

Instructional Design and Facilitation Approaches that Promote Critical Thinking in Asynchronous Online Discussions: A Review of the Literature

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Abstract: Asynchronous online discussions (AODs) are often used to promote critical thinking in online courses; however, recent research suggests that levels of critical thinking in discussions remain low. Furthermore, there is a lack of consensus in the literature about the definition of critical thinking and many of the existing studies focus on one specific cognitive construct. Therefore, it is unknown which instructional approaches have the strongest empirical support for promoting critical thinking across multiple cognitive constructs. The purpose of this article is to present a review of the literature related to instructional design and facilitation approaches that promote critical thinking in AODs across multiple cognitive constructs (cognitive domain, cognitive presence, knowledge construction, and perspective-taking). Design approaches, such as providing scaffolding and using a debate-based instructional approach, and facilitation approaches, such as using Socratic questioning and allowing students to lead discussions, are effective for promoting critical thinking. Additional research should be conducted to confirm the efficacy of case-based, problem-based, project-based, and role play instructional approaches and to reach a consensus on the definition of critical thinking as well as how critical thinking should be demonstrated and accurately assessed in AODs.

Keywords: online discussions, critical thinking, cognitive presence, knowledge construction, perspective taking

Introduction

Asynchronous online discussions (AODs) are a common instructional feature of online courses used to promote interaction and critical thinking without the constraints of time or space (Arend, 2009; Bowden, 2012; Klisc, McGill, & Hobbs, 2009; Spartariu & Winsor, 2013). AODs

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typically consist of a discussion prompt to which students must respond with an initial post, followed by a series of response posts in which students comment on, challenge, and/or question their peers (Chavira, 2011). There are several benefits to using AODs compared to traditional, face-to-face discussions, including increased opportunities for all students, rather than a select few, to contribute to the discussion and more time for information processing, reflective thinking, and the construction of high quality responses to peers (Alamro & Schofield, 2012; Cain & Smith 2009; Rizopoulos & McCarny, 2009; Rollag, 2010). However, challenges continue to persist related to effectively designing and facilitating high-quality AODs that promote critical thinking (Armstrong & Manson, 2010; Spartariu & Winsor, 2013), particularly because the consensus on what critical thinking is, as well as the specific guidance on how to effectively teach critical thinking skills is elusive (Garrison, 1991; Mulnix, 2012).

Cognitive constructs that are similar to or that promote critical thinking (cognitive domain, cognitive presence, knowledge construction, and perspective-taking) frequently appear in the AOD literature and often are used interchangeably with critical thinking. While each cognitive construct is distinct, all reflect the progression of thinking from low levels (e.g., recalling/restating facts, offering an opinion, recognizing a problem) to high levels (applying new knowledge, testing ideas, making judgments), the latter being associated with critical thinking (Table 1). Despite the myriad constructs in the literature, the scope of existing articles often is limited to examining the efficacy of AOD approaches in the context of only one cognitive construct (Darabi, Arrastia, Nelson, & Liang, 2011; deNoyelles, Zydney, & Chen, 2014; Hou, 2011; Richardson & Ice, 2010). Therefore, the purpose of this article is to present a review of the literature related to the efficacy of AOD approaches for promoting critical thinking, as reflected across multiple cognitive constructs.

Table 1. *Definitions and Categories of Cognitive Constructs in the AOD Literature*

Constructs	Definition	Categories (Listed from Simple to Complex)
Cognitive Domain	An area of learning that pertains to recall or recognition of knowledge and the development of intellectual abilities and skills (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956, p. 7).	<ol style="list-style-type: none"> 1. Remember 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create (Krathwohl, 2002, p. 215)
Cognitive Presence	The extent to which higher-order knowledge acquisition and application is gained through sustained reflection and critical discourse (Garrison et al., 2001, p. 8)	<ol style="list-style-type: none"> 1. Triggering 2. Exploration 3. Integration 4. Resolution

Knowledge Construction	A process through which interaction and higher-order thinking leads to a new understanding of meaning (Gunawardena, Lowe, & Anderson, 1997, p. 410)	<ol style="list-style-type: none"> 1. Sharing/Comparing Information 2. Discovery/Exploration of Dissonance 3. Negotiation of Meaning/Co-construction of Knowledge 4. Testing/Modification of Proposed Synthesis or Co-Construction 5. Agreement Statement/Application of Newly Constructed Meaning
Perspective Taking	The ability to cognitively move from just a sense of self to a sense of self and others, then develop and articulate messages incorporating self and other (Chadwick & Ralston, 2010, p. 2)	<ol style="list-style-type: none"> 1. Ecocentric 2. Subjective 3. Reciprocal 4. Mutual 5. Societal-Symbolic

The search for articles included in this review was limited to 2009 to 2014. Some articles published prior to 2009 were included to address historical aspects of AODs or because they were frequently cited in the existing literature. The following databases were searched: *Academic Search Complete*; *Computers & Applied Sciences Complete*; *Education Research Complete*; *ERIC*; *Library, Information Science & Technology Abstracts*; *PsycARTICLES*, *PsycINFO*, and *Education from SAGE*. The keyword used to search the databases was *online discussion*. The keyword was intentionally broad given that the aim of this article was to conduct an exhaustive search of the literature in order to identify themes related to instructional design and facilitation strategies that influence critical thinking. Using more specific keywords, such as *problem-based discussion* or *instructional design strategies*, may have produced narrower results given that educational terminology varies. Any additional articles included in the review were identified by scanning the references of the articles gathered from the initial search of the databases. What follows is a brief background of AODs in the context of the distance education movement followed by a discussion of the instructional design and facilitation approaches that promote critical thinking in AODs.

Background

The first generation of distance education courses began in the late 1890's to increase access to education in response to the growing demand for an educated workforce during the Industrial Revolution. Universities in the United States, Canada, England, and Europe offered correspondence-based courses that emphasized individual learning and one-way communication through text-based materials sent from the university to students courtesy of the postal service. Even as technology progressed over the next century, the structure of distance education courses remained largely unchanged for decades. Technologies such as radio, television, and audio and video cassettes were incorporated into distance education courses and, while revolutionary at the time, continued to emphasize individual learning and one-way communication (Sumner, 2000). Such individualized learning was limited in the extent to which critical thinking skills could

be developed, as it really was not possible to develop a "critical community of inquiry" (Anderson & Garrison, 1995, p. 197).

During the 1970s and 80s, there were major educational and technological shifts that significantly changed distance education courses and provided an impetus for the emergence of two-way communication. First, there was a major paradigm shift in education from behaviorism to constructivism (Cooper, 1993; Jonassen, Davidson, Collins, Campbell, & Haag, 1995; Harasim, 2000). While behaviorism emphasizes the one-way transmission of knowledge from an expert (faculty) to novice learners (students), constructivism was radically different, suggesting that knowledge is built through prior knowledge, experience with the outside world, and interaction with others (Cooper, 1993; Harasim, 1999; Huang, 2002; Jonassen et al., 1995). Second, there was a technological shift propelled by the advent of the personal computer and the Internet, which offered new possibilities to support the constructivist learning paradigm. In particular, computer conferencing (the connection of computers by telephone lines or microwaves) increased the possibilities for two-way communication through a computer network (Bates, 1997; Schlosser & Simonson, 2010).

