A Model for Effective Asynchronous Online Discussion
within the Community of Inquiry Framework

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Educators who utilize technology-supported tools to improve student-centered discussion may elect to format such discussions *synchronously*, when all students must be online and participating at the same time or *asynchronously*, when students may post their responses in a threaded format and do not have to be online at the same time. Asynchronous online discussion (AOD) allows students time to review, reflect, and write a post with more depth on a schedule that suits their needs (Alshahrani & Walker, 2016). Many platforms exist to support AOD ranging from public social networking sites, such as Facebook, to private learning management systems (LMS), such as Blackboard. Most AOD post formats are text-based, involving typed, written responses. Students who have difficulty with written language may feel hesitant about participating in discussions. Some educators have found that students who have low self-efficacy for written language felt more comfortable using audio-based AOD, involving recordings of students' voices while talking their responses out loud, which also promoted originality of ideas (Hew & Cheung, 2012; 2013). Social interactions that occur online may depend not only on the students' comfort with the post format, but whether there is an instructor or peer facilitator for group discussions. Hew (2015) found advantages for both instructor and peer facilitation, depending on students' level of comfort with academic material. Thus, platform type, post format, and facilitation type are important considerations for educators seeking to create a community of inquiry to meet the needs of their students.

An effective AOD can provide a means for creating a supportive community of inquiry. Following the premises of sociocultural theory (e.g., Vygotsky, 1978), a community of inquiry can be created, in which cognitive, social, and teaching presences interact to create deep learning among students (Cho & Tobias, 2016; Garrison, Anderson, & Archer, 2010; Redstone, Stefaniak, & Luo, 2018). *Cognitive presence* is the level of learning students may experience and how engaged they are with a task (Oh & Kim, 2016); *social presence* refers to online learners' sense of community and connectedness, which leads to higher quality learning (Chapman, Storberg-Walker, & Stone, 2008); and *teaching presence* refers to the patterns of facilitation of learning by instructors and/or peer leaders (Clarke & Bartholomew, 2014).

For example, Lai (2015) examined threaded AOD posts and interviews among instructors and doctoral students during their coursework and dissertation proposal phases and found that instructors' design of learning tasks affected the process of knowledge construction. Tasks during the coursework phase primarily required recall of prior knowledge, while tasks during the dissertation proposal phase were designed to meet the specific needs of learners, required more analysis, and resulted in more postings exhibiting knowledge construction. Furthermore, in discussions when knowledge construction was low, the amount of direct instruction was very high, indicating a need for teacher presence at the post-graduate level, particularly regarding modeling critical feedback and facilitating discussion (Lai, 2015). Similarly, Lee and Tsai (2011) found that, in addition to receiving support through sharing of meaningful experiences, discourse between instructors and graduate students in AOD involved elaborating on and challenging concepts (Lee & Tsai, 2011). Together, these studies suggest that co-construction of knowledge and meaning in higher education involves teacher presence through feedback, discussion facilitation, and sharing meaningful experiences, which affects and is affected by cognitive presence.

Thus far, research studies have not examined the combined influences of post format, platform type, and facilitation type on perceived learning outcomes within the context of how each contributes to cognitive, social, and teaching presences within the community of inquiry framework. Therefore, this literature review seeks to understand how text-based and audio-based AOD, public and private online discussion platforms, and teacher and peer facilitation contribute to cognitive, social, and teaching presences within the community of inquiry

framework to affect perceived learning outcomes. The goal of this literature review is to provide a basic model of these interactions to assist educators in making decisions about using AODs in their instructional practices. Consequently, the following research questions (RQ) were formulated for this study:

RQ1: In what ways do **text-based and audio-based** AOD post formats affect perceived learning outcomes within the community of inquiry framework?

RQ2: In what ways do **public forums and private LMSs** affect perceived learning outcomes within the community of inquiry framework?

RQ3: In what ways does discussion **facilitation** of AODs affect perceived learning outcomes within the community of inquiry framework?

Method

Literature Search

To obtain an overview of current research relevant to AOD, a literature search was carried out to create a scientific papers database relevant to the research questions posed. An extensive online search of peer reviewed literature was conducted via EBSCOhost through numerous databases including Academic Search Complete, Academic Search Premier, Communication and Mass Media Complete, Computer Source, Computers and Applied Sciences Complete, Education Full Text (H.W. Wilson), Education Research Complete, ERIC, Psychology and Behavioral Sciences Collection, PsycINFO, and Sociological Collection. These databases cover representative journals on learning with educational technology. During the search, one main keyword – *asynchronous online discussion* – was combined with the following keywords: *perceived learning, community of inquiry, voice, audio, social media, Facebook, Wiki*, and *facilitate**. These keywords were selected to obtain representative samples of AOD literature specific to the use of varying post formats, LMSs, and discussion facilitation types.

Inclusion and Exclusion Criteria

To be eligible for this literature review, inclusion criteria were specified. Each selected study had to meet the following criteria:

- Published between 2000 and 2018.

- Investigated some form of asynchronous computer-mediated discussion.

- Employed an experimental or quasi-experimental design.

- Addressed a component of AOD design related to post format, LMS, or discussion facilitation type.

- Published in a peer-reviewed journal, as part of a conference paper, or a published book chapter.

- Recruited participants who were proficient in English and enrolled in higher education.

A total of 27 empirical articles were identified in the literature search based on these criteria and were included for coding.

Coding

The scientific papers included in this study were coded following the research questions. To address RQ1, each study was categorized according to whether a text-based or audio-based post format was used. To address RQ2, each study was categorized according to whether a private LMS or a public environment was used as the platform type. To address RQ3, each study was categorized according to whether discussions were facilitated by an instructor or peers (i.e., fellow students enrolled in the course). Table 1 presents the results of this coding for the 27 articles reviewed in this study and provides a summary of the conclusions of each article (See Appendix A).

