R. A., Goodyear, P., & Piggott, L. (2011). A blended learning approach to teaching foreign policy: Student experiences of learning through face-to-face and online discussion and their relationship to academic performance. *Computers & Education, 56*, 856-864.

Borg, M. O., & Stranahan, H. A. (2009). Evidence on the relationship between economics and critical thinking skills. *Contemporary Economic Policy, 28*(1), 80-93.

Bradley, M. E., Thom, L. R., Hayes, J., & Hay, C. (2008). Ask and you will receive: How question type influences quantity and quality of online discussions. *British Journal of Educational Technology, 39*(5), 888-900.

Breivik, J. (2016). Critical thinking in online educational discussions measured as progress through inquiry phases: A discussion of the cognitive presence construct in the Community of Inquiry framework. *International Journal of E-Learning & Distance Education, 32*(1), 1-16.

Buraphadeja, V., & Dawson, K. (2008). Content analysis in computer-mediated communication: Analyzing models for assessing critical thinking through the lens of social constructivism. *American Journal of Distance Education, 22*(3), 130-145.

Chen, B., & Bryer, T. (2012). Investigating instructional strategies for using social media in formal and informal learning. *The International Review of Research in Open and Distributed Learning, 13*(1), 87-104.

Cheong, C. M., & Cheung, W. S. (2008). Online discussion and critical thinking skills: A case study in a Singapore secondary school. *Australasian Journal of Educational Technology and Society, 24*(5), 556-573.

Cheung, W. S., & Hew, K. F. (2005). *How can we facilitate students' in-depth thinking and interaction in an asynchronous online discussion environment? A case study.* Paper presented at the Proceedings of the AECT International Convention, Orlando, Florida, USA.

Chiu, Y.-C. J. (2009). Facilitating Asian students' critical thinking in online discussions. *British Journal of Educational Technology, 40*(1), 42-57.

Christopher, M. M., Thomas, J. A., & Tallent-Runnels, M. K. (2004). Raising the bar: Encouraging high level thinking in online discussion forums. *Roeper Review, 26*(3), 166-171.

Costley, J., & Lange, C. (2016). The relationship between social presence and critical thinking: Results from learner discourse in an asynchronous learning environment. *Journal of Information Technology Education: Research, 15*, 89-108.

Darabi, A., Arrastia, M. C., Nelson, D. W., Cornille, T., & Liang, X. (2011). Cognitive presence in asynchronous online learning: A comparison of four discussion strategies. *Journal of Computer Assisted Learning, 27*, 216–227.

De Bono, E. (1991). *Six thinking hats for schools, resource book for adult educators*. Logan, IA: USA Perfection Learning.

Deloach, S. B., & Greenlaw, S. A. (2005). Do electronic discussions create critical thinking spillovers? *Contemporary Economic Policy, 23*(1), 149–163.

deNoyelles, A., & Reyes-Foster, B. (2015). Using word clouds in online discussions to support critical thinking and engagement. *Online Learning Journal, 19*(4), 13-24.

Dietz-Uhler, B., & Lanter, J. R. (2009). Using the four-questions technique to enhance learning. *Teaching of Psychology, 36*, 38–41.

Ekahitanond, V. (2013). Promoting university students' critical thinking skills through peer feedback activity in an online discussion forum. *Alberta Journal of Educational Research, 59*(2), 247-265.

Ertmer, P. A., Richardson, J. C., Belland, B., Camin, D., Connolly, P., Coulthard, G., & Mong, C. (2007). Using peer feedback to enhance the quality of student online postings: An exploratory study. *Journal of Computer-Mediated Communication, 12*, 78-99.

Ertmer, P. A., Sadaf, A., & Ertmer, D. (2011). Designing effective question prompts to facilitate critical thinking in online discussions. *Design Principles and Practices: An International Journal, 5*(4), 1-28.

Flores, K. L., Matkin, G. S., Burbach, M. E., Quinn, C. E., & Harding, H. (2012). Deficient critical thinking skills among college graduates: Implications for leadership. *Educational Philosophy and Theory, 44*(2), 212-230.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*(2-3), 87-105.

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education, 15*(1), 7-23.

Garrison, D. R., & Arbaugh, J. B. (2007). Researching the community of inquiry framework: Review, issues, and future directions. *Internet and Higher Education, 10*, 157–172.

Ghodrati, N. (2015). Conceptualising and measuring collaborative critical thinking on asynchronous discussion forums: Challenges and possible solutions. *Digital Culture & Education, 7*(1), 86-103.