Early online educators struggled, however, to effectively use computer-mediated communication tools (e.g., email, electronic bulletin boards, and chat rooms) because they were unsophisticated, ill-equipped for the educational environment, and could not easily accommodate a high number of students and/or a high level of meaningful interaction (Harasim, 1999; Hiltz & Wellman, 1997). As online learning increased in popularity, the need for viable collaborative educational tools continued to persist, driving the development of early learning management systems. AODs became a regular fixture in learning management systems and an appealing solution to older collaborative tools because they could be more easily facilitated and organized, and they allowed for meaningful discourse, regardless of time or space (Andresen, 2009; Arend, 2009; Bassett, 2011; Harasim, 2000). However, despite the potential of AODs over other asynchronous and synchronous tools, their inclusion in courses does not guarantee learning. AODs must be more deliberately designed to "construct meaning through sustained communication . . . a vital element in critical thinking" (Garrison, Anderson, & Archer, 2000, p. 89). Numerous studies report that low levels of critical thinking and meaningful discourse persist due to a variety of instructional design and facilitation factors ranging from poorly designed discussion prompts to too little or too much faculty involvement (Arend, 2009; Chen, Wei, Wu, & Uden, 2009; Hew, Cheung, & Ng, 2010; Jorczak & Bart, 2009; Kanuka, Rourke, & Laflamme, 2007; Ling, Koo, & Ong, 2010; Mokoena, 2013; Skinner, 2007; Skinner, 2009).

Complicating the use of AODs as a means of teaching critical thinking skills in the online classroom is the lack of consensus around definitions for critical thinking as well as strategies for teaching it (Garrison, 1991; Mulnix, 2012). Many philosophers such as Plato, Thomas Aquinas, and Descartes, among others, emphasized that things are not necessarily as they appear, and training is essential to teach students how to systematically discover the true nature of those things. Halpern (1998) adopted a very pragmatic approach in referring to critical thinking as "use of those cognitive skills or strategies that increase the probability of a desired outcome" (p. 450). Garrison (1991) conceptualized a model of critical thinking as a process comprising five stages: problem identification (as a result of an event that creates cognitive dissonance); problem definition (understanding the specific nature of the problem); exploration (the search for evidence supporting the problem that provides plausible explanations); applicability (the student examines assumptions and critically examines alternatives); and integration (testing out the solution in the world, which itself may result in identification of new problems and this a re-enactment of the

cycle). Finally, based on the results of a Delphi study, Scheffer and Rubenfeld (2000) identified 10 habits of the mind (confidence, contextual perspective, creativity, flexibility, inquisitiveness, intellectual integrity, intuition, open-mindedness, perseverance, and reflection) and seven skills (analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting, and transforming knowledge) that reflect critical thinking in the nursing discipline. Given the variety of definitions and approaches to critical thinking, it can be challenging to ensure that AODs support critical thinking. In the sections that follow, the efficacy of instructional design and facilitation approaches for promoting critical thinking will be discussed. For the purposes of this review, the term “critical thinking” will be used broadly to encompass high-level categories of cognitive constructs listed in Table 1, such as cognitive presence, unless referring to the outcomes of a specific study.

Instructional Design Strategies

A review of the AOD literature revealed two broad instructional design themes that influence critical thinking. The first theme pertains to the structure of AODs, which includes the degree to which the discussion prompt is detailed and intentionally constructed to elicit a specific type of response, the level of scaffolding and expectations provided, and the extent to which the size of the discussion group is controlled. The second theme pertains to the instructional approach used to design the discussion prompt. There are case-, problem-, and project-based approaches as well as debate and role play approaches that may be used. In the sections that follow, the existing literature related to the influence of structure and instructional approaches on critical thinking in AODs will be examined.

Structure

Structured prompts. Discussion prompts may be unstructured, requiring students to discuss a topic of their choosing or to simply respond to an open-ended question without any specific parameters for participation or support materials. While unstructured prompts may be enticing because they require less pre-planning and allow for more flexibility, research suggests that structured prompts are more effective for promoting critical thinking in AODs (Darabi et al., 2011; deNoyelles et al., 2014; Kanuka et al., 2007; Lee, 2012; McLoughlin & Mynard, 2009; Sautler, 2007; Scanlan & Hancock, 2010). For example, structured discussion prompts that include detailed instructions and that elicit a specific type of response (e.g., applying knowledge to a scenario, engaging in a debate) were more effective for promoting cognitive achievement compared to traditional question and answer prompts (Darabi, Liang, Suryavanshi, & Yurekli, 2013). Furthermore, discussion prompts that are relevant to course content, include instructions for how to respond to peers (i.e., compare your experiences with your peers), and specify time parameters (i.e., complete all postings within a week) lead to higher levels of perspective-taking than unstructured discussions in which students could choose which topics to discuss, were given no instructions about how to respond to peers, and where participation was optional (Chadwick & Ralston, 2010).

Findings about the efficacy of structured discussion prompts are consistent with recent research suggesting that students exhibit low levels of critical thinking in AODs unless the prompt explicitly guides students to demonstrate higher levels of critical thinking (Alexander, Commander, & Greenburg, 2010; Arend, 2009; Hou, 2012; Pena & Almaguer, 2012; Song & McNary, 2011). For example, Alexander et al. (2010) examined the effectiveness of the four

questions technique for designing discussion prompts to promote critical thinking. Originally developed by Dietz-Uhler & Lanter (2009), the four-questions technique requires structuring a learning activity to foster analyzing, reflecting, relating, and questioning. The researchers assessed critical thinking in two AODs, one that used the four-questions technique and one that did not. The four-questions AOD pertained to a case study about social cognitive theory and asked students to analyze one important concept, research finding, or idea about social cognitive theory they learned from reading the case study (analyzing), explain why they believe social cognitive theory is important (reflecting), explain how they would apply social cognitive theory to some aspect of their lives (application), and identify questions they had after reading the case study (questioning). Critical thinking levels were higher in the AOD that included the four-questions technique (Alexander et al., 2010). Therefore, online instructors and instructional designers should engage in pre-planning to design discussion prompts that are detailed and that guide students to demonstrate higher level of critical thinking.

Scaffolding. Scaffolding is any form of instructional support that enables “students to complete tasks they would be unable to master without assistance” (Grady, 2006, p. 148). Providing scaffolding for how to construct substantive discussion posts increases the quality of discourse and the level of thinking in AODs (Spatariu & Winsor, 2013). One effective scaffolding strategy is to provide students with exemplars of initial discussion postings and responses to peers, which reduces extraneous cognitive load and allows students to focus on learning course content rather than on how to properly construct initial postings and responses that meet expectations (Darabi & Jin, 2012). For example, in studies where students were given examples of acceptable initial postings and guidelines for generating substantive responses to extend thinking (e.g., clarification/elaboration, argument/counterargument) resulted in higher levels of cognition and reflection and higher quality responses (Darabi & Jin, 2012; Land, Choi, & Ge, 2007; Stegmann, Weinberger, & Fischer, 2007). When designing a discussion prompt, online instructors and instructional designers should consider the level of scaffolding to provide, given the targeted population of students. Novice online learners who are unfamiliar with sustaining meaningful discourse in an asynchronous environment or are unaccustomed to demonstrating critical thinking are likely to benefit from more scaffolding compared to experienced online learners (Pisutova-Gerber & Malovicova, 2009). Furthermore, prior research suggests that discussions at the undergraduate level reflect lower levels of thinking (Agee & Smith, 2011); therefore, undergraduate students may need more scaffolding than graduate students.