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Results

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Post Format

AOD designs that use text-based communication rely on students discussing ideas in a written format. While a majority of AOD designs use written communication, some AOD designs rely on audio-based communication when students have the opportunity to record their voice. To address RQ1, the following section examines how text- and audio-based

communication in AODs affects perceived learning outcomes within the community of inquiry framework.

Text-Based Communication

Student self-efficacy, motivation, and participation in AOD interact during asynchronous online learning activities. To examine how these factors interact, Xie and Huang (2014) observed 132 students participating in a college level AOD within a private LMS (WebCT) with instructor facilitation and found relationships between learning beliefs, participation, and perceived learning outcomes, which were mediated by achievement goals. This relationship suggests that participation in a text-based AOD is more directly related to students' own goals for academic achievement. Whereas cognitive presence was operationalized by academic achievement goals by Xie and Huang (2014), Topcu (2010) took a more metacognitive approach by investigating the effects of *metacognitive monitoring*, the ability to monitor one's own learning, on participation and interaction within a text-based AOD in a private LMS without facilitation. Thirty pre-service teachers participated in the study and results showed that metacognitive monitoring (e.g., clarifying, inference making, judging, using strategies) was a strong predictor of interaction in an interactive, text-based AOD.

Cognitive reasons may motivate students to participate to a greater extent in collaborative text-based AODs in comparison to individualized AODs. Koh, Herring, and Hew (2010) investigated 17 graduate students' text-based AOD postings in a private LMS (Google Groups) without facilitation during both project-based and non-project learning activities. They found that discussions among students who were engaged in project-based learning activities demonstrated more advanced levels of knowledge construction; in other words, cognitive presence in the discussions was greater for students engaged in activities that required more group work and problem-solving tasks. Group work and co-construction of knowledge may be indicative of growing social presence in addition to cognitive presence. To gain a better understanding of co-construction of knowledge, Lai (2015) used text-based AOD in a private LMS (Moodle) without facilitation to examine how knowledge is constructed among 12 graduate students in Education at different phases of their program. He found that the quality of co-constructed knowledge was impacted by particular teaching strategies, such as amount of direct instruction and facilitation of discussion, suggesting that some degree of facilitation, or teaching

presence under the community of inquiry model, is required to increase cognitive presence in text-based AOD.

Audio-Based Communication

To increase cognitive presence, instructors may structure discussions such that students must collaborate to achieve higher levels of cognition. In a study with six graduate students participating in an online course, Oh and Kim (2016) examined the use of audio-based AOD in a private LMS (VoiceThread) paired with scaffolded learning to achieve high levels of thinking in discussions. Compared with students in the text-based AOD that demonstrated low levels of thinking skills, students in the audio-based AOD demonstrated higher levels of thinking skills such as application, analysis, and synthesis in their discussions, as well as averaging significantly more and longer posts. They concluded that audio-based AOD led to more positive learning experiences, increased cognitive effort and presence, and acknowledged the benefits of scaffolded learning.

In their study comparing text-based and audio-based AOD post formats, Hew and Cheung (2012) examined participation rates and thread depth among 42 undergraduate students who participated in text- or voice-based AOD in private LMS (Blackboard and Wimba) without facilitation. Although they found no significant differences between AOD post format groups in degree of participation, the voice-based AOD group had overall greater thread depth, which the authors attributed to relatability of another's speaking voice over their writing. Hew and Cheung's ongoing research (2012, 2013) indicates that the advantages of voice discussion include a) being able to convey tone and emotion through voice, b) being useful for students who prefer speaking to writing, c) promoting originality of ideas and spontaneity of voice, and d) helping to foster a sense of community due to realism and relatability of peers. In their work involving 41 graduate students and 42 undergraduate students, the authors found that participants in using audio-based AOD noted they enjoyed the ability to vocalize and express themselves, agreed it is more beneficial for students who prefer voice to text, helped promote original ideas, and enjoyed the novelty of audio-based technology. However, the majority of participants stated that they preferred text-based AOD post format for several reasons, including being self-conscious of their own voice, having more time to structure text responses than audio responses, finding the technology for text-based AOD to be less cumbersome, and feeling that text-based

AOD posts better facilitated their learning. The research by Hew and Cheung (2012, 2013) suggests that audio-based post format affords AOD another dimension of community of inquiry that is weaker in text-based post formats: social presence.

In summary, both text- and audio-based post formats affect students' perceived learning outcomes within the community of inquiry framework. For text-based AODs, participation is related to students' academic achievement goals (Xie & Huang, 2014) and metacognitive monitoring (Topcu, 2010). Higher levels of cognitive presence were evident in collaborative work (Koh et al., 2010). However, in one study, teaching presence through facilitation was required to increase cognitive presence (Lai, 2015). In studies comparing audio-based to text-based AODs, when the audio-based post format was used with scaffolded learning, students reported more positive learning experiences and higher cognitive presence was found (Oh & Kim, 2016), including greater thread depth (Hew & Cheung, 2012). Although some participants enjoy audio-based AODs for reasons related to social presence, the majority reported preferring text-based AOD (Hew & Cheung, 2013).

Platform Type

Although students do not always participate in discussions, active participation in AOD can promote higher order thinking. Many educators use private, academically-focused LMSs, like Blackboard; however, public forums, such as Facebook and Wiki, can also be used for asynchronous threaded discussions. Whether a public networking site or a private LMS is used, the central focus is collaborative learning. To address RQ2, the next section reviews literature on how platform types affect perceived learning outcomes within the community of inquiry framework.

Public Forum

Advantages of online social networking software include increasing student engagement, supporting communication, facilitating peer relations, and providing a platform that is dependent upon the larger community (Thoms & Eryilmaz, 2014). To examine the differences between online social networking software (Elgg) and a private LMS (Angel) without facilitation, Thoms and Eryilmaz (2014) observed text-based AOD participation in both platform types in 69 college students and found that students using the public online social networking software experienced

higher levels of perceived social interaction and learning community. In other words, students participating in the public forum reported greater cognitive and social presences.

