Differences in Student Performance Between Linear and Spatial Discussion Boards for Debate and Topical Discussions

by

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ABSTRACT

This study explored the use of a visual-spatial discussion board format as an alternative to traditional linear discussion boards in online classes. The type of discussion prompt can impact the quality of discussion; therefore, two types of discussion prompts were used, topical and debate, to see if the discussion board format was more effective for one type of prompt than the other. Students interacted more frequently in the spatial format when they were given the debate prompt and more frequently on the linear discussion board when given the topical prompt. However, there was no statistically significant difference in the quality of the posts between the two discussion board formats. Students given the debate prompt showed higher levels of cognitive processing than those given the topical prompt regardless of the discussion board format. There was no measurable difference between any of the conditions regarding the ability of students to synthesize the content of the discussions. Students generally preferred the linear discussion board format across all student perception measures, but familiarity with the format may have influenced their opinions. This study suggests that visual-spatial discussion board formats may be a good alternative to linear discussion boards for some types of discussions, but further exploration is needed.

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CHAPTER I

INTRODUCTION

Background of the Problem

The number of students taking online courses continues to increase; therefore, it is increasingly important that quality research is conducted to determine best practices for online learning. In Fall 2014, 28% of higher education students took at least one online course, a 17% increase from Fall 2012 (Allen, Seaman, Poulin, & Straut, 2016). Fourteen percent of higher education students took all their courses online. The growth of registration in online courses has continually outpaced overall enrollment. In fact, between Fall 2013 and Fall 2014, overall enrollment decreased while online enrollment increased 3.9%. As the number of students in online courses continues to rise, it is vital that quality research in the area is conducted to discover more effective ways of learning in an online format.

One of the challenges for online courses is to recreate the dynamic found in live discussions in face-to-face classes. Classroom discussions are vital to learning since they provide students the opportunity to explore conflicting perspectives, co-create knowledge, promote understanding of the information and facilitate student interactions (Andresen, 2009; Cho & Tobias, 2016). Research in online learning consistently reinforces the importance of interaction (Abrami, Bernard, Bures, Borokhovski, & Tamim, 2011), which is generally held via online discussion boards (Marra, Moore, & Klimczak, 2004). Unfortunately, online discussions are often less effective than predicted, with students treating discussion board posts as just another assignment instead of an opportunity to interact with their peers (Aleksic-Maslac, Magzan, & Juric, 2009).

Online discussion boards have the potential to be very effective, contributing to co-construction of knowledge and higher-order thinking (Akyol & Garrison, 2011; Cho & Tobias, 2016), collaboration (Rovai, 2007), and increased participation by students who are reluctant to participate in live discussions (Bassett, 2011; Gerbic, 2010; Sthapornnanon, Sakulbumrungsil, Theeraroungchaisri, & Watcharadamrongkun, 2009). Interacting with other students via discussion board may even be better than studying alone (Hew & Cheung, 2013). However, online discussion boards have limitations. Linear discussion boards are difficult to navigate (Albon & Pelliccione, 2005); information is difficult to synthesize (Hewitt, 2001); social presence is hard to achieve (Kear, 2010); little actual discussion takes place (Darabi, Arrastia, Nelson, Cornille, & Liang, 2011; Vanessa Paz Dennen, 2005), and there is little evidence of real interaction (Khlaif, Nadiruzzaman, & Kwon, 2017) or higher level processing (Darabi et al., 2011). Overall, discussion boards have not proven to contribute to learning as much as expected (Lapointe & Reisetter, 2008).

Efforts have been made to improve online discussions, both in trying to improve discussions within the linear, threaded discussion board format that is most commonly used (Koskey & Benson, 2016) and by looking at alternatives such as wikis (Ioannou & Artino, Jr., 2009; Tu, Blocher, & Gallagher, 2010), Facebook (Jumaat & Tasir, 2016), and nontext formats such as audio and video (Clark, Strudler, & Grove, 2015; Hew & Cheung, 2013). However, the effectiveness of these efforts has been mixed. Given the key role discussion boards play in online courses, another solution should be explored.

Statement of the Problem

Both the constructivist and social interaction theories predict that student interaction contributes to learning (Jonassen, 1991; Vygotsky, 1978). In online courses, this interaction is usually promoted through linear online discussion boards. Unfortunately, the discussions frequently have not fulfilled expectations for promoting true student interaction due to a variety of possible reasons, which will be explored in Chapter II, including difficulty in navigating the boards, the type of discussion prompt used, and students not valuing the online discussions.

The typical discussion board is linear, with comments laid out in an outline structure. However, the structure of linear discussion boards can make it difficult for students to make sense of a discussion thread that has veered off topic or to find a previously read post to refer to it later (Albon & Pelliccione, 2005; Hewitt, 2003). However, a more visual-spatial representation of information may improve the usefulness of discussion boards. Visual displays make information easier to find, free up working memory, help students see patterns (Hegarty, 2011), and help students integrate information (Nesbit & Adesope, 2006). If students find discussion boards more useful, they may participate more fully and the discussion may be more effective.

A number of research studies have indicated that the quality of discussions on linear discussion boards is affected by the type of discussion prompt (Bradley, Thom, Hayes, & Hay, 2008; Darabi et al., 2011; deNoyelles, Zydney, & Chen, 2014). As this may also be the case with spatial discussion boards, this study used two types of discussion prompts, topical and debate. The topical discussion prompts were open-ended, simply directing students to discuss the content. Debate discussion prompts specifically

directed students to reply to a post that is contrary to their own perspective, taking the role of devil's advocate when there were no conflicting posts. Looking at different types of discussion prompts provided information as to which format (linear or spatial) is more beneficial with which types of prompts.

Theoretical Framework

Social Constructivist Learning Theory

Social constructivist learning theory combines elements of social learning theory and cognitive learning theory (Palincsar, 1998). The theory proposes that learners construct knowledge through social interactions with others (Sthapornnanon et al., 2009). A review of core concepts on learning theory will help explain the development of social constructivism.

Founded in cognitive learning theory, constructivism proposes that learners construct knowledge based upon experiences and their interpretation of those experiences (Jonassen, 1991). According to this theory, everyone has a unique knowledge base, background, and set of beliefs that influence their interpretation of external reality. This contrasts with objectivism, based on behavioral learning theory, which proposes an external reality that learners internalize. Constructivism does not negate the idea of an external reality, but states that each person's interpretation of that reality is somewhat unique. Within an educational setting, instructors using the constructivist method provide resources and opportunities for students to learn by exploring, experimenting, and interacting with others. The instructor guides and directs, but the learning is student-centric.

In contrast, objectivism supports an instructor-centric approach in which knowledge is imparted from the instructor to the student (Palincsar, 1998). The instructor is the expert and students are passive receptacles for that knowledge. The pace and structure of the learning is managed by the instructor. This form of direct instruction is often more typical and can be quite effective with basic and factual knowledge. However, it is less effective in developing higher order cognitive skills, such as problem-solving, or applying knowledge to novel situations. For these types of learning, a social constructivist approach may be more effective by providing opportunities for learners to explore different hypotheses and come to their own conclusions.

Social constructivism proposes that students who work together, each presenting their own unique perspective, achieve higher levels of success than students who work alone (Palincsar, 1998). Piaget's sociocognitive conflict theory claims that when there is conflict between learners' current understanding and what they experience, they are forced to re-evaluate and explore other ways of understanding This process is more effective when discussing with peers and when learners are an integral part of the process, not mere observers. Vygotsky's (1978) sociocultural theory also emphasizes the social role in learning. By interacting with others whose knowledge and skills are slightly above theirs, learners advance more quickly than on their own. Once learners have achieved a skill or level of knowledge, they need to interact with others who are slightly above their new status. Thus, optimal learning takes place within a social and cultural context, which is constantly changing.

In summary, although direct instruction from the objectivist approach may be more familiar to many, to develop higher-order cognitive skills, a social constructivist

perspective may be more effective. With this model, learning best takes place within a social context, in which individuals collaborate to construct knowledge. In the face-to-face classroom setting, this type of learning often takes place through collaborative activities and discussions, where students construct understanding of content through sharing of their perception and experiences with each other. In online courses, discussion boards are frequently used to provide this interaction, but often fall short of expectations. In order for students to learn from each other, they need to be able to interact in a way that is natural and comfortable, so they can focus on the interaction and constructing knowledge, not navigating the online environment. It is also important for students to feel that they are interacting with other students within a community instead of interacting with only a computer. This is where the concept of social presence, the feeling that they are interacting with a real person, comes into play.

Social Presence

For learning within a social context to occur, online courses need to overcome the barriers created when students only interact through text, such as feelings of isolation and not being part of a community (Symeonides & Childs, 2015). Increasing social presence can reduce feelings of isolation and improve student interaction.

Social presence is a complex concept with a variety of definitions that have developed over the years. The original theory grew out of social psychology and is credited to Short, Williams, and Christie (1976). They looked at how a communication medium can affect the communication itself. The original definition of social presence was the degree of salience, or sense of "being there," between two parties communicating through a given communication medium. Short et al. asserted that some media inherently

have a higher level of social presence, such as video, than others, such as audio. The additional social cues found in video, such as facial expressions, increased the sense of the person "being there" and, thus, led to higher social presence. The focus was on the characteristics of the medium itself rather than the message.

In the 1990s, researchers changed the focus of research from the characteristics of the medium to users' perceptions of presence (Gunawardena, 1995; Gunawardena & Zittle, 1997). No singular, generally agreed upon definition or measurement tool exists (Lowenthal, 2009), although Richardson, Maeda, and Swan's (2010) definition of social presence is representative and frequently cited. They defined it as "the degree to which participants in computer-mediated communication feel affectively connected one to another" (p. 332). This study measured the students' perception of social presence to determine whether social presence differs between linear discussion boards and the alternate spatial discussion boards explored in this study.

Visual-Spatial Information Displays

Hegarty's (2011) multi-disciplinary meta-analysis of visual-spatial displays indicates that the visual representation of information can make it easier to synthesize information by organizing information spatially, reducing cognitive load, and making it easier to see patterns. Similarly, Nersessian (2012) found that visual representation of data is invaluable in synthesizing information from multiple research studies.

Visual displays help students group information into schemas, see visual patterns that would be hard to discern in a sequential language structure, and free up working memory for other thought processes (Hegarty, 2011). For example, a city map can integrate complex information, presenting several related concepts within the same visual

space instead of scattering the information throughout written text (Nesbit & Adesope, 2006). Students who use visual knowledge maps are more likely to converge on the same conclusion and score higher on post-test questions that require integration of information (Suthers, Vatrapu, Medina, Joseph, & Dwyer, 2008).