Expectations. Providing clear and detailed expectations for performance is similar to providing scaffolding in that it allows students to focus on learning the material rather than wondering what is expected. One of the most effective strategies to communicate expectations for AOD performance is by providing a rubric. Students can use a discussion rubric as a guide for constructing quality responses and to self-assess discussion responses prior to posting them to the discussion board (Maddix, 2012; Norton & Kuruvilla, 2013; Rovai, 2007; Rizopoulos & McCarthy, 2009). While many of the existing rubrics for AODs fail to include criteria on critical thinking (Hsiao, Chen, & Hu, 2013), those that do show promising results for fostering critical thinking. For example, a discussion rubric based on Bloom’s taxonomy lead to higher critical thinking skills among students in an online discussion (Pena & Almaguer, 2012). Points were assigned based on level of cognition reflected in discussion posts, with fewer points for lower levels (e.g., recalling facts, describing main ideas) and more points for higher levels (e.g., making judgments about information, proposing alternative solutions to problems).

Providing expectations outside of a rubric is also effective for fostering critical thinking in AODs. Bai (2009) found students who were informed that their postings must meet all four phases of cognitive presence (i.e., triggering, exploration, integration, and resolution) and were given specific descriptions of each phase had higher levels of cognitive presence than students who were not informed. Similarly, Scanlan & Hancock (2010) found that providing occupational therapy students with a framework that described elements of clinical reasoning lead to an increased frequency of discussion postings that reflected thinking at the evaluation cognitive level. In the future, online instructors and instructional designers should provide clear expectations for critical thinking, preferably in a discussion rubric, and encourage students to use the expectations as a guide when writing a discussion response and as a tool for self- assessment prior to posting a discussion response.

Group size. Another strategy for promoting critical thinking in AODs is to control the size of the discussion group. Research suggests that smaller discussion groups foster more critical thinking than larger discussion groups (Bliss & Lawrence, 2009; Scanlan & Hancock, 2010; Sautter, 2007; Schellens & Valcke, 2006). One reason may be that extraneous cognitive load is reduced because there are not as many postings to read (Schellens & Valcke, 2006). AODs limited to 13 students or fewer resulted in higher levels of knowledge construction, characterized by evaluation, proposing ideas based on theory, testing new knowledge against existing schema, and applying new knowledge (Hew & Cheung, 2011; Schellens & Valcke, 2006). Therefore, online instructors should consider breaking AODs into smaller groups, rather than conducting whole-class AODs in order to increase critical thinking.

Instructional Approaches

The second broad instructional design theme that emerged from a review of the literature is the use of specific instructional approaches to promote critical thinking. An instructional approach is a plan for determining how a prompt should be structured to meet learning objectives. There are several specific instructional approaches for designing discussion prompts, including case-based, problem-based, and project-based approaches as well as debate and role play approaches, some of which are more effective than others for promoting critical thinking.

Case-based approach. Case-based instructional approaches have been used across a variety of different disciplines, ranging from social sciences to health care, to promote the application of theory to practice, inter-professional collaboration, and the development of critical thinking, decision-making, problem-solving skills (Koole et al., 2012; Popil, 2011; Waterson, 2011). As applied to AODs, case-based discussion prompts present a specific scenario within an authentic, often discipline-related, context designed to:

engage the participants in analysis and evaluation of a given case, in order to develop their skills in handling a range of similar real-life situations later on, or, alternatively, to create a better and deeper understanding of the general principles that are illustrated by the facts of the case presented. (Romiszowski, 1995, p. 166)

Despite the potential benefits and applicability of case-based discussions to a wide variety of academic disciplines, a recent search yielded only two recent studies that examine the efficacy of case-based discussions for critical thinking. In one study, students were asked to discuss a case pertaining to learning theories. Most discussion posts (78%) were at the integration level of

cognitive presence, characterized by the connection of ideas, synthesis, and the creation of solution (Richardson & Ice, 2010). In the other study, researchers assessed student perceptions of case-based discussions. Students reported that case-based discussions were useful for critical thinking (Weil, McGulan, & Kerri, 2011). While these studies suggest that case-based discussions promote critical thinking, more research should be conducted to replicate findings and to determine for which academic disciplines case-based discussions are most effective.

Problem-based approach. While case-based AODs may elicit problem solving through the analysis of an authentic scenario, problem-based AODs exclusively focus on presenting an ill-structured problem for which students must collaboratively identify solutions. The overall aim of problem-based learning is not only to identify a viable solution, but to increase critical thinking and knowledge construction through the process of discussing viable solutions (Wu, Hou, Hwang, & Liu, 2013; Wood, 2003). Existing research on the efficacy of problem-based discussions is mixed. Şendag and Odabaşı (2009) found that students who participated in a problem-based discussion had higher scores on a critical thinking assessment than students who participated in a traditional discussion. Conversely, Hou (2011) and Wu et al. (2013) found that problem-based discussions yielded mostly lower level postings classified at the understand cognitive level of Bloom's taxonomy. For example, in one discussion where students were asked to discuss organizational management problems in an MP3 company, 78% of postings were at the understand cognitive level and in another discussion where students were asked to discuss bottlenecks faced by a real estate brokerage company, 88% of the postings were at the understand cognitive level (Hou, 2011).

There are several reasons why the problem-based discussion research may be mixed. First, the studies were conducted in different countries (i.e., Taiwan, Turkey). Therefore, it is unclear whether any cultural dimensions, such as power distance, may have influenced the results. Second, the educational level (i.e., undergraduate or graduate) was not identified, leaving questions unanswered about whether the efficacy of problem-based discussions may be influenced by level of education. Third, studies included different dependent variables. Şendag and Odabaşı (2009) measured critical thinking, via the Watson–Glaser critical thinking skills test, before and after participation in the discussions. Hou (2011) and Wu et al. (2013) used Bloom's taxonomy to code the cognitive level of students' postings. Fourth, the mixed results of the studies align with a larger body of problem-based learning research that is also mixed, suggesting that confounding variables (e.g., age, personality, course level) may need to be identified and controlled for in future studies (Şendag & Odabaşı, 2009).