Particular online social networks may hold more appeal for some users due to the popularity of the software. One such platform is Wiki, which is a collaborative editing tool that allows users to become asynchronous editors of a given topic. Ioannou (2011) researched the use of computer-supported collaborative learning using Wikis by examining the threaded discussions of 21 graduate students. Results showed that students using text-based communication in Wiki in comparison to a private LMS (WebCT) with instructor facilitation demonstrated higher levels of collaborative learning as characterized by conversations that included new ideas, modifications, elaborations, questioning, and agreement statements, which relate to higher cognitive presence. Additionally, students who used the Wiki contributed more frequently. Ioannou's (2011) research suggests that Wikis can be used to support discussions that showcase cognitive presence through informative discussions and social presence through motivation to post and collaborate with peers.

A second popular public forum is Facebook, which emphasizes individual and community connections and provides a platform that supports social interaction and improves learning performance (Lin, Hou, Wang, & Chang, 2013). Although social media networks like Facebook are primarily used to engage in social interaction and informal information sharing, they have the potential to facilitate deeper cognitive processes and social connections. Lin et al. (2013) sought to explore the distribution of knowledge and cognitive processes students may engage in by examining the text-based discussion behavior of 62 college students without facilitation. They found that the most prominent knowledge type used in Facebook-supported discussions was metacognitive, and that discussions focused on understanding information. Thus, students used text-based AOD on Facebook to achieve higher levels of cognitive presence; however, moderate levels of off-topic discussion were found. The same authors examined individual and co-construction of knowledge using text-based communication in Facebook in a more recent study (Hou, Wang, Lin, & Chang, 2015). Specifically, AODs among 50 undergraduate students were analyzed to examine differences in social knowledge construction between Facebook and a private LMS without facilitation. Results revealed that Facebook was a better platform for facilitating social interaction in that students primarily shared knowledge and

engaged in cognitive understanding during discussions. While Facebook-supported AODs were not as cognitively challenging as discussions in the private LMS, Facebook was better at supporting social presence (Hou et al., 2015).

While online social networks have many features for discussion that are built into the platform, academic and personal blogs offer more freedom for customization and give their creators more control over content and available features. Yang and Chang (2012) tested the effects of text-based academic blogs (using Blogger) without facilitation on 154 undergraduate and graduate student attitudes toward peer learning, academic achievement, and community interaction and found significant effects of positive perceptions of interaction with peers and academic achievement in course subjects. Furthermore, when students were allowed to interact with and comment on peers' posts, the advantages of academic blogs were stronger and the majority of comments were reflective, suggesting more critical thinking (Yang & Chang, 2012). Thus, academic blogs can effectively create meaningful dialogue between students by allowing for interaction that reinforces learned concepts and helps create a shared culture online.

Private LMSs

Instructors utilizing an LMS may use *protocols*, which are directions for how to structure and facilitate discussion, or they may use more open formats for AODs. To discover how the use of protocols in a text-based, private LMS-supported (Blackboard) AOD without facilitation relates to a community of inquiry framework, Zydney, deNoyelles, and Seo (2012) compared discussion behavior between two online classes of graduate students (12 and 14 students): one that used a protocol and one that did not. Overall, use of a protocol led to a more balanced distribution of cognitive, social, and teaching presences. For cognitive presence, use of the protocol promoted more shared group cognition than individual cognition, although mostly at the exploration level. For social presence, there were no differences between the classes with both demonstrating open communication. For teaching presence, the protocol class had more indicators of good instructional design than the non-protocol class. Furthermore, the use of protocols afforded more student ownership of discussion and empowered students to facilitate themselves.

Technology use and self-regulation of learning support the use of technology-based discussion to increase cognitive presence. Kovanović, Gašević, Joksomović, Hatala, and Adesope (2015) examined how cognitive presence within text-based AODs, within a private LMS (Moodle) without facilitation, differed between 81 graduate students with varying goal-orientations toward, and self-regulation of, learning. After clustering the results of discussions, Kovanović et al. (2015) concluded that variability in student participation and cognitive engagement in AODs aligned with their goal-orientations, in that students who were less motivated to engage with learning did not demonstrate high cognitive presence within their discussions.

Cognitive, social, and teaching presences may be more evident in some AODs than others using the same platform because students are engaged in topical discussions with different formats and facilitation types within a LMS. Liu and Yang (2014) investigated different levels of knowledge construction and their effects on 36 undergraduate students' attitudes toward text-based AOD using a private LMS called Digital School with instructor and peer facilitation. After analyzing student discussion board posts, the authors found that discussion based on life experiences was most effective for developing higher cognitive presence and improving social presence, whereas discussions related to case-study analysis demonstrated high cognitive presence and lower social presence, and discussions involving debate over an issue demonstrated fair social presence and low cognitive presence (Lin & Yang, 2014). These results suggest that the LMS is a strong platform for supporting cognitive and social presences, dependent upon the format of discussion topics. Cognitive and social presences are also supported through collaborative knowledge exploration, in which discourse between instructors and students in a LMS involves elaborating on and challenging concepts in addition to support through sharing meaningful experiences. Lee and Tsai (2011) investigated collaborative knowledge exploration in text-based AOD within a private LMS without facilitation between 11 graduate students and found that students engaged in social negotiation as well as supportive discourse, supporting greater social presence of the LMS. The students independently drew knowledge not only from authoritative resources, but also from professional and personal experiences, suggesting that students engaged in higher cognitive processes with a variety of resources to support knowledge construction, indicating cognitive presence.

Social interactions online may be described by an individual's perceptions of social presence, as social presence is linked with the affordances of online spaces and perceptions of immediacy and group cohesion (Akcaoglu & Lee, 2016). Online spaces, such as forums for AOD, allow students to connect with one another on their own terms regardless of geographic distance. To determine whether the size of AOD groups influences perceptions of social space, group cohesion, and social presence, Akcaoglu and Lee (2016) collected 33 students' reflections on AOD experiences in differently sized groups within online graduate courses. Small groups were rated as having greater sociability, being more conducive to building positive relationships and group cohesion, and generally more positively. These findings indicate that group size is a significant factor in determining social presence in AOD, in that smaller, more intimate discussion groups generate more social presence.