In linear online discussion boards, several students may have similar comments or opinions, but because of the linear text format, posts are dispersed throughout the thread, making it difficult for students to draw connections between comments and ideas. With a spatial format, in which similar ideas are placed near each other, students can see at a glance the distribution of opinions among the class and find related posts.

Mayer's theory of multimedia processing (Mayer, 2002) may explain why information is easier to process when there is a visual component. His theory makes three assumptions: (a) we process visual and verbal information separately, (b) deep learning requires cognitive processing, and (c) there is a limit to the amount of visual and verbal cognitive processing available. One way to reduce cognitive load is to balance the load between the visual and verbal channels. If discussion posts are organized visually and, thus, make it possible for students to take in more information visually, the load on the verbal channel is reduced, allowing students to process information more deeply. This study was designed to test aspects of this theory.

The Purpose of the Study

The purpose of this study was to explore (a) the effects of discussion board format (linear vs. spatial) on the number of posts made; (b) the quality of posts; (c) the ability to synthesize information from the discussion boards; and (4) students' perceptions of the discussion boards, which included perception of social presence, usefulness, ease of use,

potential as a collaborative tool, and overall attitude about each format. The effects will be compared between two types of discussion prompts: debate and topical.

Research Questions

There were four research questions explored in this study.

1. What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the number of posts made?
2. What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the quality of students' discussion posts?
3. What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the quality of students' synthesis of discussion posts?
4. What are the effects of discussion board format (linear vs. spatial) and time (before or after exposure) on student perceptions of discussions?

Significance of the Study

Despite their frequent use in online courses, linear threaded discussion boards generally do not result in the depth and quality of participation desired, and perhaps required, in order to contribute to high-level learning.

Several attempts have been made to improve the quality of discussion boards, such as examining the types of prompts given, how much the instructor participates in the discussion, and whether points are awarded for participating in the discussion. Alternative formats, such as wikis, Facebook, and audio, have also been tried. These

studies have met with varying degrees of success, and no clear answer has emerged as to how to promote effective online discussions.

This study looked at a different way of having discussions within an online course. The discussion posts were arranged spatially instead of linearly. This method of arrangement was expected to enhance students' ability to find related posts and organize and synthesize information. Reducing the cognitive effort needed to make sense of the content within the discussion was expected to result in more effective participation, which in turn should increase the depth of knowledge co-construction.

Past studies of linear discussion boards have found that the type of discussion prompt influences the quality of the resulting discussion. Therefore, this study compared two types of prompts: topical and debate. Topical prompts are open-ended, simply asking students to comment on the subject. Debate prompts specifically direct students to participate in a debate on the subject by responding to a comment with which they disagree, playing devil's advocate as necessary to have a debate.

If spatial discussion boards had proven to have a benefit in producing effective discussions in online classes, not only will it provide a useful tool for online courses, but new areas of research will be opened for exploring specific aspects of spatial discussion boards that are significant. Factors that have been found to contribute to learning in linear discussion boards, such as other types of discussion prompts, may also be explored. Finding the correct balance of tool, prompt, instructor participation, grading, and other variables can turn one of the most difficult parts of online teaching into an effective learning experience.

Limitations

There were several potential limitations in this study, including the participants and tools used. Participants were graduate students, most majoring in instructional technology, and, thus, may have had more experience with online courses than the general student population. Also, because data were collected over just one semester, the study was limited by the number of times students were in each experimental condition.

There were also limitations related to the spatial discussion board tool that was used. Because a tool designed for spatial discussion boards does not yet exist, this study used an online, mind-mapping tool as an approximation. While the tool did allow for more than one user to edit the mind map, it was possible for one student to accidentally overwrite or delete another's comments. It also did not automatically track who made changes to the map. These were addressed by careful instruction and training of students; however, accidental deletions or posts made by unknown students were still possible.

Definition of Terms

Discussion board. A discussion board is "a forum that includes a running commentary of messages used by a group to facilitate asynchronous online discussions" ("The Online Learning Definitions Project," 2011).

Linear discussion board. Linear discussion boards display responses indented underneath the original post. They are sometimes referred to as threaded discussion boards.

Spatial discussion board. In a spatial discussion board, posts appear as nodes that are visually linked to each other. Responses branch off from the original post.

Discussion prompt. A discussion prompt is a question or topic presented by the instructor for students to respond to in their discussion board posts.

Debate discussion prompt. A debate discussion prompt is a question or topic presented by the instructor, explicitly directing students to debate with each other on the provided topic.

Topical discussion prompt. A topical discussion prompt is a question or topic presented by the instructor, simply directing students to discuss the provided topic. These prompts are more open-ended than debate prompts.

Quality of posts. The quality of posts is a measure of how well posts show original thought supported by facts, as opposed to merely summarizing readings or agreeing with previous posters.

Synthesis. Synthesis is the act of integrating information from various sources, finding themes, and drawing conclusions that demonstrate original thought. This is contrasted to summary, an encapsulation of content without integration or original conclusions.

Social presence. Social presence is "the degree to which participants in computer-mediated communication feel affectively connected one to another" (Richardson et al., 2010).

Summary

As the number of students taking online courses increases, it becomes more important that quality research is conducted to determine best practices. Discussion boards are commonly used in online courses to stimulate student interaction, but often do not create the quality of discussion desired. The researcher examined spatial discussion

boards as an alternative to typical threaded discussion boards to see whether there would be differences in the number of posts, the quality of posts, students' ability to synthesize information, and student perceptions and attitudes, including social presence, ease of use, usefulness, collaboration, and overall attitude, with respect to the format. Two different types of discussion prompts were used, debate and topical, to see whether there would also be an effect depending on the type of discussion desired. Exploring an alternative method of providing student interactions was expected to result in a more effective exchange of ideas and subsequently, increased higher-level learning.

CHAPTER II

REVIEW OF THE LITERATURE

This review of related literature followed the main research question, "What efforts have been made to increase the effectiveness of student interaction through online discussions and what have been the effects of these efforts?" as a guide to narrowly focus the review. The review looked specifically at (a) benefits of interaction through discussion boards, (b) limitations of online discussion boards, and (c) efforts to improve online discussions. Additionally, topics related to the main research question were included, such as the importance of student interaction and social presence. Resources for this review were collected through a variety of measures including electronic databases such as ERIC, IEEE, and WorldCat. The following key words exemplify the ones combined to find relevant articles: online/asynchronous, discussion boards, student interaction, social construction, social presence, and visual representation of information. The online tools Google Scholar and Mendeley were also used successfully. Google Scholar has an alert function that notifies the user if a new article is found related to previous searches. Mendeley can be used to search for articles related to those stored in a personal database. Both features successfully led to relevant articles. The bibliographies of articles were used to find other relevant articles, as well as searching Google Scholar for articles that cited found articles. Recommendations from colleagues and faculty also provided leads to relevant research.

This review will describe (a) the role of interaction in student learning, (b) the importance of social presence in online courses, (c) components of online discussions, (d) the benefits and limitations of threaded discussion boards, (e) recent efforts to improve

online discussions, and conclude with a look at (f) alternatives to linear discussion boards including the potential for spatial discussion boards.

Roles of Interaction in Student Learning

According to the social constructivist theory, student interaction is an integral component of learning (Palincsar, 1998; Sthapornnanon, Sakulbumrungsil, Theeraroungchaisri, & Watcharadamrongkun, 2009; Vygotsky, 1978) that has long been linked to increased learning in face-to-face classes (Hrastinski, 2009). Interaction among students can result in high-order thinking as well as greater engagement, higher self-esteem, and higher test scores (Jacobs, Renandya, & Power, 2016). Various types of student interaction can contribute to the co-construction of knowledge (Du, Zhang, Olinzock, & Adams, 2008). Processing new information on their own requires a significant amount of cognitive load, defined as the capacity of an individual's working memory. When students work in small groups to share thoughts and knowledge, the workload is distributed across the group and, thus, the amount of cognitive load on any individual student is reduced, freeing up mental resources for processing the information at a more complex level. Examples of how this sharing and interaction can take place include explaining concepts to other students, giving each other feedback, and asking and answering questions.

For online courses, discussion boards have been used in an attempt to replicate the student interaction found in face-to-face classes (Carr-Chellman & Duchastel, 2000), and are considered one of the most influential features of online courses (Swan, Shea, Fredericksen, Pickett, & Pelz, 2000). A meta-analysis of related studies indicates that students collaborating in online discussions outperform students in face-to-face courses

(Lou, Bernard, & Abrami, 2006), though the improved performance may be due to small group interactions instead of the medium of online discussions. The discussion boards allow for reflection and for multiple sources of feedback, which may not be present in face-to-face classroom discussions. Another meta-analysis found strong support for student-to-student interactions as contributing to learning, but only when the collaborative activities were thoughtfully and pedagogically planned and implemented (Borokhovski, Bernard, Tamim, Schmid, & Sokolovskaya, 2016).

However, the use of discussion boards has met with varying degrees of success (Albon & Pelliccione, 2005). Discussion boards have the potential to reduce feelings of isolation, which is frequently found among online students (Lou et al., 2006). One of the key components to reducing isolation is increasing the feeling of social presence, which can be created through online discussions.

Importance of Social Presence

To co-construct knowledge in an online environment, students need to feel part of a community that includes other students and that they are interacting with other students, not an impersonal computer (Garrison & Cleveland-Innes, 2005). This feeling of connectedness is called social presence. While there is no single definition or measure of social presence, a representative definition was given by Richardson, Maeda, and Swan (2010) who defined social presence as "the degree to which participants in computer-mediated communication feel affectively connected one to another" (p. 332). Social presence supports high-order thinking through the development of relationships that allow an exchange of ideas and collaboration, resulting in co-construction of knowledge (deNoyelles, Zydney, & Chen, 2014; Joksimovic, Gasevic, Kovanovic, Adesope, &

Hatala, 2014; Wei & Chen, 2012). It has consistently been found to be related to student satisfaction, online interaction, and student perceptions of the quality and quantity of their learning, regardless of the specific definition or measurement instrument used (Gunawardena & Zittle, 1997; Liu, Gomez, & Yen, 2009; Maddrell, Morrison, & Watson, 2017; Picciano, 2002; Richardson & Swan, 2003), though there is some debate about whether social presence contributes to learning as measured by the instructor (Maddrell et al., 2017). Social presence alone does not ensure that learning will happen, but true interaction with other students is difficult without it (Garrison & Cleveland-Innes, 2005). So, while social presence may play an important role in creating true discussions resulting in learning, it can be difficult to achieve in online courses.