Project-based approach. Project-based learning primarily focuses on the targeted application of and integration of knowledge, rather than the acquisition of knowledge, to create a concrete artifact in an authentic context (Papanikolaou & Boubouka, 2010; Mills & Treagust, 2003). Most of the recent research on project-based learning suggests that it positively influences critical thinking in AODs (Koh, Herring, & Hew, 2010; Papanikolaou & Boubouka, 2010; Thomas & MacGregor, 2005). For example, Koh et al. (2010) found that students in project-based discussions, who were asked to develop e-learning courseware, engaged in higher levels of knowledge construction than students in non-project-based discussions. Higher levels of knowledge construction were characterized by the integration, justification, and resolution of ideas as opposed to lower levels characterized by sharing information, posting questions, and exploring ideas. Conversely, Wu et al. (2013) found that most postings reflected the understand cognitive level of Bloom's taxonomy during a discussion in which students were asked to design lesson plans for children's digital instructional media. However, one notable difference between the

studies is timing. Studies suggesting that project-based learning had a positive influence on critical thinking included project-based discussions that occurred over the span of several weeks or the entire course (Koh, Herring, & Hew, 2010; Papanikolaou & Boubouka, 2010; Thomas & MacGregor, 2005) while Wu et al. (2013) examined a project-based discussion that lasted only two weeks. Therefore, when using a project-based instructional approach, online instructors and instructional designers may want to design a project-based discussion that spans several weeks.

Debate-based approach. The debate instructional approach requires students to take a position on an issue, which provides opportunities for the development and justification of arguments and counterarguments, the identification of inconsistencies in reasoning, the re-evaluation of initial arguments, and the resolution of differences between perspectives (Darabi et al., 2011; Jonassen, 1997). There is strong evidence that the use of debate-based AODs leads to higher levels of critical thinking. For example, debate approaches in which students were required to develop arguments for or against an issue led to high levels of exploration (e.g., explore relevant ideas, organize and make sense of facts), integration (e.g., making judgments about ideas or hypotheses), and resolution (e.g., testing ideas or hypotheses) (Darabi et al., 2011; Kanuka et al., 2007; Richardson & Ice, 2010). One limitation, however, of using a debate-based AOD is that students may be inclined to support their position with only their opinions, particularly if they feel strongly about the issue (Darabi et al., 2011). Assigning students to take a position for or against an issue might reduce the risk of this possibility, as opposed to allowing students to select a stance based on personal beliefs.

Role play approach. The role play approach encourages students to examine a topic or problem from different perspectives (Darabi et al., 2011; Kalelioğlu & Glbahar, 2014). There are two sub-approaches for designing a role play discussion prompt. The first sub-approach entails asking students to portray discipline-specific roles (e.g., financial manager, human resources manager, teacher, policy maker) to increase the level of discipline-specific knowledge and promote communication, teamwork, and decision-making skills (McLaughlin, 2007). The second sub-approach entails asking students to portray generic roles (e.g., devil's advocate, summarizer, synthesizer) to improve the overall quality of the discussion (Wise, Saghafian, & Padmanabhan, 2012).

Research on the effectiveness of discipline-specific role play AODs is mixed. For example, information management students asked to portray discipline-specific roles (e.g., HR manager, sales manager, financial manager) in response to a business case study yielded discussion posts that primarily reflected the understand cognitive level of Bloom's taxonomy and a low level of knowledge construction (sharing/comparing of information) (Hou, 2011; Hou, 2012). Similarly, assigning students educational roles (administrator, teacher, student, and content specialist) and asking them to discuss a professional problem resulted in low levels of cognitive presence as well, characterized by sharing ideas (Kalelioğlu & Glbahar, 2014). However, education and engineering students asked to portray discipline-specific roles in response to a case study reflected high levels of integration, characterized by the testing of ideas and the application of content (Darabi et al., 2011; McLaughlin, 2007). Studies in which students were allowed choose their roles report higher levels of critical thinking. Allowing students to choose their roles may foster critical thinking for two reasons. First, discipline-specific role playing requires some degree of domain knowledge (Darabi et al., 2011); therefore, students may select roles with which they are most familiar based on prior educational or professional experience, giving them enough foundational knowledge to construct better arguments and justifications. Second,

students may choose a role about which they feel most passionate and interested, which may increase the level of engagement with classmates and time spent thinking about the content.

The second sub-approach of role playing pertains to the assignment of generic roles, such as starter, questioner, and summarizer (see a list of roles and corresponding functions in Table 2). Generic roles do not require domain-specific knowledge and, as a result, may be more appropriate for novice learners than discipline-specific roles. Overall, using the generic role approach produces a large number of postings at a low level of knowledge construction, characterized by sharing information (De Wever, Van Keer, Schellens, & Valcke, 2010; Wise & Chiu, 2011). However, discussions with generic roles produce higher levels of knowledge construction than those without (De Wever et al., 2010), suggesting that there may be a benefit to using the generic role play approach. Furthermore, some generic roles are more effective than others for fostering knowledge construction. For example, the summarizer, synthesizer, and wrapper roles, all of which have similar functions are most effective for fostering higher levels of knowledge construction (De Wever et al., 2010; Hew et al., 2010; Wise & Chiu, 2011). In particular, the synthesizer/wrapper role was particularly effective mid-discussion to facilitate the transition in discussion from low to high levels of knowledge construction (Wise & Chiu, 2011). In addition, students perceived the devil's advocate, questioner, and synthesizer roles most helpful for thinking about and contributing to the discussion (Wise et al., 2012). It is important to note that the roles that are most effective inherently require higher levels of thinking. For example, the devil's advocate and questioner roles focus on challenging peers while the summarizer, synthesizer, and wrapper roles focus on making connections between posts, synthesizing what has been said, and drawing conclusions. These functions are more likely to elevate levels of thinking compared to other roles such as the elaborator and the importer which focus on sharing ideas (De Wever et al., 2010; Wise & Chiu, 2011).

Table 2. *Student Roles and Functions*

Roles	Function
Devil's Advocate	Take an opposing position of a classmate and justify it.
Elaborator	Expand or provide support for an idea someone else has already made.
Importer	Bring outside ideas, from other classes or the news, into the discussion.
Inventor	Generate new ideas and perspectives that have yet to be brought up.
Mini-Me	Represent the author's position (from an assigned reading) on the discussion topic.
Moderator/ Questioner	Monitor the discussion, ask questions and probe others to elaborate on ideas.
Starter	Begin the discussion, add new points that could be built upon, raise most important issues.
Source Searcher	Seek external information pertaining to the discussion.
Summarizer/Wrapper	Post interim summaries during the discussion and a final synopsis at the end; identify areas of dissonance and harmony and draw conclusions.
Synthesizer	Make connections between posts and push the conversation forward.
Theoretician	Introduce theoretical information to the discussion.
Traffic Director	Keep the discussion moving and intervene when discussion gets off track.

Note: Roles and functions were gathered from De Wever et al. (2010), Wise et al. (2012), and Wise & Chiu (2011).

Summary

Both the structure of AODs and the instructional approaches used to design AODs influence critical thinking, although the level of empirical support varies. There is strong empirical support for the design of detailed discussion prompts that intentionally guide students to demonstrate higher levels of thinking, the use of scaffolding to help students construct quality initial prompts and response posts, the inclusion of clear expectations that focus on critical thinking, and small group size. Strong support also exists for using a debate-based instructional approach to design AODs. However, there is mixed support for the use of case-based, problem-based, project-based, and role play approaches for promoting critical thinking in AODs.