In summary, both public and private LMSs affect students' perceived learning outcomes within the community of inquiry framework. Studies examining the use of AODs in public forums that employ social networking software, including Wiki (Ioannou, 2011) and academic blogs (Yang & Chang, 2012), have found that they support higher levels of cognitive and social presences. Studies examining the use of AODs in private LMSs have found that they support cognitive and social presence through collaborative knowledge exploration (Lee & Tsai, 2011), but levels may vary depending on the type of discussion (i.e., life experiences, case study analysis, or debate; Liu & Yang, 2014). Furthermore, only students who followed instructor-designed protocols reported more cognitive and teaching presences (Zydney et al., 2012). Students who were less motivated to engage with learning did not show high cognitive presence within discussions (Kovanović et al., 2015). Smaller, more intimate groups generate more social presence (Akcaoglu & Lee, 2016). Studies that directly compare the use of AODs in public forums to AODs in a LMS have found that students report higher levels of cognitive and social presences in the public forums (Thoms & Elyilmaz, 2014). Facebook was viewed as better for facilitating social interaction related to sharing knowledge and understanding in comparison to an LMS (Hou et al., 2015; Lin et al., 2013).

Facilitation Type

Monitoring of AODs can be a challenging task taken on by either instructors or knowledgeable others. Instructors may take either a passive or active facilitator role to monitor discussions, or they may charge student leaders with the task. To address RQ3, the next section reviews literature on how facilitation type contributes to perceived learning outcomes within the community of inquiry framework.

Instructor or Expert Facilitation

Whether the instructor or an external content expert plays the role, facilitated regulation of AOD can give students guidance and promote higher levels of knowledge construction. Gašević, Adesope, Joksomović, and Kovanović (2015) hypothesized that instructor facilitation would scaffold student learning to higher levels of cognitive presence and observed text-based AODs within a private LMS (Moodle) among 82 graduate students. When combined with external motivation, such as participation grading, instructor facilitation led to increases in cognitive presence.

Instructors may facilitate online discussions in different ways, from observing and monitoring discussions to providing feedback and using questioning techniques. Feedback may be used to provide students with outcome information regarding correctness and quality of their responses, thereby increasing cognitive presence (Guo, Chen, Lei, & Wen, 2014). To measure the effects of feedback on levels of cognitive engagement, Guo et al. (2014) analyzed text-based AOD transcripts from 110 graduate students in an online course for in-service teachers using a private LMS (Moodle). Despite no significant differences in the quantity of discussion posts between students with facilitated feedback and without, cognitive engagement levels increased over time in groups with feedback, whereas levels of cognitive engagement decreased over time in groups with no feedback. Cognitive presence was also detected in research on externally facilitated regulation of AOD, specifically using Socratic dialogues to support critical thinking skills. Yang (2008) compared the quality of text-based AOD posts within a private LMS (Blackboard) between groups of 278 undergraduate students, one group with Socratic dialogue with an external facilitator, and one group without active facilitation. Results indicated that students whose group discussion was facilitated with Socratic questioning moved from lower to

higher levels of critical thinking compared with those whose discussion was not actively facilitated.

Active instructor facilitation may not be as specific as Socratic questioning; instructors may participate in discussions to generally guide conversation with no specific protocol for how they facilitate AOD. Evans, Ward, and Reeves (2017) studied the methods of 28 active external facilitators who were all content matter experts and found that facilitation was frequently used to encourage, acknowledge, or reinforce student contributions to a text-based AOD within a private LMS. Facilitation was also useful for prompting discussion, setting a comfortable learning climate, presenting content, summarizing the content of discussions, and establishing time parameters for discussion contributions, which are all factors of instructional design and cognitive presence.

To examine the role of AOD in online students' learning experiences such as community of inquiry, satisfaction, and academic achievement, Cho and Tobias (2016) collected data on 82 undergraduate students who engaged in no AOD, AOD without instructor facilitation, and AOD with instructor facilitation within a private LMS (Blackboard). The authors found that AOD groups (text-based) showed significantly higher levels of open communication and group cohesion, indicating social presence, and that the AOD with instructor facilitation group showed significantly higher affective presence. The results mainly demonstrated the strength of social presence, although Cho and Tobias (2016) recognized that course concepts were basic enough that learning was achievable without strong cognitive or teaching presence as an explanation for why academic achievement was not significantly different between groups.

Peer Facilitation

Whereas instructor facilitation in AOD may be used to keep discussions on track, establish rules and behavior, help students understand particular issues, or draw attention to opposing perspectives, peer facilitation in AOD may be used to increase student comfort and generate and challenge ideas, a topic that has been investigated by Hew and Cheung and other colleagues for over a decade (Hew, 2015). To compare the effects of instructor and peer facilitation on teaching presence, Hew (2015) examined three different groups of students (35

undergraduate students, 65 graduate students, and 64 practicing professionals) and gathered data on their preferences regarding text-based AOD within a private LMS (Blackboard). The majority of participants preferred instructor facilitation and cited reasons such as instructors being subject matter experts and skilled in keeping discussions on topic, resolving conflicts, and motivating discussion. Those who preferred peer facilitation cited reasons including feeling more at ease in the AOD and a sense of ownership over discussions, and gaining practical experience with facilitating discussion (Hew, 2015). Therefore, both instructor and peer facilitation can create teaching presence and the use of either may depend on the needs of the students.