Gokhale, A., & Machina, K. (2018). Guided online group discussion enhances student critical thinking skills. *International Journal on E-Learning, 17*(2), 157-173.

Greenlaw, S. A., & DeLoach, S. B. (2003). Teaching critical thinking with electronic discussion. *Journal of Economic Education, 34*(1), 36-52.

Guiller, J., Durndell, A., & Ross, A. (2008). Peer interaction and critical thinking: Face-to-face or online discussion? *Learning and Instruction, 18*, 187-200.

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

Hammond, M. (2005). A review of recent papers on online discussion in teaching and learning in higher education. *Online Learning (formally the Journal of Asynchronous Learning), 9*(3), 9-23.

Hemphill, L. S., & Hemphill, H. H. (2007). Evaluating the impact of guest speaker postings in online discussions. *British Journal of Educational Technology, 38*(2), 287-293.

Hew, K. F. (2015). Student perceptions of peer versus instructor facilitation of asynchronous online discussions: Further findings from three cases. *Instructional Science, 43*, 19–38.

Hew, K. F., & Cheung, W. S. (2010). Possible factors influencing Asian students' degree of participation in peer-facilitated online discussion forums: A case study. *Asia Pacific Journal of Education, 30*(1), 85-104.

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

Hou, H.-T., Chang, K.-E., & Sung, Y.-T. (2008). Analysis of Problem-Solving-Based Online Asynchronous Discussion Pattern. *Educational Technology & Society, 11*(1), 17-28.

Hrastinski, S. (2008). What is online learner participation? A literature review. *Computers & Education, 51*, 1755–1765.

Hsieh, Y.-H., & Tsai, C.-C. (2012). The effect of moderator's facilitative strategies on online synchronous discussions. *Computers in Human Behavior, 28*, 1708-1716.

Jacob, S. M. (2012). Analyzing critical thinking skills using online discussion forums and California Critical Thinking Skills Test (CCTST). *Procedia - Social and Behavioral Sciences, 31*, 805-809.

Jeong, A. C. (2003). The sequential analysis of group interaction and critical thinking in online. *American Journal of Distance Education, 17*(1), 25-43.

Joiner, R., & Jones, S. (2003). The effects of communication medium on argumentation and the development of critical thinking. *International Journal of Educational Research Review, 39*, 861–871.

Kalelioğlu, F., & Gülbahar, Y. (2014). The effect of instructional techniques on critical thinking and critical thinking dispositions in online discussion. *Educational Technology and Society, 17*(1), 248–258.

Kanuka, H., Rourke, L., & Laflamme, E. (2007). The influence of instructional methods on the quality of online discussion. *British Journal of Educational Technology, 38*(2), 260–271.

Klisc, C., McGill, T., & Hobbs, V. (2012). The effect of instructor information provision on critical thinking in students using asynchronous online discussion. *International Journal on E-Learning, 11*(3), 247-266.

Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers & Education, 78*, 160-173.

Landis, M., Swain, K. D., & Friehe, M. J. (2007). Evaluating critical thinking in class and online: Comparison of the Newman Method and the Facione Rubric. *Communication Disorders Quarterly, 28*(3), 135–143.

Lee, K. (2007). Online collaborative case study learning. *Journal of College Reading and Learning, 37*(2), 82-100.

Leng, B. A. d., Dolmans, D. H. J. M., Jöbsis, R., Muijtjens, A. M. M., & Vleuten, C. P. M. v. d. (2009). Exploration of an e-learning model to foster critical thinking on basic science concepts during work placements. *Computers & Education, 53*, 1–13.

Lim, S. C., Cheung, W. S., & Hew, K. F. (2011). Critical thinking in asynchronous online discussion: An investigation of student facilitation techniques. *New Horizons in Education, 59*(1), 52-65.

Lin, P.-C., Hou, H.-T., Wang, S.-M., & Chang, K.-E. (2013). Analyzing knowledge dimensions and cognitive process of a project-based online discussion instructional activity using Facebook in an adult and continuing education course. *Computers & Education, 60*, 110-121.

Liu, P.-H. E., Wu, W.-C. V., & Shieh, R.-S. (2015). Enhancing EFL students' critical thinking and writing: An asynchronous debate instructional design. *English Teaching & Learning, 39*(3), 33-59.