Social presence is especially hard to achieve in online courses because of the lack of visual cues and the delay between messages and responses (Kear, 2010; Lou et al., 2006; Symeonides & Childs, 2015). Many students find this type of communication cold and impersonal, lacking in social presence, which inhibits them from participating fully in the online discussions. When students avoid participating in the discussions for fear of causing offense or being misunderstood, they can feel isolated and not part of the student community (Symeonides & Childs, 2015). Students who feel isolated in online courses are less likely to complete the course (Rovai, 2007). Therefore, it is important to find ways to create social presence in online courses, such as encouraging participation in discussion boards.

Online discussions can contribute to the creation of social presence in online courses. Cho and Tobias (2016) compared three sections of a course, one which did not use discussion boards, one in which students interacted on discussion boards, and one

which included instructor participation in the discussion. The students who participated in discussions, with or without the instructor, reported statistically significant higher social presence than the students who did not use discussion boards. Discussion boards can help create the feeling of social presence, if students participate in them.

Online discussions serve as the primary method for interaction and the creation of social presence in online courses. The next section will further define the components of an online discussion.

Components of Online Discussions

Online discussions are composed of two parts: the software tool that is used to host the discussion and the discussion prompt that directs the topic of discussion.

Discussion Boards

While some instructors experiment with other formats, most online discussions are text-based and linear. Generally, this means that an initial post is left-aligned and responses are indented underneath. Subsequent responses are indented further, like an outline. The combination of an initial post and all responses underneath is called a "thread" (Figure 1). When reading posts, most readers follow a thread linearly from the initial post through the responses (Albon & Pelliccione, 2005). These types of asynchronous threaded discussion boards are usually built into the learning management systems used by most online courses.

Depending on the specific software used, there may be other features available. For example, students may be able to set up notifications to send an email when someone responds to their post, or they may be able to subscribe to a specific thread, getting notified when someone posts to it. They may be able to upload a photo or other image

that identifies the author of a post, similar to Facebook. Some systems will allow the student to attach documents to the post, link to an external website, or add an audio comment. These additional features are not available on all platforms, but all of them allow for text-based, threaded discussions.

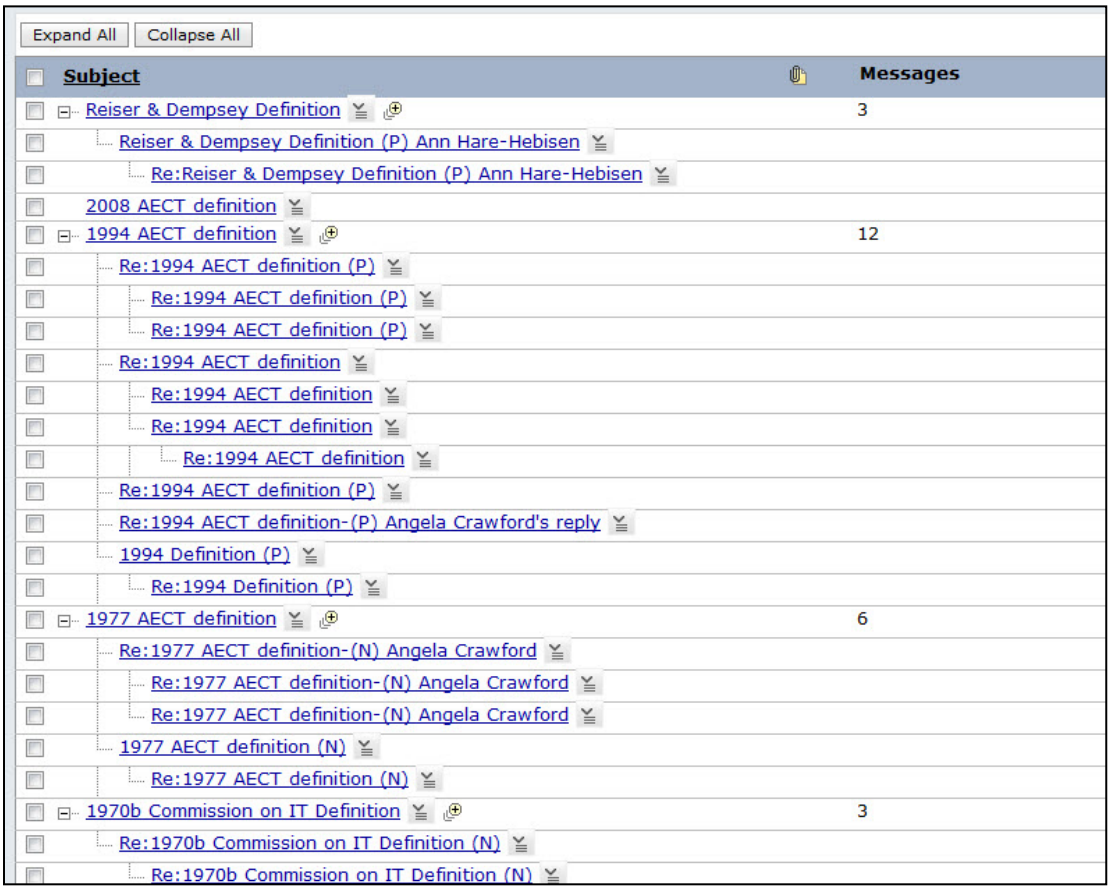

Figure 1. Example of threaded discussion board.

Because most discussions take place in a similar linear, text-based format, the difference between a successful and unsuccessful discussion may be partially due to the discussion prompt, which is the instruction given by the instructor for the discussion.

Types of Discussion Prompts

The type of discussion prompt has a significant effect on the quality of discussion board posts. In general, prompts that require students to analyze, evaluate, and take on different perspectives lead to higher levels of cognitive processing.

Bradley, Thom, Hayes and Hay (2008) explored the effects of six different types of discussion board prompts. These included (a) direct link, which asks students for an interpretation or analysis of a specific reference or quote from a reading; (b) course link, which asks students to integrate information from the reading with other course content; (c) brainstorm, which asks students to generate any and all solutions to an issue; (d) limited focal, which presents students with a few alternative solutions to an issue and asked students to take a position and defend it; (e) open focal, which presents students with just one alternative and asks students for their opinion; and (f) application, which asks students to apply information from the reading to a scenario.

Not surprisingly, the prompts that specifically asked students to provide analyses (direct link, course link) and to generate all possible solutions to a problem (brainstorm) resulted in the most evidence of high-order thinking.

Darabi, Arrastia, Nelson, Cornille, and Liang (2011) found that debate and role-play situations resulted in higher levels of cognitive processing than when students were simply asked to respond to questions. DeNoyelles et al. (2014) proposed three types of prompts that are most effective in promoting high-order thinking. The first type of recommended prompts are problem-based prompts, which include role-play scenarios similar to those used by Darabi et. al. (2011). For example, students may take on the role of school district committee members and need to come up with a consensus-based

intervention for a social problem. This would require them to work together and, with the course content, come up with a solution.

The second type of recommended prompt is project-based, which results in a product or deliverable. For example, students may be asked to develop an e-learning solution for a specific audience (Koh, Herring, & Hew, 2010). Students are most successful when the design problem is complex, when they create project milestones that walk them through the cognitive stages, when students are prompted to reflect, and when faculty provide increased facilitation in the last stages, which are often the most difficult for students.

The third type of recommended prompt is debate prompt. Debate prompts are widely researched and have been found to promote higher levels of cognitive processing (Darabi et al., 2011; Kanuka, Rourke, & Laflamme, 2007; Nussbaum, Winsor, Aqui, & Poliquin, 2007). In a debate, students argue for or against a position, usually with the goal of trying to convince others to come to the same conclusion. Participating in debates can result in higher levels of resolution, exploration and integration (Darabi et al., 2011), increased numbers of posts (Kanuka et al., 2007), and more sophisticated arguments (Nussbaum et al., 2007). However, debates can be difficult for some students who feel reluctant to disagree with their classmates. This can be alleviated by providing guidelines for polite debate and how to evaluate and respond to opposing viewpoints.

Richardson and Ice (2010) compared three common types of discussion prompts, a case study, debate, and an open-ended (topical) prompt. For the case study, students analyzed a case study related to learning theories and related articles. For the debate, students were presented with articles presenting the question of whether students should

be taught differently because of their access to new technologies. Students were assigned to a pro or con side and debated online. The topical condition, one of the most common types of discussion prompts, was an open-ended discussion on the issue of plagiarism. Students preferred the topical prompt because they felt more freedom to express their own opinions and because there were no right or wrong answers. They liked that there were fewer restrictions and guidelines and felt that they learned the material better with this format. The debate prompt was the next most preferred because they were able to see both sides of an issue and enjoyed the challenge of supporting a position even when it was not their own personal opinion. Those who preferred the case-based prompt liked that they were applying knowledge to a real-world situation. Regardless of their preference, however, students showed similar levels of critical thinking across all three conditions. The levels of critical thinking demonstrated were higher than those shown in many studies, indicating that high levels of critical thinking are possible across a variety of prompt types.

Prompts that specifically direct students to do more mentally complex tasks, such as analyzing or debating, consistently result in evidence of higher order processing, although critical thinking has been demonstrated across a variety of prompt types. So, while prompts influence high-order thinking, they are just one component of a successful online discussion. The next section will explore the benefits and limitations of discussion boards as a tool for student interaction.

Benefits and Limitations of Threaded Discussion Boards

Benefits of Threaded Discussion Boards

Online discussion boards have many potential benefits, which include (a) providing a platform for collaboration, (b) co-construction of knowledge, (c) and allowing all students to participate more fully.

Many students appreciate the opportunity to interact and learn from each other. In online courses, communities are built and sustained through discussion boards (Rovai, 2007). Some students value the opportunity to see other points of view and to ask questions of each other (Bassett, 2011; Vonderwell, Liang, & Alderman, 2007). They often feel more comfortable asking a classmate for clarification instead of the instructor and feel that a classmate may be able to more clearly explain or clarify information they found difficult in the readings or lecture. Asking other students questions and for explanations can lead to co-construction of knowledge through practical inquiry.

Under the practical inquiry model, students interact with each other and use critical thinking to reflect on the content, analyze the information, and synthesize it into co-constructed meaning (Garrison, Anderson, & Archer, 2001. Akyol and Garrison (2011) found that in on-line courses students could use discussion boards for practical inquiry, leading to a resolution of a problem or dilemma. This resulted in evidence of high-order thinking, perceived learning, and actual learning outcomes (Akyol & Garrison, 2011). Discussion boards can lead to co-construction of knowledge, though cognitive processing still tends to be at the lower levels of Bloom's Taxonomy (Roseli & Umar, 2015). Sharing knowledge can be most beneficial when all students are able to participate in the process.