Student or peer facilitation in particular has advantages over instructor facilitation when instructors or other external facilitators hold a position of power over students and their mere presence can prevent students from engaging in peer discussion. To address the influence of student facilitation on critical thinking, Lim, Cheung, and Hew (2011) analyzed text-based AOD threads from ten graduate level students within a private LMS (Blackboard). They found that the majority of discussion posts showed in-depth levels of critical thinking and the bulk of student facilitation posts were sent to acknowledge or show appreciation of others' contributions to the AOD, indicating social presence. Discussion forums that achieved higher levels of critical thinking employed facilitation techniques such as showing appreciation, questioning, agreement, and providing opinions and explanations, indicating cognitive presence, while forums that achieved lower levels of critical thinking used acknowledgement or appreciation and inviting comments. Lim, Cheung, and Hew (2011) concluded that peer facilitators should focus on more techniques that foster greater cognitive presence in order for students to engage in more in-depth critical thinking. Similarly, Ng, Cheung, and Hew (2009) explored specific types of peer facilitation that increase discussion participation and interaction or create more meaningful discussions in text-based AOD threads within a private LMS (Blackboard). Results from posts made by 16 graduate students indicated factors such as having an interesting topic, being familiar with the topic, knowing the facilitator, being given clear guidelines, and having limited time to respond influenced student participation. Students reported that the peer facilitation techniques they perceived to influence their participation in AOD most were asking open-ended questions and clarifying and elaborating on information, although these were not the most frequently used

techniques (Ng, Cheung, and Hew, 2009). Together, these studies suggest that peer facilitation techniques can be used to increase cognitive presence and social presence.

In peer facilitation, the facilitators are equal participants in AOD and can benefit from discussions that support a community of inquiry. Cheung and Hew (2010) sought to explore the benefits of text-based AOD within a private LMS (Blackboard) for peer facilitators in blended graduate coursework by examining habits of mind among peer facilitators in two case studies, one involving 13 students and the other involving 16 students. The authors reported how peer facilitators more often exhibited awareness of thinking and open mindedness, especially within the top 30% of forums in terms of student participation. Therefore, cognitive presence within AOD extends to the student facilitators themselves, not just student discussants.

Interestingly, Oh, Huang, Mehdiabadi, and Ju (2018) compared an instructor re-directed group and a peer-redirected group using text-based AOD within a private LMS (Moodle) for a scenario-based debate on ethical decision-making in 37 students participating in an online graduate level program evaluation course. Although there were no significant differences in cognitive presence between the groups, significant differences were found for interaction dynamics and perspective change within the groups. The authors concluded that peer facilitation was more effective for fostering critical thinking and collaboration than instructor facilitation, indicating that teaching presence may influence cognitive and social presences (Oh, Huang, Mehdiabadi, & Ju, 2018).

In summary, facilitation, whether by an instructor, external content matter expert, or peer, affects students' perceived learning outcomes within the community of inquiry framework. Instructor facilitation led to higher affective presence (Cho & Tobias, 2016). When combined with participation grading, instructor facilitation increased cognitive presence (Gašević et al., 2015) and feedback increased cognitive engagement (Guo et al., 2014). External content matter experts use facilitation to support cognitive presence by prompting discussion, presenting content, and summarizing discussions (Evans et al., 2017). Higher levels of critical thinking were found in groups with an external facilitator using Socratic dialogue (Yang, 2008). Studies suggest that student facilitation techniques, such as questioning, providing opinions and explanations (Lim et al., 2011), and elaborating (Ng et al., 2009), can increase cognitive and social presences. Furthermore, increases in cognitive presence extend to the student facilitators

themselves, not just student discussants (Cheung & Hew, 2010). Studies comparing instructor to peer facilitation have found that both types create teaching presence; however, the majority of students prefer instructor facilitation of AOD (Hew, 2015). Oh and colleagues (2018) found that peer facilitation is more effective for fostering critical thinking and collaboration, aspects of cognitive and social presences, respectively, than instructor facilitation.

Theoretical Model for Effective AOD Design

With all the possible combinations of AOD design and their differential outcomes on students' perceived learning, it is difficult to know how each component separately contributes to perceived learning through the community of inquiry framework. Therefore, the results of our literature review were synthesized to create a theoretical model of how AOD design affects perceived learning outcomes within the community of inquiry framework, which is displayed in Figure 1. The model uses the community of inquiry framework to demonstrate the moderating effects of cognitive, social, and teaching presences between the three AOD tools (post format, platform type, facilitation type) and perceived learning outcomes. Additionally, the model breaks the three AOD tools into the types discussed previously in order to portray each tool's contribution to cognitive, social, and teaching presences. As shown in Figure 1, regarding post format, the results of the literature review indicate that both text- and audio-based communication in AOD facilitate cognitive and social presences related to perceived learning outcomes. Regarding platform type, the use of AODs in both public forums and private LMSs also promotes cognitive and social presences related to perceived learning outcomes, but private LMSs also may include teaching presence as a mediator of perceived learning outcomes. Regarding facilitation type, both instructor/expert and peer facilitation foster cognitive, social, and teaching presences as mediators of perceived learning outcomes.