Loncar, M., Barrett, N. E., & Liu, G.-Z. (2014). Towards the refinement of forum and asynchronous online discussion in educational contexts worldwide: Trends and investigative approaches within a dominant research paradigm. *Computers & Education, 73*, 93-110.

Mandernach, B. J., Forrest, K. D., Babutzke, J. L., & Manker, L. R. (2009). The role of instructor interactivity in promoting critical thinking in online and face-to-face classrooms. *Journal of Online Learning and Teaching, 5*(1), 49-62.

Mathesona, R., Wilkinson, S. C., & Gilhooly, E. (2012). Promoting critical thinking and collaborative working through assessment: Combining patchwork text and online discussion boards. *Innovations in Education and Teaching International, 49*(3), 257-267.

McLoughlin, D., & Mynard, J. (2009). An analysis of higher order thinking in online discussions. *Innovations in Education and Teaching International, 46*(2), 147-160.

Meyer, K. A. (2003). Face-to-face versus threaded discussions: The role of time and higher-order thinking. *Journal of Asynchronous Learning Networks, 7*(3), 55-65.

Morrison, J. R., Watson, G. S., & Morrison, G. R. (2012). Comparison of restricted and traditional discussion boards on student critical thinking. *The Quarterly Review of Distance Education, 13*(3), 167-176.

Newman, D. R., Webb, B., & Cochrane, C. (1995). A content analysis method to measure critical thinking in face-to-face and computer supported group learning. *Interpersonal Computing and Technology, 3*, 56–77.

Nicholas, A., McNett, J. M., & Harvey, C. (2003). Critical thinking in the management classroom: Bloom's taxonomy as a learning tool. *Journal of Management Education, 27*(5), 533-555.

Partnership for 21st Century Skills, P. (January, 2016). Framework for 21st Century Learning. Retrieved December 19, 2016, from http://www.p21.org/storage/documents/docs/P21_framework_0816.pdf

Paul, R., & Elder, L. (2014). *The Miniature Guide to Critical Thinking Concepts & Tools*: Foundation for Critical Thinking.

Pena, C., & Almaguer, I. (2012). The use of online discussions to foster critical thinking in a teacher education prograann. *International Journal of Instructional Media, 39*(1), 25-32.

Philip, C. A., Robert, M. B., Borokhovski, E., Wade, A., Michael, A. S., Tamim, R., & Zhang, D. (2008). Instructional interventions affecting critical thinking skills and dispositions: A stage 1 meta-analysis. *Review of Educational Research, 78*(4), 1102–1134.

Piro, J., & Anderson, G. (2015). Discussions in a Socrates Café: Implications for critical thinking in teacher education. *Action in Teacher Education, 37*(3), 265-283.

Pisutova-Gerber, K., & Malovicova, J. (2009). Critical and higher order thinking in online threaded discussions in the Slovak context. *International Review of Research in Open and Distance Learning, 10*(1), 1-15.

Richard, D., & Rebecca, D. (2010). The role of professional learning communities in advancing 21st century skills. In A. B. James & S. B. Ronald (Eds.), *21st century skills: Rethinking how students learn*. Bloomington: Solution Tree Press.

Richardson, J. C., & Ice, P. (2010). Investigating students' level of critical thinking across instructional strategies in online discussions. *Internet and Higher Education, 13*, 52-59.

Rizopoulos, L. A., & McCarthy, P. (2008-2009). Using online threaded discussions: Best practices for the digital learner. *Journal Educational Technology Systems, 37*(4), 373-383.

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Assessing social presence in asynchronous text-based computer conferencing. *Journal of Distance Education, 14*(3), 51-70.

Rusdia, S. H., & Umara, I. N. (2015). *Students' levels of critical thinking, supportive behaviors and types of questions in an online forum learning environment.* Paper presented at the 7th World Conference on Educational Sciences (WCES-2015), Novotel Athens Convention Center, Athens, Greece.

Sawyer, R. K. (2006). *The Cambridge Handbook of the Learning Sciences*. New York: Cambridge University Press.

Schellens, T., Keer, H. V., Wever, B. D., & Valcke, M. (2009). Tagging thinking types in asynchronous discussion groups: Effects on critical thinking. *Interactive Learning Environments, 17*(1), 77-94.

Schindler, L. A., & Burkholder, G. J. (2014). Instructional design and facilitation approaches that promote critical thinking in asynchronous online discussions: A review of the literature. *Higher Learning Research Communications, 4*(4), 11-29.