Similarly, some students resist participating in live classroom discussions for many reasons such as fear they will be ridiculed, insecurity about their speaking skills, or needing more time to form their thoughts. Online discussions provide the opportunity for those students to more comfortably participate. For example, some students are hesitant to speak up in class if they feel their ideas may be controversial or contrary to the opinion of others. The relative anonymity of the online environment provides a measure of protection for them (Ho & McLeod, 2008; Sthapornnanon et al., 2009). The inability to be interrupted may also make it a more comfortable environment, as students can fully express their opinions without fear of interruption (Andresen, 2009). Non-native English speakers often feel self-conscious about speaking up in class because they are not confident in their ability to communicate clearly in English. Participating in online discussions provides them time to compose their answers, which alleviates their anxiety (Bassett, 2011; Gerbic, 2010). Similarly, some students simply require more time to reflect and process information before contributing to the discussion. In a live discussion, the conversation may move on to a new topic by the time they have formed a comment or response to a previous topic (Hawkes & Romiszowski, 2001; Sthapornnanon et al., 2009). The asynchronous nature of the online discussion provides students with sufficient time to form their thoughts and comments and grants them the ability to move from topic to topic as desired.

As can be seen, there are benefits to online discussions. However, these benefits may be due to the student interaction more than the discussion board format itself. Given the drawbacks to linear discussion boards detailed below, another way to provide student interaction may provide the benefits of discussion boards without the drawbacks.

Limitations of Threaded Discussion Boards

While online discussion boards have been used in an attempt to replicate the discussions that happen in face-to-face courses and to encourage high-level discussions with evidence of critical thinking, results often fall short of expectations. Simply providing students with the opportunity to interact with each other does not mean that they will collaborate or participate in ways that lead to positive educational outcomes (Kirschner & Erkens, 2013). This section will discuss limitations including (a) little evidence of high levels of cognitive processing, (b) the impact of difficult navigation, (c) the difficulty in synthesizing information, (d) the concern that little actual discussion takes place, and (e) the fact that students often feel they are just doing busy work and, therefore, participate only minimally.

There is little evidence of true discussion and high-level processing happening on discussion boards (Darabi et al., 2011). Participation is often low, but even when there is high activity on discussion boards, students still tend to post comments that fall into Vygotsky's lower levels of cognitive processing, including sharing and comparing of information as well as the exploration of inconsistencies (Zhao, Liang, & Liu, 2016). They did not cross into the higher levels of processing, which include co-construction of knowledge, testing the proposed co-construction, and agreeing upon the application of the new knowledge. This lack of high-order thinking may be a result of the frustration students have with features of online discussions such as navigation.

Students find threaded discussion boards difficult to navigate (Albon & Pelliccione, 2005). When reading text on paper, such as a book, readers can easily jump from one section to another, flipping back and forth as needed to find information. With

online threaded discussion boards, it is much more difficult to open and close messages, find a previously read post to re-read, and to keep from getting lost in the maze of posts. There is a perceived loss of freedom, and readers feel they are forced to read the content as presented despite any personal preference to the contrary. Because of this, students have difficulty seeing the entirety of the discussion.

Due to the nature of threaded discussion boards, it is difficult to synthesize information into an overall understanding of the opinions of the class. Hewitt (2001) found that while students desire the ability to synthesize and summarize discussion contents, they found it difficult to do so in online threaded discussion boards. Similar conversations may be going on in separate threads without the participants of each conversation being aware of the others. There is a tendency for students to only read and respond to the most recent comments, which could be problematic if the discussion has gone off topic, since students will miss the most relevant comments (Hewitt, 2003). In fact, because students tend to respond only to the most recent posts instead of going back to read older comments, students rarely felt that their posts were even part of a larger discussion.

A frequent student complaint is that posting on the discussion boards is like writing a note, putting it in a bottle, and dropping it in the ocean (Rovai, 2007). Students may never know if anyone ever read it. This lack of response or feedback is frustrating when students spend time, thought, and effort on composing their messages. Students self-reported that online discussions do not contribute to their learning and that they either find them an inconvenient course requirement (Lapointe & Reisetter, 2008) or just an assignment to get through instead of an opportunity to engage in discussion with their

classmates (Aleksic-Maslac, Magzan, & Juric, 2009). As a result, students read and respond to the messages of other students without deep consideration or processing (Palmer, Holt, & Bray, 2008). This perceived lack of purpose to the discussion can result in low participation.

Students will often do just the minimum amount of work. Students do not tend to respond to peers' posts if not required to do so (An, Shin, & Lim, 2009) and, when given required postings, such as responding to two classmates' posts, that is all most students will do (Khlaif, Nadiruzzaman, & Kwon, 2017). This minimal activity does not lead to real interaction. Just because students compose and post messages to a discussion board does not mean they are involved in an actual dialogue, which requires a back-and-forth exchange between at least two people (Dennen, 2005). Garrison and Cleveland-Innes (2005) found that high levels of online interaction alone does not result in deep levels of learning, echoing the findings of Pawan, Paulus, Yalcin, and Chang (2003) who noted that online discussions do not become interactive and collaborative on their own without guidance. Without prompting, students often indulge in monologues without challenging others or reaching any sort of integration or resolution to questions asked. Students consistently fail to take advantage of the opportunity to participate in discussions or, if they do, the discussions are not effective (Abrami, Bernard, Bures, Borokhovski, & Tamim, 2011; Kirschner & Erkens, 2013).

Students find the discussion board format difficult to navigate and feel that discussion board posts lack purpose, which becomes a self-fulfilling prophecy when students fail to participate. However, there have been many attempts to improve online discussions.

Efforts to Improve Online Discussions

Efforts have been made to increase the effectiveness of online discussions. These have included both efforts to improve linear discussion boards and attempts to use alternatives such as wikis, Facebook, and audio/video.

Improving Linear Discussion Boards

Many factors have been suggested to increase student participation and the quality of the discussion including (a) different types of prompts, (b) dividing the class into smaller groups, (c) assigning roles, (d) assigning grades to the discussion, and (e) instructor participation in the discussion.

The importance of the type of discussion prompt has been previously discussed. Prompts that require students to analyze, evaluate, debate, and do other complex cognitive tasks generally result in high-order thinking (Bradley et al., 2008; Darabi et al., 2011; deNoyelles et al., 2014). Dennen (2005) also suggested that topics that closely align with the students' interests or fields of study help them see the relevance of the discussion. She found that relevant, goal-based activities that require discussion board participation and were clearly communicated to the students led to higher participation as measured through the number of discussion board posts made. Additionally, more activity was observed when discussion prompts were phrased in such a way that students could take various viewpoints and express their own opinions. However, the quality of these posts was not measured. Similarly, Kanuka et al. (2007) found some improvement when instructors created well-structured activities, required debate, and helped students clearly define roles and responsibilities. However, students still did not show evidence of critical thinking and demonstrated only low levels of cognitive presence. Regardless of

the prompt, it can be difficult to manage online discussions when a large number of students are participating.

Dividing a large class into smaller groups can make managing online discussions easier. Discussions are difficult to manage in face-to-face courses that are held in large lecture halls, and this is no different in large online courses (Koskey & Benson, 2016). Students can be overwhelmed by the large amount of posts to read and intimidated by the number of students who will read their posts. To make discussions more manageable, most learning management systems allow the creation of smaller groups. These groups can be made up of homogeneous groups, such as students in the same discipline, or purposefully diverse groups to encourage exposure to a variety of perspectives. Interacting with just a few classmates instead of the whole class can be more comfortable, but some students still find participating in online discussions intimidating.

Students may feel anxious about posting or self-conscious about what to say or how to say it (Hancock, 2016). Hancock and Rowland (2017) tried to address this by providing a list of roles including Discussion Starter, Key Terms Definer, Passage Seeker, Connect to Research, Connect to Theory, Connect to Social Constructs, Summarizer, Devil's Advocate, Class Clown, and Quiet Kid in the Back. The Discussion Starter serves as a discussion leader and posted thoughts, concerns, feelings, and questions that would get the conversation started. They might find something interesting about a previous post and ask for more information. The Key Terms Definer focuses on defining or explaining key terms related to the topic. The Passage Seeker focuses on specific parts of the reading that were poignant or that can be connected to real-life examples or other content. The Connect to Research role has students providing

additional, credible research on the topic. Connect to Theory requires students to offer theories that relate to the topic. Connect to Social Constructs focuses on social aspects of the topic, such as groups that are affected or cultural differences. The Summarizer summarizes the main ideas of the readings and may include their own ideas on the topic. The Devil's Advocate presents opposing ideas, debating ideas, and exploring other perspectives. The Class Clown is not disruptive of the class, as it sounds, but is rather disruptive of ideas, using humor, satire, or hyperbole to get people to think. And finally, the Quiet Kid in the Back role writes general comments on the topic, possibly agreeing with another post and explaining why or adding an example to expand on an idea.

Students chose the role that they wanted to play and stated their choice at the end of the post. Students were not required to take a role but, when used, the roles provided structure to the discussion and encouraged students to move beyond the common "I agree" type of post. Students felt safe expressing their ideas within a role without fear of embarrassment. They felt free to disagree with another student, for example, because they were playing the role of Devil's Advocate. The authors reported higher levels of cognitive processing in students who used the roles, though it is not clear how the data were analyzed.

No matter how the discussion is organized, students generally do not participate in online discussion boards if it is not required (An et al., 2009) Because of this, Rovai (2003) suggested making it part of the course grade. He found that grading student posts at 10%–20% of the course grade was the optimal percent for increasing post activity. However, the specifics of how students are graded is also important. Often, students are graded only on the number of postings made, not on the quality of the post, so a well-

designed rubric needs to emphasize the post quality (Koskey & Benson, 2016; Rovai, 2007).

Researchers are not in consensus about instructor participation in discussion boards. An et al. (2009) found students were more likely to interact with each other when the instructor participation was minimal. If an instructor is part of the conversation, there is a tendency for students to primarily interact with the instructor instead of each other (Andresen, 2009; Vonderwell et al., 2007). However, Garrison and Cleveland-Innes (2005) found that instructor participation could be beneficial in developing deep learning as long as the focus is on encouraging ongoing and thoughtful discourse. Higher levels of social presence have been reported in discussion boards in which the instructor participates (Cho & Tobias, 2016). Baran and Correia (2009) had success with using students as peer-moderators, which provided structure and guidance to the discussions without the authoritative presence of the instructor. It is likely that difference lies in how the instructor participates and not just in the presence or absence of the instructor in the discussion. The most effective role for the instructor in an online class is likely a moderator, asking questions that encourage deeper processing of information. If an instructor posts a comment giving his or her own opinion, it is likely to shut down further conversation as students will not want to disagree with the instructor. Instead of trying to improve the quality of discussions in linear, threaded formats, the solution may lie in using a different format.