Figure 1

Theoretical model for effective AOD design and perceived learning outcomes within the community of inquiry framework
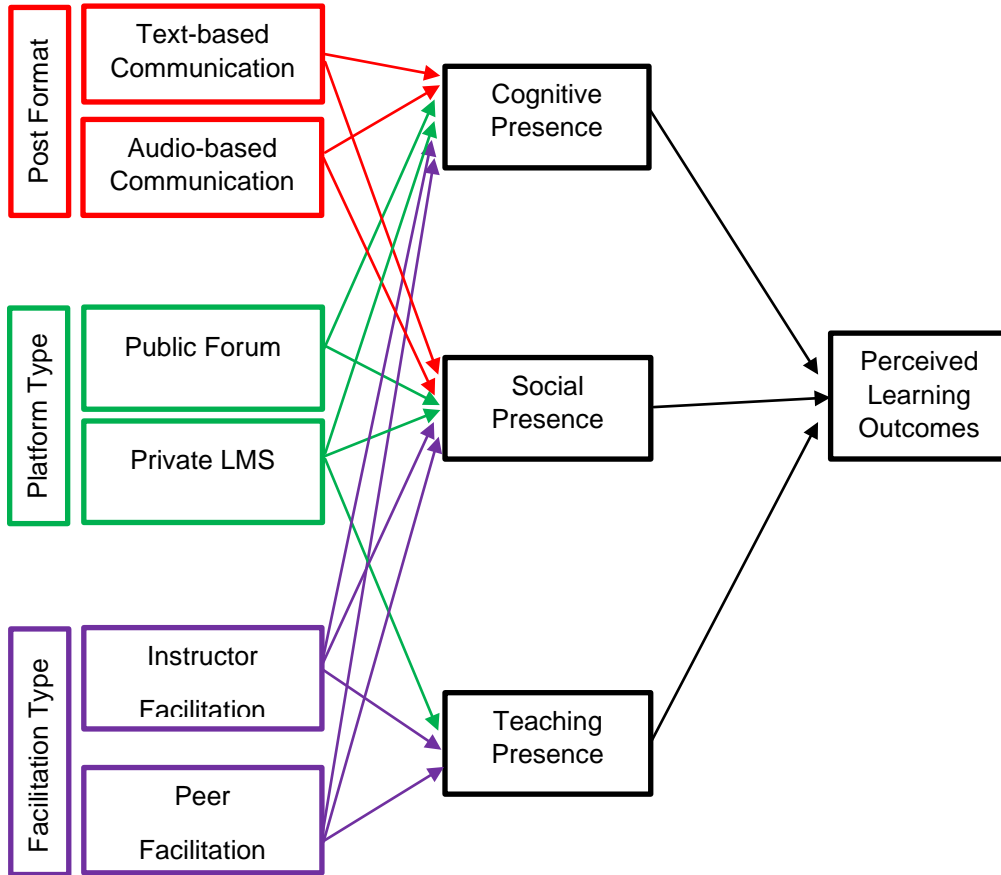
Discussion

While it is widely acknowledged that AODs are beneficial for supporting student learning, how to design effective discussions with educational technology in ways that optimize collaborative learning is much less straightforward. Educators hold different perspectives on which designs work best for helping students co-construct knowledge, ranging from the use of text-based communication in forums on public media platforms with minimal instructor oversight to audio-based AODs housed in academically focused LMSs that are closely monitored by facilitators. The effectiveness of different AOD design factors is a nuanced topic that instructors must learn, yet a model for integrating such factors into a cohesive design that positively impacts community of inquiry has been largely absent from the research literature. The goal of this literature review is to provide a basic model of the interactions between design factors, such as post format, platform type, and facilitation type, and cognitive, social, and teaching presences within the community of inquiry framework as mediators of students' perceived learning outcomes to assist educators in making decisions about using AODs in their instructional practices. The results, depicted in Figure 1, are discussed in the following paragraphs in more detail for each of the three research questions that guided this literature review.

Relating results from empirical studies on AODs to the community of inquiry framework within the model reveals the value of different AOD design tools to educators. In answering RQ1, as shown in Figure 1, the literature indicates that both text- and audio-based AOD post formats benefit cognitive and social presences, which are linked to perceived learning outcomes, such as academic achievement goals (Xie & Huang, 2014). In studies comparing text- to audio-based AODs, students preferred text-based (Hew & Cheung, 2013), but benefitted more from the audio-based post format, reporting more positive learning experiences, higher cognitive presence (Oh & Kim, 2016), including greater thread depth attributed to the originality, spontaneity, and relatability of voice (Hew & Cheung, 2012), and peer connectedness, which is similar to Chou's (2012) finding of audio-based discussion increasing social presence. It is possible that group differences may have been found due to the tendency of audio-based discussions to inherently require greater higher-order thinking skills. Further research is needed to more accurately

compare the effects of text- and audio-based discussions on cognitive presence using more controlled methods.

In answering RQ2, as shown in Figure 1, both public forums and private LMSs affect cognitive and social presences, which are linked to student learning outcomes. The use of AODs in public forums, such as Blogger, Facebook, and Wiki, promotes higher levels of cognitive and social presences when compared to their use in private LMSs (Thoms & Elyilmaz, 2014). More specifically, Facebook was better for facilitating social interaction related to sharing knowledge and understanding in comparison to a private LMS; however, Facebook-supported AODs were not as cognitively challenging as discussions in the private LMS (Hou et al., 2015; Lin et al., 2013). Furthermore, although a relationship was not found between AODs in public forums and teaching presence, a relationship was found for AODs in private LMSs, such as Blackboard, Moodle, or WebCT (Zydney et al., 2012), along with evidence suggesting that private LMSs support cognitive and social presences (Lee & Tsai, 2011; Lin & Yang, 2014). Since this literature review is the first to compare the use of AODs in public forums to private LMSs within a community of inquiry framework, there is no additional literature to support these findings. It is possible that group differences may have been found due to students' increased comfort with a known, private LMS as opposed to repurposing a more public platform for academic use. Therefore, further research is needed to compare the use of AODs in public forums and private LMSs on perceived learning outcomes using cognitive, social, and teaching presences from a community of inquiry framework as mediators.

In answer to RQ3, as shown in Figure 1, facilitation, whether by an instructor, external content matter expert, or peer, affects students' perceived learning outcomes within the community of inquiry framework. This finding is consistent with sociocultural theory, in that greater learning occurs through shared experiences and with the guidance of a more knowledgeable other, whether instructor or peer. Furthermore, both instructor/expert (Cho & Tobias, 2016; Evans et al., 2017; Gašević et al., 2015; Yang, 2008) and peer facilitation (Cheung & Hew, 2010; Lim et al., 2011; Ng et al., 2009) were linked to cognitive, social, and teaching presences within the community of inquiry framework. Although students prefer instructor facilitation of AOD for promoting cognitive and teaching presences (Hew, 2015), in some cases, peer facilitation may more effective for fostering critical thinking, collaboration, and social

presence (Oh et al., 2018). From an educator's perspective, these findings have the potential to impact how AODs are designed, whereby the instructor's goals for cognitive or social/emotional development can help educators decide how best to facilitate online discussions. Further research is needed to compare the use of AODs with different types of facilitators (instructors, experts, and peers) to AODs without facilitation on perceived learning outcomes as mediated by cognitive, social, and teaching presences within the community of inquiry framework and to understand whether any effects are dependent on group size.