Inconsistencies in findings may be due to different dependent variables (e.g., critical thinking scores, phases of cognitive presence, cognitive level per Bloom's taxonomy, phases of knowledge construction) or due to the wording of the discussion prompt. Unfortunately, very few studies revealed the exact wording of the prompts used, which may offer some indication of why some instructional approaches were more effective than others. Existing research emphasizes the importance of intentionally designing prompts to guide students to demonstrate critical thinking, given that some students may not achieve higher levels of thinking without being required to do so (Alexander et al., 2010; Arend, 2009; Hou, 2012; Pena & Almaguer, 2012; Song & McNary, 2011). While prompts may be designed using sound instructional approaches, the wording used to elicit responses may unintentionally promote lower levels of thinking (e.g., Describe the steps you would take to address the problem in the case study). Therefore, whenever possible, future studies should include the exact wording of the discussion prompt studied.

Facilitation Strategies

A well-designed discussion prompt is the first step in ensuring that critical thinking occurs in AODs. The second step is effective facilitation. AOD facilitators can provide additional scaffolding and prompting to help students achieve higher levels of thinking and can mitigate the negative effects of a poorly designed discussion prompt. AODs may be facilitated by faculty members, by students, or a combination of both. In the paragraphs that follow, the existing literature on the influence of faculty and student AOD facilitation approaches on critical thinking will be discussed.

Faculty Facilitation

Level of participation. Determining the appropriate level of faculty participation in AODs is challenging. On one hand, too little participation from faculty may result in AODs that stray off topic or devolve into exchanges based solely on opinion (Maddix, 2012). Furthermore, without feedback or direction from faculty, students may be left feeling like the AOD is equivalent to putting a message in the bottle and dropping it into the ocean (Rovai, 2007). On the other hand, too much participation from faculty may stifle the discussion and the free flow of ideas, leaving students feeling like they have nothing to contribute (Maddix, 2012). The majority of existing research suggests that a low level of faculty participation is more helpful for promoting critical thinking, either directly or indirectly by increasing the amount of student-student interaction (Arend, 2009; An, Shin, & Lim, 2009; Dennen, 2005). Specifically, responding to nearly every student's post or responding with comments that are off-topic or more conversational than

academic is detrimental to the promotion of critical thinking in AODs (Arend, 2009; Bliss & Lawrence, 2009). Therefore, the research seems to emphasize the quality, rather than the quantity, of faculty participation for the promotion of critical thinking.

Questioning. One of the most widely studied AOD facilitation strategies is Socratic questioning. Socratic questioning entails asking a series of questions designed to clarify assertions, probe assumptions, and elicit reasoning and evidence (Hew et al., 2010). There is significant support for the use of Socratic questioning to promote critical thinking in AODs (Darabi et al., 2013; Maddix, 2012; Rovai, 2007; Yang, Newby, & Bill, 2005; Yang, Newby, & Bill, 2008; Xie & Ke, 2011). For example, Yang et al. (2005) found that AODs in which the instructor used Socratic questioning reflected higher levels of knowledge construction compared to AODs in which the instructor did not use Socratic questioning. There are two reasons why Socratic questioning may be effective for promoting critical thinking. First, Socratic questioning challenges students to move beyond restating knowledge or giving their opinion by explaining their reasoning or providing evidence for their points. Second, using Socratic questioning is a form of cognitive modeling which may help students learn how to ask probing questions of themselves and their classmates (Xie & Ke, 2011; Yang et al., 2008). Therefore, online instructors should be using Socratic questioning in AODs, particularly at the beginning of the course to promote critical thinking in discussion postings and to develop students' critical thinking skills over time.

Student Facilitation

In some cases, the presence of an instructor in an AOD may stifle interaction and the likelihood for high levels of critical thinking and knowledge construction. For example, Correia and Baran (2010) found that instructor-led AODs resulted in a series of essays from students rather than meaningful student-student interaction. Therefore, student-facilitated AODs may be a viable option to improve the quality of AODs. In particular, several student facilitation strategies have been identified as effective for promoting critical thinking in AODs. The strategies include showing appreciation, providing comments/opinions/explanations, asking questions, encouraging peers to contribute, giving peer feedback, and summarizing what has been discussed thus far (Ekahitanond, 2013; Hew & Cheung, 2011; Lim, Cheung, & Hew, 2011).

Some of student facilitation strategies reflect an explicit relationship to critical thinking while others do not. For example, asking questions that prompt students to clarify or justify their position or re-examine their assumptions, providing feedback to peers about whether they agree or disagree, and offering a summary of the discussion align with the higher phases of cognitive presence and perspective-taking. In addition, these strategies are consistent with what has been found in the existing research regarding the effectiveness of Socratic questioning (Darabi et al., 2013; Maddix, 2012; Rovai, 2007; Yang et al., 2005; Yang et al., 2008; Xie & Ke, 2011) and assigning students the summarizer and devil's advocate roles in promoting critical thinking (Wise et al., 2012; Wise & Chiu, 2011). Conversely, other effective strategies, such as showing appreciation or providing comments/opinions/explanations, are not explicitly related to critical thinking. Hew and Cheung (2011) acknowledged this paradox and suggested that showing appreciation motivates students to make additional contributions and providing comments or opinions may generate further discussion. While the increase in postings does not guarantee critical thinking, interaction is an important aspect of the construction of knowledge.

Summary

Both faculty and student facilitation are effective for promoting critical thinking in AODs. Effective faculty facilitators limit their involvement in AODs and, when they do participate, use Socratic questioning to model and promote critical thinking. Effective student facilitators show appreciation for and encourage peers to participate, ask questions of or provide comments to peers, give feedback to peers, or summarize the content of peers' posts. While student facilitation is advantageous because it encourages more student-student interaction, faculty facilitation may be needed as well especially if the discussion becomes off-topic, devolves into an exchange of opinions, or if students do not have strong critical thinking skills. Therefore, depending on the educational level and experience of the students in the course, both faculty and student facilitation strategies may be more effective than one or the other.

Conclusion and Recommendations

AODs are a constant fixture in today's online courses used to promote critical thinking through interaction with others, regardless of time and space (Arend, 2009; Bowden, 2012; Spartariu & Winsor, 2013). Given the ubiquity of AODs, it is important to examine which instructional design and facilitation approaches are most effective for promoting critical thinking in AODs. A review of the literature revealed several specific approaches that promote critical thinking in AODs, as reflected in multiple cognitive constructs (e.g., cognitive presence, cognitive domain, knowledge construction, and perspective-taking). There is strong empirical support for some of the approaches (as shown in Table 3) and little or mixed empirical support for others, including the use of case-based (Richardson & Ice, 2010; Weil et al., 2011), problem-based (Hou, 2011; Şendag & Odabaşı, 2009; Wu et al., 2013), project-based (Koh et al., 2010; Papanikolaou & Boubouka, 2010; Thomas & MacGregor, 2005; Wu et al., 2013), and role play instructional approaches (Darabi et al., 2011; Hou, 2011; Hou, 2012; Kalelioğlu & Gúlbahar, 2014; McLaughlin, 2007).