Exploring Alternatives to Linear Discussion Boards

Studies have looked at various alternatives to threaded discussion boards. These include (a) wikis, (b) Facebook, and (c) audio discussions.

Wikis are like a website that can be edited by multiple contributors. Students can edit each other's work to work collaboratively toward a final product. In many cases, each student's actions can be tracked through a history tool so the instructor can see what each student contributed. Furthermore, wikis offer other features such as tags, RSS feeds, and links to outside websites. Wikis have been used for discussions in different ways. Ioannou and Artino (2009) asked students to come to consensus and present their conclusions on the wiki. On the other hand, Tu, Blocher, and Gallagher (2010) used the wiki to hold discussions structured similarly to threaded discussion boards, but encouraged the use of additional features available on a wiki such as social tagging, RSS feeds, and social networking features such as profiles and pictures/avatars.

The efforts to use wikis as an alternative to discussion boards for student interactions have produced mixed results. In many ways, students prefer the familiarity of threaded discussion boards and find them easier to use (Ioannou & Artino, 2009; Tu et al., 2010). The wikis may be better for synthesizing and for collaboration (Tu et al., 2010) but students are often hesitant to edit other students' work (Ioannou & Artino, 2009). The benefits of wikis may become more apparent when students become more familiar with the format and with guidelines and policies to help students feel more comfortable editing each other's work. Other attempts have used a format more familiar to many students, Facebook.

Many students already use and are comfortable with Facebook. The social aspect of Facebook was predicted to help students create a sense of community amongst themselves as the discussions feel more natural, informal, and relaxed (Jumaat & Tasir, 2016). Once again, the research exploring this alternative is mixed. In one study,

students were given an option of joining a Facebook page or the threaded discussion board in the learning management system for interaction with other students and the instructor (Schroeder & Greenbowe, 2009). Neither discussion board was required and less than half of the students chose to join the Facebook page. However, there were 67 posts on the Facebook page compared to just 17 on the discussion board, indicating that students preferred the Facebook format. However, because participation was optional and the discussions were unstructured, it is difficult to judge from this study whether Facebook would be a good format for structured discussion.

DeSchryver, Mishra, Koehler, and Francis (2009) had students participate in more structured discussions either on Facebook or on threaded discussion boards in the learning management system and found no differences in number of posts, length of posts, or sense of community. Many instructors are against the idea of using Facebook in their classes because of privacy concerns, the loss of control when using a third-party application, and feeling that it is inappropriate and possibly unethical for faculty and students to be Facebook friends. Many students also feel uncomfortable having their instructors “invading” their social space on Facebook and want to keep their personal life separate from their school life (Dennen & Burner, 2017; DeSchryver et al., 2009). Given these issues and the lack of clear benefit of using Facebook over typical threaded discussion boards, Facebook may not be a viable alternative. Alternatives have not been limited to text-based formats.

Hew and Cheung (2013) explored the use of audio-based discussions. Students liked being able to hear each other’s voice and felt that it was sometimes easier to explain their idea verbally, but the majority still preferred text interactions because it was faster

to read than listen to posts, and many students were self-conscious about recording themselves. Clark, Strudler, and Grove (2015) found a similar result using both asynchronous video posts and synchronous video chat. There was an increase in social and teaching presence in the video formats over a threaded, linear discussion board. Students were very self-conscious about appearing on video at first, but overcame it throughout the course.

While several alternatives to linear, threaded discussion boards have been explored, no clear alternative has emerged as a replacement. An alternative that is more visual may prove useful.

Potential of Spatial Discussion Boards

A spatial discussion board format may provide a promising alternative. As previously discussed, there are many benefits to visual representations of information which may overcome some of the limitations of linear discussion boards. Linear discussion boards can make it hard for students to synthesize information (Hewitt, 2001, 2003), but visual-spatial presentation of information makes synthesizing information easier (Hegarty, 2011; Nersessian, 2012) and aids in this integration of content (Nesbit & Adescope, 2006; Suthers, Vatrapu, Medina, Joseph, & Dwyer, 2008). Students found linear discussion boards difficult to navigate and felt constricted by the format (Albon & Pelliccione, 2005), whereas a visual representation of the discussion that allows students to see the whole discussion at once should allow for more freedom of navigation. Consumption, creation, and manipulation of visual representations can improve learning (Huron, Jansen, & Carpendale, 2014). According to Mayer's (2003) theory of multimedia processing, visual presentation of information reduces cognitive load on the verbal

channel, which frees up cognitive load capacity for processing information at a higher level. Therefore, it is likely that using a visual format for online discussions may result in higher quality discussions. However, no software exists that has been designed for a visual-spatial discussion board. For the purposes of this study, it was decided to use mind mapping software as the closest approximation of a visual-spatial discussion board format.

Mind mapping is a technique for visually mapping thoughts and ideas. Mind maps can take different forms, but at its most basic, "nodes" are created to represent an idea and related nodes are connected to each other with a line, providing a visual representation of how ideas are connected to each other. Subtopics radiate from the central idea. See Figure 2 for a simple example.

Figure 2. Example of a mind map.

Depending on the software used, there are many other features available for online mind maps. A brief summary of the concept can be placed in the node, but a connected text box can contain more detailed information. Users may be able to link to websites, include images or sound recordings, attach documents, or change the color and

font of the nodes. Many online mind maps allow for collaboration, so multiple individuals can work on the same mind map, all of which makes them a viable tool for visual-spatial online discussions.

There are several ways that mind mapping software might be used for online discussions. For example, the discussion prompt can be at the center, with student original posts radiating from it. Responses are connected to the original post with a line. This would make it easy to see which comments already had responses and where most of the conversation is happening. If students use the node for a brief phrase that summarizes their comment and put their comment in the text box, then all students can get a general feel for the whole conversation by looking at one screen, then clicking on any node to see the comment attached to it. This should help with both navigation and synthesis.

Another use is to provide opposing ideas in two separate nodes on different sides of the screen. If students place their node along a continuum to indicate which idea they most agree with, it would be easy to get a general feel for the opinions of the class at a glance. Both ideas were used in this study in an attempt to maximize the potential benefits of a spatial format.

Measuring Discussion Quality

Many different approaches have been used to measure the quality of online discussion board prompts. A review of articles from 2002 to early 2010 showed 56 different coding schemes used to measure the quality of online discussion posts (Weltzer-Ward, 2011). The schemes did cluster into fewer categories, depending on the specific feature of discussion being examined and the theoretical basis. For example, some

schemes looked specifically at social interactions (An et al., 2009; Rourke, Anderson, Garrison, & Archer, 2007), while others looked for evidence of critical thinking (Chen & Chiu, 2008; Jeong, 2003). Others took a more global approach, looking at the overall quality of the content (Ho & Swan, 2007; Rovai, 2007). The community of inquiry framework is a popular theoretical foundation for scoring discussion board posts (Anderson, Rourke, Garrison, & Archer, 2001; Garrison, Anderson, & Archer, 2001; Rourke, Anderson, Garrison, & Archer, 2007).

Various schemes were considered before settling on the interaction analysis model (IAM; Gunawardena, Lowe, & Anderson, 1997), which is detailed in the Chapter III, Methods. The Cooperative Principle Rating Scale (Ho & Swan, 2007) was initially considered because of the multiple ways that it provides to evaluate discussion board posts. In addition to a Quality score that assesses how well the post contributes to the conversation by adding new information supported by examples or evidence, the scale also looked at Quantity, Relevance, and Manner. The Quantity evaluates the appropriateness of the length of the post and whether it is long enough to convey information sufficiently without being too long. The Relevance score evaluates how well the post relates to the previous post as well as the overall topic. And finally, Manner evaluates the written quality of the post, how well it is organized and whether there are grammar or spelling errors. The multiple ways of considering the quality of the post was appealing; however, this tool has not been widely used, and there is little data supporting its reliability or validity. Therefore, other tools were explored.

Another scoring mechanism that was considered was educationally valuable talk (EVT; Uzuner, 2007). EVT is a very easy-to-use rubric that is quick to use and has high

interrater reliability (Bliss & Lawrence, 2009). Posts are rated as to whether they contribute to the educational discussion by using techniques such as reasoning, creativity, reflection. Posts are scored simply as EVT or educationally less valuable talk (EVLT). ELVT posts may be valuable in other ways, such as building social presence and community, but do not contribute directly to the topic being discussed. This tool was reviewed and ultimately rejected based on the lack of sensitivity it has for discovering nuances in the quality of posts.

The IAM (Gunawardena, Lowe, & Anderson, 1997) was not originally considered because it focuses on discussions in which students are working to come to consensus and students in this study were not directly instructed to do so. However, it is the most widely used tool for assessing quality of online discussions (Lucas, Gunawardena, & Moreira, 2014; Weltzer-Ward, 2011) and was used in a pilot study (Case, Crooks, & Cheon, 2012). Therefore, it was chosen as one of the tools to be used to evaluate the online discussions, but was not used alone. This study used different tools to assess the various aspects of discussion board quality and the potential for visually-based discussion boards as an alternative to linear discussion boards. In addition to the IAM, this study used the number of posts made, the ability of students to synthesize information in a synthesis paper, and a survey to assess students' attitudes about different aspects of the online discussions.

Summary

Although research continues to seek alternatives to the threaded discussion boards, such as wikis and Facebook, most researchers have looked at ways to create effective discussions within the traditional threaded discussion board format without

critiquing the limitations of the format. The benefits of online threaded discussion boards may be attributable to the student interaction, not the discussion board format. Instead of trying to work within a limited system structure, alternative formats should be examined. Since the difficulty of navigating and synthesizing information has been shown to be limitations of threaded discussion boards, research is warranted to find a method that may make these tasks easier. A visually-based discussion board should improve navigation and make synthesis easier, resulting in an increase in the quality of online discussions among students.

CHAPTER III

METHODOLOGY

This study explored how students differ in the number of posts, the quality of posts, the quality of synthesizing information, and student perceptions of discussions when using either a linear or spatial discussion format. It also examined whether there were differences depending on whether the discussion prompt was a debate or a topical prompt. The debate and topical prompts were chosen because of their frequent use in online discussion boards.

Research Questions

1. What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the number of posts made?
2. What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the quality of students' discussion posts?
3. What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the quality of students' synthesis of discussion posts?
4. What are the effects of discussion board format (linear vs. spatial) and time (before or after exposure) on student perceptions of discussions?

Research Design

This study used a within-groups design with counterbalancing, which is an experimental and quantitative design. Students were divided into four groups that rotated

through four discussion conditions (linear/debate, linear/topical, spatial/debate, spatial/topical), thus serving as their own controls.

Participants

Participants consisted of 20 graduate students in an introductory, online, instructional technology course. Some students did not complete all assignments; therefore, the number of subjects in each analysis varied.