Limitations

This study employed a literature review to describe types of AOD designs and understand how factors such as post format, platform type, and facilitation type help create a community of inquiry and affect students' perceived learning outcomes. While this review provides useful information, it did not directly test correlational or causal relationships between factors. Future research should employ correlational and experimental methods to test the relationships shown in Figure 1 to potentially support or expand the proposed model of effective AOD design.

Participants in these studies included undergraduate and graduate students at various levels of their academic programs. The current study reviewed articles from both types of students without parsing out potential differences in cognitive, social, and motivational factors related to their educational levels, which presents a limitation in generalizability. Future research should examine differences in discussion participation and learning and between undergraduate and graduate students with the intention of proposing different models of effective AOD design for students at different educational levels.

The articles reviewed in this study utilized both text-based and audio-based communication tools in their AOD designs. Regardless of the post format, several researchers reported difficulties in the usability of AODs, as well as cultural and language barriers that prevented some students from participating in discussions. Such cultural and technology barriers present limitations for this study in that discussion posts by students who had difficulty accessing or participating in discussions may not accurately reflect their full knowledge construction. Future research should account for these limitations by studying more user-friendly technologies and placing students and learning within their cultural context.

While this review makes an important contribution to the field, it is also limited by its time period and scope. Our review concluded at the end of 2018. Due to the fast-paced nature of advancements in educational technology, it is possible that the platforms used to house AODs in the reviewed articles have been updated and that other platforms are now available. Future research should examine newly developed educational technologies and advancements in online learning that support a community of inquiry. Furthermore, although we chose to focus our review on aspects of AOD design that affect perceived learning outcomes within a community of inquiry framework, other outcomes could be examined. Future research could expand upon this review by examining the relations to performance-based learning outcomes, such as knowledge demonstration assessed using rubrics or grades.

Implications for Using AODs in Higher Education Instructional Contexts

Despite the limitations noted, the findings of this literature review may be used to guide instructors in higher education in making decisions about how to use AODs in their pedagogical practices. Specific decisions implied by the findings of this literature review in relation to the community of inquiry framework, as presented in Figure 1, are:

- ✓ Use both *text- and audio-based* means of communication for AODs.
- ✓ Use a *private LMS*, such as Blackboard, Moodle, or WebCT, to administer AODs.
    - When teaching presence is not critical, use a *public forum*, such as Blogger, Facebook, or Wiki, for sharing knowledge and understanding and facilitating social interactions.
- ✓ Use *project-based learning activities* to advance knowledge construction.
- ✓ Organize *smaller discussion groups* to generate more social presence.
- ✓ Use *both* instructor and peer facilitation for AODs.
    - Use *instructor facilitation* for setting a comfortable learning climate; encouraging, acknowledging, and reinforcing student contributions; presenting content; prompting discussion, establishing time parameters for contributions, keeping discussions on topic, and summarizing the content of discussions; Socratic questioning; and resolving conflicts.

- Use *participation grading*.
        - Have students relate discussions to their *life experiences*.
        - Provide *feedback* regarding the accuracy and quality of students' responses.
- Use *peer facilitation* to help students feel more at ease, have a sense of ownership over discussions, and gain practical experience with facilitating discussions, especially when the mere presence of an instructor as an authority figure may stifle participation (i.e., controversial or potentially personally revealing topics).
        - Instructors should establish *clear guidelines* for peer facilitators, including being known by all students in their group, providing an interesting topic that is familiar to students, asking open-ended questions, establishing time limitations for responses, clarifying and elaborating upon information, showing appreciation and agreement, and providing opinions and explanations.
- Use *protocols* to provide elements of good instructional design and address the community of inquiry framework when facilitation is not used.

Of these, the most emphasis is placed on the recommendation to use facilitation. As shown in Figure 1, both facilitation types affect cognitive, social, and teaching presences within the community of inquiry framework. For example, from the literature reviewed, Lai (2015) found that particular teaching strategies, such as facilitation of discussion, affected students' co-construction of knowledge in text-based AOD. The only other AOD design factor that affects all three presences within the community of inquiry framework is use of a private LMS, which is also highly recommended because they contain built-in features for conducting AODs that can include facilitation and participation by instructors and students, as well as many other features that are explicitly designed for instruction within higher education contexts.

Conclusion

The goal of this literature review was to provide a basic model of the interactions between design factors, presences within the community of inquiry framework, and students' perceived learning outcomes to assist educators in making decisions about using AODs in their instructional practices. The model that was developed (see Figure 1) shows that text- and audio-

based communication and the use of public forums for AODs affect cognitive and social presences, which, in turn, affect perceived learning outcomes. Use of a private LMS, instructor/expert facilitation, and peer facilitation each contribute to cognitive, social, and teaching presences, which affect students' perceived learning outcomes. These findings suggest that instructors should consider using facilitation in their AODs to promote all aspects of the community of inquiry framework.

Educators are currently facing challenges related to online learning because the COVID-19 pandemic has forced many instructors to quickly convert their face-to-face lessons into online instruction. This move to online instruction has led to significant increases in the use of educational technology, including AODs. With the information gathered from this review, instructors can enter the field of online learning with more confidence and structure collaborative discussions in ways that support positive learning communities. Future research should aim to test and validate the proposed model of effective AOD, as well as to expand the current research on online learning by studying more current technologies.