Table 3. *Empirically Supported Instructional Design and Facilitation Strategies for Promoting Critical Thinking in AODs*

Strategy	Sources
1. Design discussion prompts that are structured (e.g., clear, detailed, specify instructions for participation and time parameters).	Chadwick & Ralston, 2010; Darabi et al., 2013; deNoyelles et al., 2014; Kanuka et al., 2007; Lee, 2012; McLoughlin & Mynard, 2009; Sautler, 2007; Scanlan & Hancock, 2010
2. Design discussion prompts to intentionally elicit a response that reflects higher levels of thinking.	Alexander et al., 2010; Arend, 2009; Hou, 2012; Pena & Almaguer, 2012; Song & McNary, 2011
3. Provide scaffolding in the form of initial and response posts exemplars.	Darabi & Jin, 2012; Land et al., 2007; Stegmann et al., 2007
4. Provide clear expectations regarding how students are expected to demonstrate critical thinking in posts.	Bai, 2009; Pena & Almaguer, 2012; Scanlan & Hancock, 2010
5. Limit the size of the discussion group to 13 students or fewer.	Bliss & Lawrence, 2009; Hew & Cheung, 2011; Scanlan & Hancock, 2010; Sautter, 2007; Schellens & Valcke, 2006

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| 6. Use debate-based approaches to design AODs. | Darabi et al., 2011; Kanuka et al., 2007; Richardson & Ice, 2010 |
| 7. Limit faculty participation in AODs (e.g., avoid responding to every student's post; use Socratic questioning when necessary to elicit higher levels of thinking and to model critical thinking) | Arend, 2009; An et al., 2009; Darabi et al., 2013; Dennen, 2005; Yang et al., 2005; Yang et al., 2008; Xie & Ke, 2011 |
| 8. Incorporate student facilitation in AODs and encourage facilitators to show appreciation to peers, provide comments/opinions/explanations to peers, ask questions to peers, encourage peers to contribute, give peer feedback, and summarize what has been discussed thus far | Ekahitanond, 2013; Hew & Cheung, 2011; Lim et al., 2011 |

In the future, additional research should be conducted to determine the efficacy of case-based, problem-based, project-based, and role play instructional approaches for promoting critical thinking. Specifically, it would be useful to conduct studies in which such approaches are compared to address existing limitations in the literature related to the use of different dependent variables (e.g., cognitive presence, knowledge construction, cognitive level) and the influence of potentially confounding variables (e.g., variances in participants' nationality, level of education, extent and type of instructor/student facilitation). Furthermore, researchers should identify a clear definition of critical thinking and a comprehensive description of how critical thinking should be demonstrated and assessed in AODs. This information will help instructional designers and faculty purposefully develop discussion prompts that align with specific, identified skills, which in turn, will allow for the assessment of those skills.

References

- Agee, J., & Smith, S. U. (2011). Online discussions in a doctoral research methods course: "Like a text by many authors." *Students in Continuing Education*, 33(3), 301-319. <http://dx.doi.org/10.1080/0158037X.2010.515574>
- Alamro, A. S., & Schofield, S. (2012). Supporting traditional PBL with online discussion forums: A study from Qassim Medical School. *Medical Teacher*, 34(s1), S20-S24. <http://dx.doi.org/10.3109/0142159X.2012.656751>
- 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. Retrieved from <http://jolt.merlot.org/>
- An, H., Shin, S., & Lim, K. (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussions. *Computers & Education*, 53(3), 749-760. <http://dx.doi.org/10.1016/j.compedu.2009.04.015>
- Anderson, T., & Garrison, D. R. (1995). Critical thinking and distance education: Developing critical communities in an audio teleconference context. *Higher Education*, 29(2), 183-199.
- Andresen, M. A. (2009). Asynchronous discussion forums: success factors, outcomes, assessments, and limitations. *Educational Technology & Society*, 12(1), 249-257.
- Arend, B. (2009). Encouraging critical thinking in online threaded discussions. *The Journal of Educators Online*, 6(1), 1-23. Retrieved from <http://www.thejeo.com/>

-
- Armstrong, K., & Manson, M. (2010). What is lost and what remains: An exploration of the pedagogical challenges of online discussions in two online teacher education learning communities. *Language & Literacy: A Canadian Educational E- Journal*, 12(2), 18-29.
- Ayers- Schlosser, L., & Simonson, M. R. (2010). *Distance education: Definitions and glossary of terms* (3rd ed.). Charlotte, NC: IAP-Information Age Publishing.
- Bai, H. (2009). Facilitating students' critical thinking in online discussions: An instructor's experience. *Journal of Interactive Online Learning*, 8(2), 156-164. Retrieved from <http://www.ncolr.org/>
- Bassett, P. (2011). How do students view asynchronous online discussions as a learning experience? *Interdisciplinary Journal of E- Learning and Learning Objects*, 7, 69-79.
- Bates, A.W. (1997). The impact of technological change on open and distance learning. *Distance Education*, 18(1), 93-109. <http://dx.doi.org/10.1080/0158791970180108>
- Bliss, C. A., & Lawrence, B. (2009). Is the whole greater than the sum of its parts? A comparison of small group and whole class discussion board activity in online courses. *Journal of Asynchronous Learning Networks*, 13(4), 25-39.
- Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals*. London: Longmans, Green, and Co.
- Bowden, R. (2012). Online graduate education: Developing scholars through asynchronous discussion. *International Journal of Teaching and Learning in Higher Education*, 24(1), 52-64.
- Cain, J., & Smith, D. (2009). Increasing moral reasoning skills through online discussions. *Quarterly Review of Distance Education*, 10(2), 149-163.
- Chadwick, S., & Ralston, E. (2010). Perspective- taking in structured and unstructured online discussions. *International Journal of Teaching & Learning in Higher Education*, 22(1), 1-11.
- Chavira, M. C. (2011). *The relationship between social patterns of discourse to meaning making in asynchronous text-based discussions* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses. (UMI No. 3534139)
- Chen, N.-S., Wei, C.-W., Wu, K.-T., & Uden, L. (2009). Effects of high level prompts and peer assessment on online learners' reflection levels. *Computers & Education*, 52(2), 283-291. <http://dx.doi.org/10.1016/j.compedu.2008.08.007>
- Cooper, P. A. (1993). Paradigm shifts in designed instruction: From behaviorism to cognitivism to constructivism. *Educational Technology*, 33(5), 12-19.
- Darabi, A., Arrastia, M. C., Nelson, D. W., Cornille, T., & Lang, X. (2011). Cognitive presence in asynchronous online learning: A comparison of four discussion strategies. *Journal of Computer Assisted Learning*, 27(3), 216-227. <http://dx.doi.org/10.1111/j.1365-2729.2010.00392.x>
- Darabi, A. & Jin, L. (2013). Improving the quality of online discussion: The effects of strategies design based on cognitive load theory principles. *Distance Education*, 34(1), 21-36. <http://dx.doi.org/10.1080/01587919.2013.770429>
- Darabi, A., Liang, X., Suryavanshi, R., & Yurekli, H. (2013). Effectiveness of online discussion strategies: A meta-analysis. *American Journal of Distance Education*, 27(4), 228-241. <http://dx.doi.org/10.1080/08923647.2013.837651>
- Dennen, V. P. (2005). From message posting to learning dialogues: Factors affecting learner participation in asynchronous discussion. *Distance Education*, 26(1), 127-148. <http://dx.doi.org/10.1080/01587910500081376>
- deNoyelles, A., Zydney, J. M., & Chen, B. (2014). Strategies for creating a community of inquiry through online asynchronous discussions. *Journal of Online Learning and Teaching*, 10(1), 153-165. Retrieved from <http://jolt.merlot.org>
-