Data Collection

This study used archival data from activities completed as part of regular course requirements for an online instructional technology course. The information collected included discussion board posts, synthesis papers, and student feedback about the discussions.

Instrumentation

Amount of interaction. To measure the amount of interaction in the discussions, this study used the number of response posts made. The original posts were not counted as they only served as the impetus for interaction.

Quality of discussion. To measure the quality of discussion board posts, this study used the interaction analysis model (see Appendix A), or IAM (Gunawardena, Lowe, & Anderson, 1997). The IAM is based on the constructivist idea of social co-construction of knowledge (Jonassen, 1991; Vygotsky, 1978) and the work of Henri (1992) who attempted to define the aspects of online interactions that demonstrate meaningful learning. It is one of the most frequently used methods for measuring discussion board quality (Lucas, Gunawardena, & Moreira, 2014; Weltzer-Ward, 2011). There are five phases that follow the stages of debate and resolution: sharing information,

exploring dissonance, negotiation of a co-construction, testing the co-construction and, finally, agreement.

The first phase is sharing and comparing of information. Examples of posts that would score a Level 1 would be a statement of observation or opinion, a statement of agreement, a corroborating example, asking or answering questions for clarification, or identification of a problem.

The second level is the discovery and exploration of dissonance or inconsistency among ideas, concepts, or statements. In general, a post that scores a Level 2 would disagree with the previous post. Examples of a Level 2 score include identifying or stating areas of disagreement, asking or answering questions to clarify the source or extent of disagreement, or advancing the argument by providing examples from one's own experience, literature, data, or analogy

The higher levels of cognitive processing consist of Levels 3, 4, and 5. In the third level, students negotiate meaning or co-construction of knowledge, coming to a potential resolution of the dissonance in Level 2. Examples include negotiation or clarification of terms, negotiation of the relative weight to apply to different arguments, identification of areas where the conflicting perspectives agree or overlap, or the proposal and negotiation of new statements that embody compromise or co-construction. These three levels compose the lower-level of cognitive processing, the level at which most students stop in online discussions.

At Level 4, students test and modify the synthesis or co-construction that was created at Level 3. They test the new construction against their own experiences, formal data that has been collected, their cognitive schemata, and against contradictory

testimony from the literature. If necessary, the co-construction is revised until it can hold up against these types of challenges and tests.

The final stage, Level 5, is a statement of agreement and application of the new knowledge. Students may summarize the agreement, apply the new knowledge, or make metacognitive statements about how their knowledge or way of thinking has changed as a result of the interaction.

In this study, only the responses were scored, not the original post, as the quality of the original post is not likely to be affected by the conditions. Also, off topic posts, such as "Thank you for your response," were not coded.

Because of the subjective nature of content analysis, two raters were used and interrater reliability was established at .95. The author of this study served as one rater. The other rater was an instructional technologist who was working both as the Assistant Director of the Instructional Design and Technology Team and teaching Instructional Technology courses at a major public university. Raters reviewed the rubric together to make sure they were in agreement on how it would be applied. Twenty posts were scored independently by both raters who agreed on 19 of the 20 posts. They discussed and came to agreement on the one score on which they differed, then divided the remaining posts and scored them individually. While posts were provided in context so the rater could see the whole discussion thread, all identifying information was removed.

Quality of synthesis. Students have difficulty synthesizing information in linear discussion boards because the format is difficult to navigate, making it hard to find a previously read post; it can be difficult to make sense of a thread that has veered off topic, and it is difficult to get a sense of the overall discussion (Hewitt, 2001). However, a

visual representation of information can help students synthesize information (Hegarty, 2011; Nersessian, 2012). Because the spatial format should make synthesizing information easier, this study examined how well students were able to synthesize the discussions in each condition.

After each discussion was concluded, students were asked to write a short synthesis paper on the content of the discussion. Because most students are likely to receive a high grade on the assignment and, thus, not provide the variability necessary to see any effects that might be present, content analysis was performed on the assignments to look for indications of high-level integration and synthesis of information as opposed to mere summary. After a review of several example rubrics for scoring synthesis, an original rubric for this assignment was created (Appendix B).

Because of the subjective nature of content analysis, two raters were used and interrater reliability was established at .85. The same raters who evaluated the discussion posts were used.

Student perceptions. Students often feel that discussion boards do not lead to learning or are only busy work (Aleksic-Maslac, Magzan, & Juric, 2009; Lapointe & Reisetter, 2008; Rovai, 2007). To assess how students felt about the two different discussion board formats, this study measured perceptions of social presence, usefulness, ease of use, collaboration, and attitude toward the discussion formats, using a questionnaire revised from one used in a pilot study. A questionnaire from a previous pilot study was revised (Case, Crooks, & Cheon, 2012). The questionnaire presents 15 Likert-type statements (using a 5-point scale). The questionnaire measured student perspectives of social presence as well as usefulness, ease of use, collaboration, and

attitude regarding each discussion board format. In addition, the questionnaire included three open-ended questions to assess what students liked and disliked about each format. For this study, the questionnaire was adapted by adding an open-ended question to address the ease of synthesizing information for the synthesis paper (see Appendix C).

Students were given an introductory, practice assignment that required them to create a post in each of the discussion board formats. After this practice assignment, the survey was administered to students to get their initial impressions of the two discussion board tools. They completed the same survey after the fourth discussion assignment to see if their perceptions had changed over time. At each administration of the survey, students were given two versions of the Likert-type questions, one for the linear tool and one for the spatial tool, and one copy of the qualitative questions that covered both formats.

Treatments

For each discussion, there were two versions of the discussion prompt, a debate version and a topical version (see Appendix D). Under both conditions, students were asked to make two original posts, then respond to at least two of their classmates' posts.

Under the debate prompt condition, students were asked to make a judgment about the topic. The first debate prompt asked students to comment about the definition of instructional technology with which they agreed and disagreed the most. The second prompt asked them to comment on traditional ID models and whole task ID models, again writing about the one with which they agreed and disagreed the most. The third prompt asked students to choose between constructivism and objectivism. Finally, the

fourth prompt presented six instructional design theories and asked students to post about the ones with which they agreed and disagreed the most.

Students under the debate prompt condition were then asked to find at least two posts by classmates who made choices different from theirs. They were asked to post a response to each one, addressing the original post with counterarguments from their own perspective. Students were instructed to debate, but to be courteous and respectful. If they could not find a post with which they disagreed, they were instructed to assume the role of Devil's Advocate and make counterarguments as if they disagreed (see Appendix D for detailed prompts and instructions.)

Under the topical prompt condition, students were asked to make the same number of posts (two original and at least two responses), but were given more freedom in the content of the post and response. For the first discussion, related to instructional design definitions, students were asked to post on two of the topics and consider how definitions have changed over time, historical or cultural changes that might have influenced the definitions, or changes in technology or educational theories that may have influenced the definition. However, students were free to comment with any thoughts they had on the topic. For the second discussion, related to traditional ID models and whole task ID models, students were asked to create a post under each model considering how each model might be applied to different situations, the types of learners that might do better with one or the other, or how other factors would influence the choice of model. For the third discussion, students were asked to compare constructivism and objectivism. Students were asked to think about different subjects that might affect which approach they would take or other variables such as age of learner or expertise. Finally, in the

fourth discussion, related to Instructional design theories, students were asked to consider how preferences for one model or another have changed over time, which one might be best for different subjects, or learner characteristics that might fit one theory over another. In all cases, considerations were presented as suggestions and students were encouraged to write about whatever thoughts they had on the subject. Students were asked to respond to at least two peers, but no instructions were given as to the content.

The two discussion board formats used were linear and spatial. The spatial format used a free online mind mapping site called WiseMapping (www.wisemapping.com). Posts are visually linked to each other so that responses branch off from the original post (see Figure 3). To create a "branch" or comment on a post, students clicked on the post they wanted to respond to and pressed the Return key. This would create a new line on which students could type the title of their post as directed in the instructions. Using the tool bar at the top of the screen, students could add longer comments in a text box, change the color of their text, add links, and do other customizations. If the response was accidentally attached to the wrong comment, it could easily be dragged and dropped to a new location.

The linear format was presented in a free forum hosting site called ProBoards website (www.proboards.com). The site uses a common forum format with threaded posts, in which responses are shown under the original post (Figure 4).

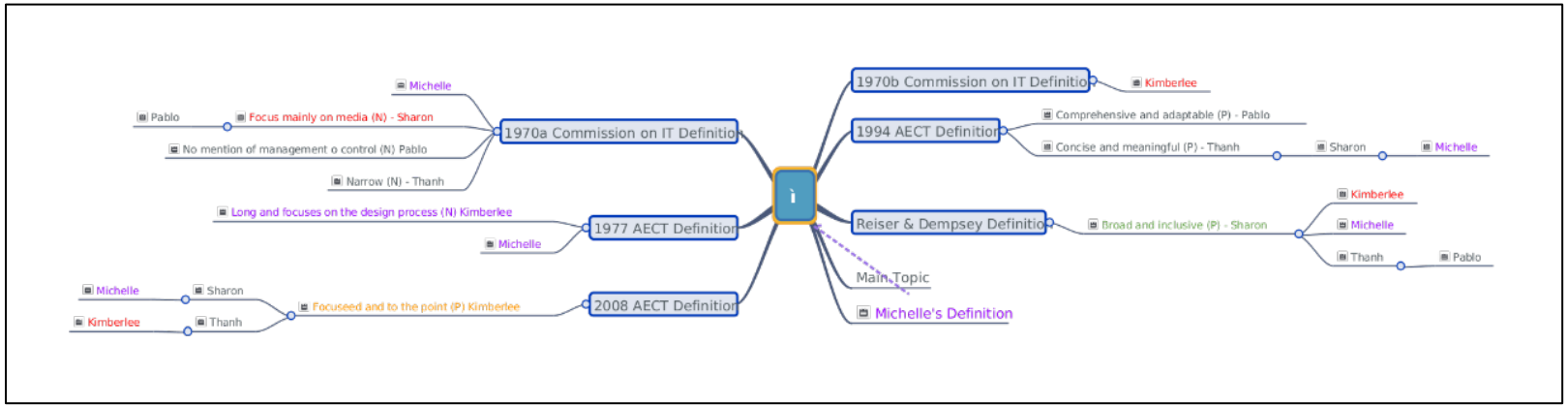

Figure 3. WiseMapping discussion thread.