In conclusion, this review's significance extends beyond identifying and recommending specific AOD tools that promote specific aspects of community of inquiry by contributing to the larger body of literature exploring the benefits of online discussion, the application of sociocultural theory in online learning, and how student-centered online discussion can contribute to perceived learning outcomes. Although further research is undoubtedly needed to better understand the effects of AOD tools individually and their effects on measures of actual academic achievement, the theoretical and practical implications of AOD design for education are abundant.

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Appendix A

Table 1

Literature Review Categorization Based on Model Fit and Article Conclusions

Model Category	Authors (publication date)	Conclusions
Post Format		
Text-Based communication	Xie & Huang (2014)	Used a private LMS (WebCT) with instructor facilitation. Found relationships between learning beliefs, participation, and perceived learning, indicating cognitive presence.
	Topcu (2010)	Used a private LMS (course website) without facilitation. Found that metacognitive monitoring predicted AOD participation, indicating cognitive presence.
	Koh, Herring, & Hew (2010)	Used a private LMS (Google Groups) without facilitation. Found greater cognitive and social presences with project-based learning.
	Lai (2015)	Used a private LMS (Moodle) without facilitation. Found that teaching presence (i.e., strategies, direct instruction, flow of facilitation) affected knowledge construction (i.e., cognitive presence).
Audio-Based communication	Oh & Kim (2016)	Used a private LMS (VoiceThread) without facilitation. Found greater cognitive presence in audio over text discussions.
	Hew & Cheung (2012)	Used a private LMS (Blackboard) without facilitation. Found that audio helped foster sense of community (i.e., social presence).
	Hew & Cheung (2013)	Used a private LMS (Blackboard) without facilitation. Students preferred text for usability and learning (i.e., cognitive presence) and audio for expression (i.e., social presence).

Platform Type		
Public Forum	Thoms & Eryilmaz (2014)	Used text AOD without facilitation. Found greater social interaction, course community, engagement, and satisfaction, indicating cognitive and social presences, in a public forum (Elgg) over a private LMS (Angel).
	Ioannou (2011)	Used text AOD with instructor facilitation. Found greater levels of collaborative discussion and participation, indicating cognitive and social presences, with public forum (Wiki) over private LMS (WebCT).
	Lin, Hou, Wang, & Chang (2013)	Used text AOD in public forum (Facebook) without facilitation. Metacognitive knowledge, understanding, and comprehension were found in discussions, indicating cognitive presence, with a moderate level of off-topic discussion.
	Hou, Wang, Lin, & Chang (2015)	Used text AOD without facilitation. Found greater social presence in public (Facebook) over a private LMS. Students shared knowledge and understanding during discussion, rather than engaging in advanced knowledge construction.
	Yang & Chang (2012)	Used text AOD (Blogger) without facilitation. Blogs significantly affected positive perceptions of interaction with peers (i.e., social presence) and academic achievement. Blog comments indicated critical thinking (i.e., cognitive presence).
Private LMS	Zydney, deNoyelles, & Seo (2012)	Used text AOD in private LMS (Blackboard) without facilitation. Use of protocol in AOD led to more balanced distribution of cognitive, social, and teaching presences and promoted more shared group cognition, student ownership, and empowerment of facilitation.
	Kovanović, Gašević, Joksimović, Hatala, &	Used text AOD in Moodle without facilitation. Found association between motivation to engage in learning and cognitive presence within discussions.

	Adesope (2015)	
	Liu & Yang (2014)	Used text AOD in Digital School with instructor and peer facilitation. Found that Digital School is a strong platform for supporting cognitive and social presences, depending on the format of discussion topics, including collaborative knowledge exploration.
	Lee & Tsai (2011)	Used text AOD in a private LMS without facilitation. Students engaged in social negotiation and supportive discourse, indicating social presence, and drew knowledge from resources and experiences, indicating cognitive presence.
	Akcaoglu & Lee (2016)	Used text AOD in private LMS without facilitation. Found greater levels of social presence among smaller discussion groups.
Facilitation Type		
Instructor or Expert Facilitation	Gašević, Adesope, Joksimović, & Kovanović (2015)	Used text AOD in private LMS (Moodle). When combined with participation grading, instructor facilitation led to increases in cognitive presence.
	Guo, Chen, Lei, & Wen (2014)	Used text AOD in private LMS (Moodle). Found that facilitator feedback led to increased cognitive presence over time.
	Yang (2008)	Used text AOD in private LMS (Blackboard). Found that scaffolded learning by an external facilitator using Socratic questioning led to increased critical thinking, indicating cognitive presence.
	Evans, Ward, & Reeves (2017)	Used text AOD in a private LMS. Found that facilitation by external content experts was used to promote aspects of cognitive (e.g., prompting discussion, presenting content, summarizing

		discussions) and teaching presence (e.g., setting learning climate, establishing time parameters).
	Cho & Tobias (2016)	Used text AOD in private LMS (Blackboard). Found greater social presence and affective presence with instructor facilitation.
Peer Facilitation	Hew (2015)	Used text AOD in private LMS (Blackboard). Found that most students prefer instructor facilitation due to their expertise and skill in guiding discussions, indicating teaching presence. Peer facilitation is preferred for helping students feel more at ease and providing a sense of ownership and experience.
	Lim, Cheung, & Hew (2011)	Used text AOD in private LMS (Blackboard). Found that student facilitation posts supported others' contributions, indicating social presence, and some fostered in-depth critical thinking, indicating cognitive presence.
	Ng, Cheung, & Hew (2009)	Used text AOD in private LMS (Blackboard). Found that student participation is influenced by topics, knowing the facilitator, establishing guidelines, posing questions and clarifying and elaborating on information, indicating cognitive and social presences.
	Cheung & Hew (2010)	Used text AOD in private LMS (Blackboard). Found that facilitators exhibited awareness of own thinking and open-mindedness, indicating cognitive presence, more than peers.
	Oh, Huang, Mehdiabadi, & Ju (2018)	Used text AOD in private LMS (Moodle). Found that peer facilitation was more effective for fostering critical thinking and collaboration than instructor facilitation, indicating that teaching presence may influence cognitive and social presences.