- De Wever, B., Van Keer, H., Schellens, T., & Valcke, M. (2010). Roles as a structuring tool in online discussion groups: The differential impact of different roles on social knowledge construction. *Computers in Human Behavior*, 26(4), 516-523. <http://dx.doi.org/10.1016/j.chb.2009.08.008>
- Dietz-Uhler, B. & Lanter, J. R. (2009). Using the four- questions technique to enhance learning. *Teaching of Psychology*, 36(1), 38-41. <http://dx.doi.org/10.1080/00986280802529327>
- 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. Retrieved from <http://ajer.synergiesprairies.ca>
- Garrison, D. R. (1991). Critical thinking and adult education: A conceptual model for developing critical thinking in adult learners. *International Journal of Lifelong Education*, 10(4), 287-303. <http://dx.doi.org/10.1080/0260137910100403>
- 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. <http://dx.doi.org/10.1080/08923640109527071>
- Grady, H. M. (2006). Instructional scaffolding for online courses. In *2006 IEEE International Professional Communication Conference* (pp. 148-152). Saratoga Springs, NY: Institute of Electrical and Electronics Engineers. doi:10.1109/IPCC.2006.320377
- Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research*, 17(4), 397-431.
- Halpern, D. F. (1998). Teaching critical thinking for transfer across domains: Dispositions, skills, structure training, and metacognitive monitoring. *American Psychologist*, 53(4), 449-455.
- Harasim, L. (1999). A framework for online learning: The Virtual-U. *Computer*, 32(9), 44-49. <http://dx.doi.org/10.1109/2.789750>
- Harasim, L. (2000). Shift happens: Online education as a new paradigm in learning. *Internet and Higher Education*, 3(1-2), 41-61. [http://dx.doi.org/10.1016/S1096-7516\(00\)00032-4](http://dx.doi.org/10.1016/S1096-7516(00)00032-4)
- Hew, K. F., & Cheung, W. S. (2011). Higher-level knowledge construction in asynchronous online discussions: An analysis of group size, duration of online discussion, and student facilitation techniques. *Instructional Science*, 39(3), 303-319. <http://dx.doi.org/10.1007/s11251-010-9129-2>
- Hew, K. F., Cheung, W. S., & Ng, C. S. L. (2010). Student contribution in asynchronous online discussion: A review of the research and empirical exploration. *Instructional Science*, 38(6), 571-606. <http://dx.doi.org/10.1007/s11251-008-9087-0>
- Hiltz, S. R., & Wellman, B. (1997). Asynchronous learning networks as a virtual classroom. *Communications of the ACM*, 40(9), 44-49.
- Hou, H.-T. (2011). A case study of online instructional collaborative discussion activities for problem solving using situated scenarios: An examination of content and behavior cluster analysis. *Computers and Education*, 56(3), 712-719. <http://dx.doi.org/10.1016/j.compedu.2010.10.013>
- Hou, H.-T. (2012). Analyzing the learning process of an online role-playing discussion activity. *Educational Technology & Society*, 15(1), 211-222.
- Hsiao, W.-Y., Chen, M. W., & Hu, H.-W. (2013). Assessing online discussions: Adoption of critical thinking as a grading criterion. *International Journal of Technology, Knowledge, and Society*, 9(3), 15-25.
- Huang, H.-M. (2002). Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology*, 33(1), 27-37. <http://dx.doi.org/10.1111/1467-8535.00236>

-
- Jonassen, D. H. (1997). Instructional design models for well-structured and ill-structured problem- solving learning outcomes. *Educational Technology Research and Development*, 45(1), 65-94. <http://dx.doi.org/10.1007/BF02299613>
- Jonassen, D., Davidson, M., Collins, M., Campbell, J., & Haag, B. B. (1995). Constructivism and computer-mediated communication in distance education. *American Journal of Distance Education*, 9(2), 7-26. <http://dx.doi.org/10.1080/08923649509526885>
- Jorczak, R. L. & Bart, W. (2009). The effect of task characteristics on conceptual conflict and information processing in online discussion. *Computers in Human Behavior*, 25(5), 1165-1171. <http://dx.doi.org/10.1016/j.chb.2009.04.010>
- Kalelioğlu, F. & Gülbahar, Y. (2014). The effect of instructional techniques on critical thinking and critical thinking dispositions in online discussion. *Educational Technology & 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. <http://dx.doi.org/10.1111/j.1467-8535.2006.00620.x>
- Klisc, C., McGill, T., & Hobbs, V. (2009). The effect of assessment on the outcomes of asynchronous online discussion as perceived by instructors. *Australasian Journal of Educational Technology*, 25(5), 666-682.
- Koh, J. H. L., Herring, S. C., & Hew, K. F. (2010). Project-based learning and student knowledge construction during asynchronous online discussion. *The Internet and Higher Education*, 13(4), 284-291. <http://dx.doi.org/10.1016/j.iheduc.2010.09.003>
- Koole, S., De Wever, B., Aper, L., Vervaeke, S., Derese, A., & De Bruyn, H. (2012). Using online periodontal case-based discussions to synchronize theoretical and clinical undergraduate dental education. *European Journal of Dental Education*, 16(1), 52-58. <http://dx.doi.org/10.1111/j.1600-0579.2011.00719.x>
- Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into Practice*, 41(4), 212-264. http://dx.doi.org/10.1207/s15430421tip4104_2
- Land, S. M., Choi, I., & Ge, X. (2007). Scaffolding online discussions to promote reflection and revision of understanding. *International Journal of Instructional Media*, 34(4), 409-418.
- Lee, J. (2012). Patterns of interaction and participation in a large online course: Strategies for fostering sustainable discussion. *Educational Technology & Society*, 15(1), 260-272.
- Lim, S. C. R., 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.
- Ling, S. W., Koo, A. C., & Ong, C. C. (2010). The reasons for encouraging or inhibiting students' active participation in asynchronous online discussion: Three cases from Malaysia. *International Journal of Interdisciplinary Social Sciences*, 5(1), 421-430.
- Maddix, M. A. (2012). Generating and facilitating effective online learning through discussion. *Christian Education Journal*, 9(2), 372-385.
- McLaughlan, R. G. (2007). Instructional strategies to educate for sustainability in technology education. *International Journal of Engineering Education*, 23(2), 201-208.
- McLoughlin, D., & Mynard, J. (2009). An analysis of higher order thinking in online discussions. *Innovations in Education and Teaching International*, 46(2), 147-160. <http://dx.doi.org/10.1080/14703290902843778>
- Mills, J. E., & Treagust, D. F. (2003). Engineering education – Is problem-based or project-based learning the answer. *Australasian Journal of Engineering Education*, 3, 2-16.
- Mokoena, S. (2013). Engagement with and participation in online discussion forums. *The Turkish Online Journal of Educational Technology*, 12(2), 97-105.
-