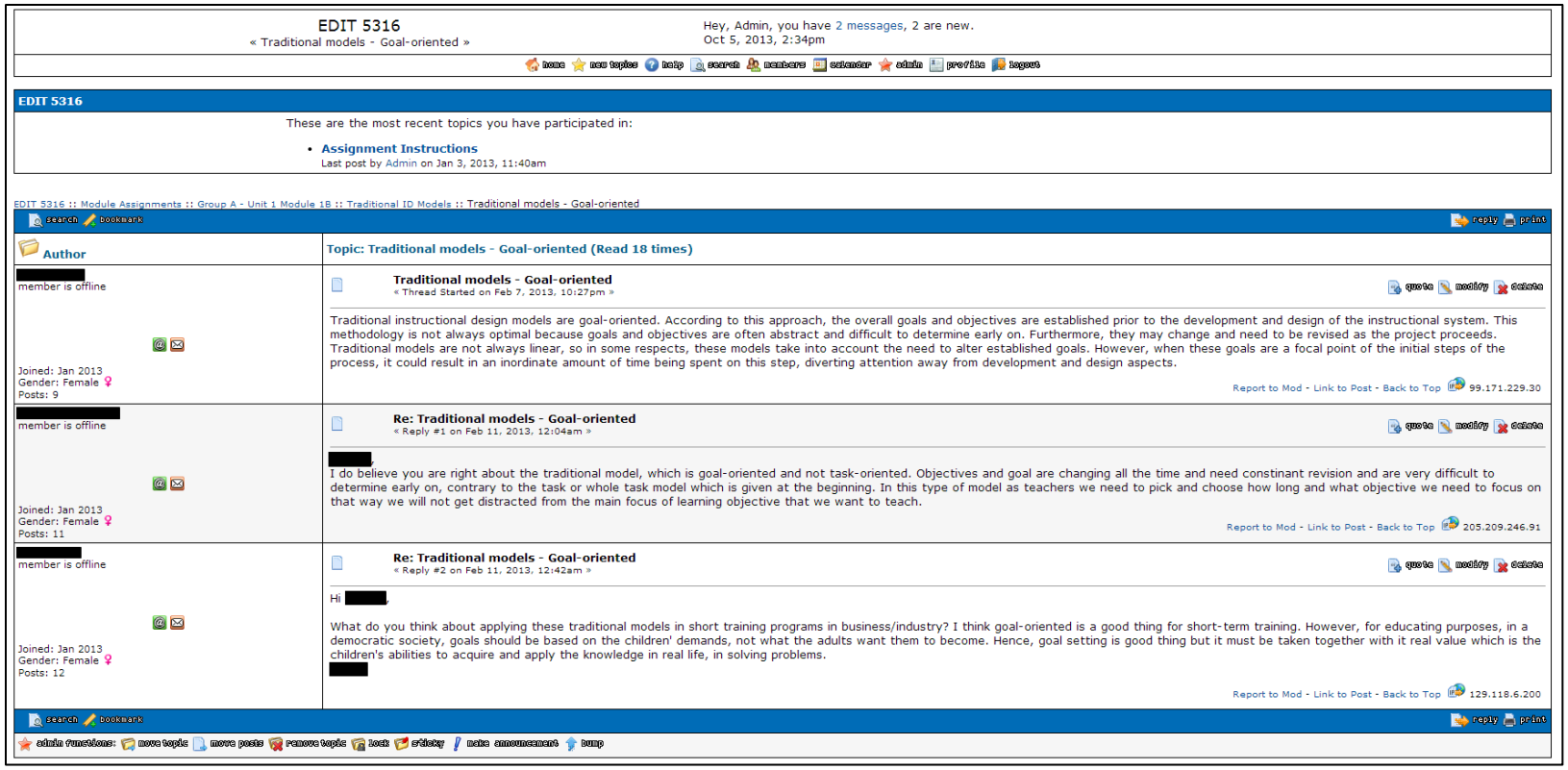

Figure 4. ProBoards discussion thread.

Although the course used Blackboard for course management and it contained its own linear discussion board, this study used an outside site in order to control for the novelty of the platform. It is likely that the students had experience with the Blackboard platform, so they may have felt more comfortable with Blackboard and preferred it to the spatial format simply because of familiarity. To reduce the possibility of familiarity as a confounding variable, this study used sites that students most likely had not used before for both the linear and spatial formats. The "ease of use" question from the attitude survey assessed whether one tool was found to be easier to use than the other, as well as whether there was a change over time as students gained experience with the tools.

Procedure

At the beginning of the semester, students were given two introductory assignments, one using ProBoards and one using WiseMapping. These early assignments gave students a chance to become familiar with the tools prior to actual discussion board assignments. After these introductory assignments, students were given the attitude survey to establish their first impressions of the tools. The survey consisted of two copies of the Likert-type scale, one for each discussion board tool and one copy of the open-ended questions, which covered both tools.

Students were divided into four groups, designated as Groups A, B, C, and D. For each discussion, there were four different conditions: spatial/debate, spatial/topical, linear/debate, and linear/topical. For the first discussion, Group A posted on the spatial discussion board in response to the debate prompt (see Table 1). Group B also posted to the spatial discussion board, but was given the topical prompt. Group C posted on the linear discussion board in response to the debate prompt, and Group D posted on the

linear discussion board in response to the topical prompt. Each group had its own boards, so students never saw the posts of students outside of their group.

For the second discussion, students either had a different discussion prompt type or a different discussion board format. See Table 1 for the rotation.

Table 1

Group Discussion Rotation

	Group			
Discussion	A	B	C	D
1	Spatial/ debate	Spatial/ topical	Linear/ debate	Linear/ topical
2	Linear/ topical	Spatial/ debate	Spatial/ topical	Linear/ debate
3	Linear/ debate	Linear/ topical	Spatial/ debate	Spatial/ topical
4	Spatial/ topical	Linear/debate	Linear/ topical	Spatial/ debate

After each discussion, students wrote a one- to two-page synthesis paper covering the information from the discussion (see Appendix E).

After the fourth discussion, students were given the attitude survey again. As before, the survey consisted of two copies of the Likert-type scale, one for each discussion board tool, and one copy of the open-ended questions, which covered both tools.

The perception survey was scored by averaging the scores from relevant items to create an overall score for each of the five measures: ease of use (items 1, 2 and 3), usefulness (items 4, 5, and 6), attitude (items 7, 8, and 9), collaboration (items 10, 11, and 12), and social presence (items 13, 14 and 15).

Data Analysis

For the first three research questions, data were analyzed using two-way repeated-measures analyses of variance. The discussion board format (linear or spatial) and discussion prompt type (debate or topical) were the independent variables. Number of discussion replies, quality of discussion posts, and quality of synthesis were the dependent variables. For student perceptions, descriptive statistics were used due to the low number of complete student responses.

The open-ended questions of the attitude questionnaire were used for additional qualitative information about the students' experience and attitudes.

Conclusion

This study was an exploration of the differences in the number of response posts, the quality of response posts, and the quality of synthesizing information, as well as student perceptions of discussions when using either a linear or spatial discussion format, comparing debate and topical discussion prompts.

CHAPTER IV

RESULTS

The purpose of this study was to explore the effects of discussion board format and discussion prompt on the number of posts, the quality of posts, the quality of synthesizing information, and student perceptions of discussions. All research questions were analyzed using a two-way repeated-measures analysis of variance, except for Research Question 4, which looked at student perceptions. Only 5 of the 20 students completed the questionnaires; therefore, only descriptive statistics are provided. The number of participants included in each analysis varied, depending on the number of students who completed the various assignments.

Research Question 1

What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the number of posts made?

Fifteen of 20 students completed all four discussions and were included in this analysis.

The main effect of discussion board format was not statistically significant, $F(1,14) = 0.17$, $p = .69$, $\eta_p^2 = .01$. The number of posts did not differ between the linear and spatial board formats (see Table 2 for means).

The main effect of discussion board prompt was not statistically significant, $F(1,14) = 0.52$, $p = .48$, $\eta_p^2 = .04$. The number of posts did not differ between the topical and debate discussion board prompts (see Table 3 for means).

Table 2

Mean and SD for Discussion Prompt (Number of Posts)

Discussion Prompt	*M*	*SD*	*n*
Topical	2.47	1.07	15
Debate	2.33	0.88	15

Table 3

Mean and SD for Discussion Format (Number of Posts)

Discussion Format	*M*	*SD*	*n*
Spatial	2.37	0.16	15
Linear	2.43	0.20	15

The interaction effect was statistically significant, $F(1,14) = 4.70$, $p = .05$, $\eta_p^2 = .25$. For the spatial discussion board, there was a larger number of posts when students were given the debate prompt. On the linear discussion board, there were more posts when students were given the topical prompt (see Table 4 for means).

Table 4

Mean and SD for Discussion Format by Discussion Prompt (Number of Posts)

	Discussion Prompt					
	Topical			Debate		
Discussion Format	*M*	*SD*	*n*	*M*	*SD*	*n*
Spatial	2.13	0.74	15	2.60	1.12	15
Linear	2.80	1.27	15	2.07	0.46	15

Research Question 2

What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the quality of students' discussion posts?

Fifteen of 20 students completed all four discussions and were included in this analysis. Possible scores on the interaction analysis model (IAM) ranged from 1 to 5.

The main effect of discussion board format was not statistically significant, $F(1,14) = 0.09$, $p = .77$, $\eta_p^2 = .08$. The quality of discussion board posts did not differ between the spatial and linear discussion board formats (see Table 5 for means).

The main effect of discussion board prompt was statistically significant, $F(1,14) = 8.45$, $p = .01$, $\eta_p^2 = .13$. The discussion board posts were of higher quality when the debate prompt was given (see Table 6 for means).

The interaction effect was not statistically significant, $F(1,14) = 0.21$, $p = .65$, $\eta_p^2 = .00$ (see Table 7 for means).

Table 5

Mean and SD for Discussion Prompt (IAM)

Discussion Prompt	*M*	*SD*	*n*
Topical	1.25	0.45	15
Debate	1.55	0.47	15

Table 6

Mean and SD for Discussion Format (IAM)

Discussion Format	*M*	*SD*	*n*
Spatial	1.40	0.51	15
Linear	1.39	0.45	15

Table 7

Mean and SD for Discussion Format by Discussion Prompt (IAM)

	Discussion Prompt					
	Topical			Debate		
Discussion Format	*M*	*SD*	*n*	*M*	*SD*	*n*
Spatial	1.23	0.50	15	1.59	0.48	15
Linear	1.27	0.42	15	1.51	0.46	15

Research Question 3

What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the quality of students' synthesis of discussion posts?

Twelve of 20 students completed all four synthesis papers and were included in this analysis. Possible scores on the synthesis paper ranged from 0 to 3.

The main effect of discussion board format was not statistically significant, $F(1,11) = 1.00$, $p = .34$, $\eta_p^2 = .08$. The quality of synthesis did not differ between linear and spatial discussion board formats (see Table 8 for means).