Shea, P., & Bidjerano, T. (2010). Learning presence: Towards a theory of self-efficacy, self-regulation, and the development of a communities of inquiry in online and blended learning environments. *Computers & Education, 55*(4), 1721–1731.

Singhal, A., & Kalra, B. M. (2012). A literature review of online discussion forum in e-learning scenario. *International Journal of Advanced Research in Computer Engineering & Technology, 1*(4), 2278 – 1323.

Snodgrass, S. (2011). Wiki activities in blended learning for health professional students: Enhancing critical thinking and clinical reasoning skills. *Australasian Journal of Educational Technology & Society, 27*(4), 563-580.

Szabo, Z., & Schwartz, J. (2011). Learning methods for teacher education: The use of online discussions to improve critical thinking. *Technology, Pedagogy and Education, 20*(1), 79-94.

Thormann, J., Gable, S., Fidalgo, S., & Blakeslee, G. (2013). Interaction, critical thinking, and Social Network Analysis (SNA) in online courses. *International Review of Research in Open and Distance Learning, 14*(3), 294-317.

Trilling, B., & Fadel, C. (2009). *21st Century Skills: Learning for Life in Our Times*. Hoboken, New Jersey: John Wiley & Sons.

Tsai, C.-C., Chuang, S.-C., Liang, J.-C., & Tsai, M.-J. (2011). Self-efficacy in Internet-based learning environments: A literature review. *Educational Technology & Society, 14*(4), 222–240.

Vaughan, N., & Garrison, D. R. (2005). Creating cognitive presence in a blended faculty development community. *Internet and Higher Education, 8*, 1–12.

Vonderwell, S., Liang, X., & Alderman, K. (2007). Asynchronous discussions and assessment in online learning. *Journal of Research on Technology in Education, 39*(3), 309-328.

Wang, Q. (2008). Student-facilitators' roles in moderating online discussions. *British Journal of Educational Technology, 39*(5), 859–874.

Wang, Q., & Woo, H. L. (2007). Comparing asynchronous online discussions and face-to-face discussions in a classroom setting. *British Journal of Educational Technology, 38*(2), 272–286.

Wang, Q., & Woo, H. L. (2010). Investigating students' critical thinking in weblogs: An exploratory study in a Singapore secondary school. *Asia Pacific Education Review, 11*, 541–551.

Wang, Q., Woo, H. L., & Zhao, J. (2009). Investigating critical thinking and knowledge construction in an interactive learning environment. *Interactive Learning Environments, 17*(1), 95–104.

Williams, L., & Lahman, M. (2011). Online discussion, student engagement, and critical thinking. *Journal of Political Science Education, 7*, 143–162.

Wu, W.-H., Wu, Y.-C. J., Chen, C.-Y., Kao, H.-Y., Lin, C.-H., & Huang, S.-H. (2012). Review of trends from mobile learning studies: A meta-analysis. *Computers & Education, 59*, 817–827.

Xie, Y., Ke, F., & Sharma, P. (2010). The effects of peer-interaction styles in team blogs on students' cognitive thinking and blog participation. *Journal of Educational Computing Research, 42*(4), 459-479.

Yang, Y.-T. C. (2008). A catalyst for teaching critical thinking in a large university class in Taiwan: Asynchronous online discussions with the facilitation of teaching assistants. *Education Technology Research Development, 56*, 241-264.

Yang, Y.-T. C., Chuang, Y.-C., Li, L.-Y., & Tseng, S.-S. (2013). A blended learning environment for individualized English listening and speaking integrating critical thinking. *Computers & Education, 63*, 285-305.

Yang, Y.-T. C., Newby, T., & Bill, R. (2008). Facilitating interactions through structured web-based bulletin boards: A quasi-experimental study on promoting learners' critical thinking skills. *Computers & Education, 50*, 1572–1585.

Yang, Y.-T. C., Newby, T. J., & Bill, R. L. (2005). Using socratic questioning to promote critical thinking skills through asynchronous discussion forums in distance learning environments. *American Journal of Distance Education, 19*(3), 163-181.

Yeh, Y.-c. (2012). A co-creation blended KM model for cultivating critical-thinking skills. *Computers & Education, 59*(4), 1317–1327.

Yeo, T. M., & Quek, C. L. (2011). Investigating design and technology students' peer interactions in a technology-mediated learning environment: A case study. *Australasian Journal of Educational Technology & Society, 27*(4), 751-764.

Zhu, E. (2006). Interaction and cognitive engagement: An analysis of four asynchronous online discussions. *Instructional Science, 34*, 451–480.