- Mulnix, J. W. (2012). Thinking critically about critical thinking. *Educational Philosophy and Theory*, 44(5), 464-479. <http://dx.doi.org/10.1111/j.1469-5812.2010.00673.x>
- Norton, S., & Kuruville, A. (2013). "What is not to discuss?" – Best practices for using discussions in online pedagogy. In *The Fourth International Conference on e-Learning (ICEL2013)* (pp. 178-783). Ostrava, Czech Republic: SDIWC Digital Library.
- Papanikolaou, K., & Boubouka, M. (2010). Promoting collaboration in a project-based e-learning context. *Journal of Research on Technology in Education*, 43(2), 135-155.
- Pena, C., & Almaguer, I. (2012). The use of online discussions to foster critical thinking in a teacher education program. *International Journal of Instructional Media*, 39(1), 25-32.
- 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.
- Popil, I. (2011). Promotion of critical thinking by using case studies as teaching method. *Nurse Education Today*, 31(2), 204-207. <http://dx.doi.org/10.1016/j.nedt.2010.06.002>
- Richardson, J. C., & Ice, P. (2010). Investigation students' level of critical thinking across instructional strategies in online discussions. *Internet and Higher Education*, 13(1-2), 52-59. <http://dx.doi.org/10.1016/j.iheduc.2009.10.009>
- Rizopoulos, L. A., & McCarthy, P. (2009). Using online threaded discussions: Best practices for the digital learner. *Journal of Educational Technology Systems*, 37(4), 373-383.
- Rollag, K. (2010). Teaching business cases online through discussion boards: Strategies and best practices. *Journal of Management Education*, 34(4), 499-526. <http://dx.doi.org/10.1177/1052562910368940>
- Romiszowski, A. J. (1995). Use of hypermedia and telecommunications for case-study discussions in distance education. In F. Lockwood (Ed.), *Open and distance learning today* (pp. 164-172). New York, NY: Routledge.
- Rovai, A. P. (2007). Facilitating online discussions effectively. *Internet and Higher Education*, 10(1), 77-88. <http://dx.doi.org/10.1016/j.iheduc.2006.10.001>
- Sautter, P. (2007). Designing discussion activities to achieve desired learning outcomes: Choices using mode of delivery and structure. *Journal of Marketing Education*, 29(2), 122-131. <http://dx.doi.org/10.1177/0273475307302014>
- Scanlan, J. N. & Hancock, N. (2010). Online discussions develop students' clinical reasoning skills during fieldwork. *Australian Occupational Therapy Journal*, 57(6), 401-408. <http://dx.doi.org/10.1111/j.1440-1630.2010.00883.x>
- Scheffer, B. K., & Rubenfeld, M. G. (2000). A consensus statement on critical thinking in nursing. *Journal of Nursing Education*, 39(8), 352-359.
- Schellens, T., & Valcke, M. (2006). Fostering knowledge construction in university students through asynchronous discussion groups. *Computers & Education*, 46(4), 349-370. <http://dx.doi.org/10.1016/j.compedu.2004.07.010>
- Song, L., & McNary, S. W. (2011). Understanding students' online interaction: Analysis of discussion board postings. *Journal of Interactive Online Learning*, 10(1), 1-14.
- Spatariu, A., & Winsor, D. (2013). Factors that influence the quality of online discussions. In T. Bastiaens & G. Marks (Eds.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2013* (pp. 1398-1406). Chesapeake, VA: AACE.
- Stegmann, K., Weinberger, A., & Fischer, F. (2007). Facilitating argumentative knowledge construction with computer-supported collaboration scripts. *Computer-Supported Collaborative Learning*, 2(4), 421-447. doi:10.1007/s11412-007-9028-y

- Şendag, S., & Odabaşı, H. F. (2009). Effects of an online problem based learning course on content knowledge acquisition and critical thinking skills. *Computers & Education*, 53(1), 132-141. <http://dx.doi.org/10.1016/j.compedu.2009.01.008>
- Skinner, E. (2007). Building knowledge and community through online discussion. *Journal of Geography in Higher Education*, 31(3), 381-391.
- Skinner, E. (2009). Using community development theory to improve student engagement in online discussion: A case study. *Research in Learning Technology*, 17(2), 89-100.
- Sumner, J. (2000). Serving the system: A critical history of distance education. *Open Learning*, 15(3), 267-285.
- Thomas, W. R., & MacGregor, S. K. (2005). Online project-based learning: How collaborative strategies and problem solving processes impact performance. *Journal of Interactive Learning Research*, 16(1), 83-107.
- Waterston, R. (2011). Interaction in online interprofessional education case discussions. *Journal of Interprofessional Care*, 25(4), 272-279. doi:10.3109/13561820.2011.566647
- Weil, S., McGuigan, N., & Kern, T. (2011). The usage of an online discussion forum for the facilitation of case-based learning in an intermediate accounting course: A New Zealand case. *Open Learning*, 26(3), 237-251. doi:10.1080/02680513.2011.611685
- Wise, A. F., & Chiu, M. M. (2011). Analyzing temporal patterns of knowledge construction in a role- based online discussion. *Computer-Supported Collaborative Learning*, 6(3), 445-470. doi:10.1007/s11412-011-9120-1
- Wise, A. F., Saghafian, M., & Padmanabhan, P. (2012). Towards more precise design guidance: Specifying and testing the functions of assigned student roles in online discussions. *Educational Technology Research and Development*, 60(1), 55-82. doi:10.1007/s11423-011-9212-7
- Wood, D. F. (2003). ABC of learning and teaching in medicine: Problem based learning. *BMJ*, 326(7384), 328-330.
- Wu, S.-Y., Hou, H.-T., Hwang, W.-Y., & Liu, E. Z.-F. (2013). Analysis of learning behavior in problem- solving-based and project-based discussion activities within the seamless online learning integrated discussion (SOLID) system. *Journal of Educational Computing Research*, 49(1), 61-82. doi:10.2190/EC.49.1.c
- Xie, K. & Ke, F. (2011). The role of students' motivation in peer-moderated asynchronous online discussions. *British Journal of Educational Technology*, 42(6), 916-930. <http://dx.doi.org/10.1111/j.1467-8535.2010.01140.x>
- 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.
- Yang, Y.-T. C., Newby, T. J., & Bill, R. L. (2008). Facilitating interactions through structured web- based bulletin boards: A quasi-experimental study on promoting learners' critical thinking skills. *Computers & Education*, 50(4), 1572-1585. <http://dx.doi.org/10.1016/j.compedu.2007.04.006>

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