Table 8

Mean and SD for Discussion Prompt (Synthesis)

Discussion Prompt	*M*	*SD*	*n*
Topical	1.08	0.83	12
Debate	1.33	0.82	12

The main effect of discussion prompt was not statistically significant, $F(1,11) = 1.57$, $p = .24$, $\eta_p^2 = .13$. The quality of synthesis did not differ between the topical and debate discussion prompts (see Table 9 for means).

The interaction effect was not statistically significant, $F(1,11) = 0.00$, $p = 1.00$, $\eta_p^2 = .00$ (see Table 10 for means).

Table 9

Mean and SD for Discussion Format (Synthesis)

Discussion Format	*M*	*SD*	*n*
Spatial	1.13	0.74	12
Linear	1.30	0.91	12

Table 10

Mean and SD for Discussion Format by Discussion Prompt (Synthesis)

	Discussion Prompt					
	Topical			Debate		
Discussion Format	*M*	*SD*	*n*	*M*	*SD*	*n*
Spatial	1.00	0.74	12	1.25	0.75	12
Linear	1.17	0.94	12	1.42	0.90	12

Research Question 4

What are the effects of discussion board format (linear vs. spatial) and time (before or after exposure) on student perceptions of discussions?

Only five of 20 students completed both surveys, one before participating in the discussions and one after completing four discussions. Twelve students completed the first survey and seven completed the second, with only five doing both. Therefore, only descriptive statistics are provided. Possible scores on the questionnaire ranged from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*).

Ease of Use

The Ease of Use score assessed how easy students felt the discussion board formats were to use. Ease of Use was highest for the linear discussion board on the post-survey (M = 4.73) and lowest for the spatial discussion board on the pre-survey (M = 3.00). Means and standard deviations can be found in Table 11.

Table 11

Mean and SD for Survey Administration by Discussion Format (Ease of Use)

	Survey Administration					
	Pre			Post		
Discussion Format	*M*	*SD*	*n*	*M*	*SD*	*n*
Spatial	3.00	1.70	5	3.27	1.19	5
Linear	4.13	0.51	5	4.73	0.44	5

Usefulness

The Usefulness score assessed how useful they felt the two discussion board formats were for having online discussions. Usefulness was highest for the linear discussion board on the pre-survey (M = 3.27) and lowest for the spatial discussion board on the pre-survey (M = 2.46). Means and standard deviations can be found in Table 12.

Table 12

Mean and SD for Survey Administration by Discussion Format (Usefulness)

	Survey Administration					
	Pre			Post		
Discussion Format	*M*	*SD*	*n*	*M*	*SD*	*n*
Spatial	2.46	1.01	5	2.67	1.23	5
Linear	3.27	0.98	5	2.93	1.59	5

Attitude

The Attitude score assessed how students felt about their experience participating in discussions in each of the two discussion board formats. Attitude was highest for the linear discussion board on the pre-survey ($M = 4.20$) and lowest for the spatial discussion board on the post-survey ($M = 3.33$). Means and standard deviations can be found in Table 13.

Table 13

Mean and SD for Survey Administration by Discussion Format (Attitude)

	Survey Administration					
	Pre			Post		
Discussion Format	*M*	*SD*	*n*	*M*	*SD*	*n*
Spatial	3.47	1.59	5	3.33	1.43	5
Linear	4.20	0.65	5	3.80	0.56	5

Collaboration

The Collaboration score assessed how students felt about the potential of the two discussion tools for collaborating with other students. Collaboration was highest for the linear discussion board on the pre-survey (*M* = 3.60) and lowest for the spatial discussion board on the post-survey (*M* = 2.80). Means and standard deviations can be found in Table 14.

Table 14

Mean and SD for Survey Administration by Discussion Format (Collaboration)

	Survey Administration					
	Pre			Post		
Discussion Format	*M*	*SD*	*n*	*M*	*SD*	*n*
Spatial	3.07	1.42	5	2.80	1.02	5
Linear	3.60	1.59	5	3.40	1.01	5

Social Presence

The Social Presence score assessed how much social presence and sense of community students felt through each of the discussion board formats. Social Presence was highest for the linear discussion board in the pre-survey (*M* = 3.60) and lowest for the spatial discussion board on the post-survey (*M* = 3.00). Means and standard deviations can be found in Table 15.

Table 15

Mean and SD for Survey Administration by Discussion Format (Social Presence)

	Survey Administration					
	Pre			Post		
Discussion Format	*M*	*SD*	*n*	*M*	*SD*	*n*
Spatial	3.27	1.46	5	3.00	1.00	5
Linear	3.60	1.21	5	3.20	0.97	5

CHAPTER V

DISCUSSION AND CONCLUSION

This chapter is a review and summary of the present study, which examined the effects of discussion board format and discussion prompt on the number of posts, the quality of posts, the quality of synthesizing information, and student perceptions of discussions. Key findings and limitations of the study are discussed and recommendations for future research suggested.

Summary

Procedure

Students in an online graduate school instructional technology course were asked to participate in online discussions as part of their course assignments. There were two formats for the discussion board: linear, which used an online site called ProBoards, and spatial, which used the online mind mapping tool, WiseMapping. The discussion board prompts fell into two categories: topical, which was opened-ended, and debate, which directed students to post a response either to a post with which they disagreed or to assume the role of Devil's Advocate in their response. In all conditions, students were asked to make one original post and respond to the posts of at least two of their peers. With a 2 x 2 within-subjects repeated measures design, there were four conditions: linear/topical, linear/debate, spatial/topical, and spatial/debate. There were four discussions, so each student was in each condition once over the course of four discussions and, thus, served as their own controls.

Students wrote a paper at the end of each discussion in which they were asked to synthesize the content from the discussion. This was measured as part of the study to see

if the discussion board format or discussion prompt affected the quality of synthesis. To assess student impressions of the two different discussion board formats, students completed a survey after a brief exposure to the linear and spatial boards, then again after completing the four discussion board assignments.

The amount of interaction in the boards was measured by the number of response posts made. The quality of posts was determined by scoring the response posts using Gunawardena, Lowe, and Anderson's interaction analysis model (IAM, 1997). The synthesis paper was scored using a rubric developed by the author after a review of similar rubrics. The survey produced student opinions about the discussion boards as they relate to social presence, usefulness, ease of use, collaboration, and general attitude.

The data were analyzed using a two-way repeated-measures analysis of variance and descriptive statistics.

Key Findings

Some of the key findings of this study include:

1. There were more discussion board posts when students were given the debate prompt and posted on the spatial discussion board, and more discussion board posts when students were given the topical prompt and posted on the linear discussion board.
2. The quality of discussion board posts was higher when students were given the debate prompt.
3. There were no statistically significant differences in the quality of synthesis papers between any of the conditions.

4. Means were higher for the linear discussion board than the spatial discussion board on all student perception measures.

Discussion

Research Question 1

What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the number of posts made?

The number of posts made was used as a measure of the quantity of interaction. There were more posts made on the spatial discussion board when students were given the debate prompt and more posts on the linear discussion board when given the topical prompt.

One way to interpret this result is that while the debate prompt increased cognitive load, the visual-spatial presentation of the spatial discussion board reduced cognitive load, therefore, providing a more comfortable experience for participating in the discussion. Debates result in higher load because presenting an alternate viewpoint, as is required when debating, requires a higher level of cognitive processing than agreeing with the previous post (Gunawardena, Lowe, & Anderson, 1997). Presenting information visually can reduce cognitive load by organizing information in a way that is easier to access (Hegarty, 2011; Mayer & Moreno, 2003). As demonstrated in Figure 5, the WiseMapping posts and connecting posts can all be seen at once. In this example, students were presented with two theories of instructional design: traditional and whole task. They were asked to post a response to both theories, explaining why they either liked or disliked the theory. To show how much they liked the theory, the post was physically placed closer to the top if they agreed or closer to the bottom if they disagreed.

This let students determine how much a poster liked a theory before even opening the post. Presenting this information visually should decrease cognitive load, suggesting that the spatial discussion board format is a good choice for discussion prompts that increase cognitive load such as debates.

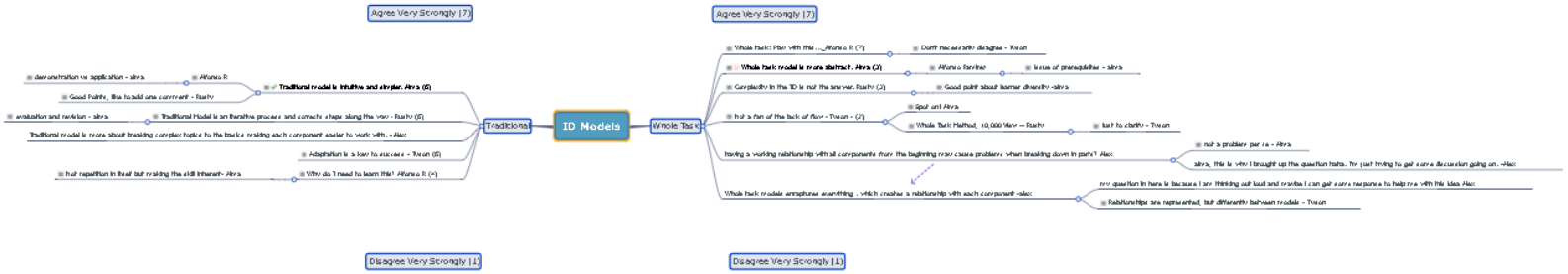

Figure 5. Example of WiseMapping debate discussion.

However, the survey indicated that students found the spatial discussion board more difficult to use. Even though the specific linear discussion board used for this study was one students had probably not used before, the general idea of the linear board was familiar and, therefore, easier to use. The extra effort needed to use the unfamiliar spatial format may have increased cognitive load, negating any benefit offered by the format in reducing load. This may explain why there was no main effect for the type of discussion board used.

However, there was a difference for which discussion board format had more posts depending on the prompt type, with more posts for the debate prompt on the spatial discussion board and more posts for the topical prompt on the linear discussion board. The increased number of posts may have been related to the spatial format's ease of navigation instead of the reduced cognitive load. Because students participating in a debate are expecting others to disagree with them, they may be more interested in revisiting previous posts than students in the topical prompt condition. As previously discussed, linear discussion boards can be difficult for students to navigate to find previous posts in order to continue a conversation (Albon & Pelliccione, 2005). In spatial discussion boards, students get a feel for the entire discussion on one screen and can easily navigate to the posts they wish to read. Not only can students see the entire discussion and how posts are related to each other simultaneously, they can easily navigate to a specific post and click to read it. Therefore, the structure of the visual discussion board should make it easier for students to find previous discussions and continue the conversation, resulting in more posts.

While students participating in debates may be more interested in revisiting posts to see how others have responded to them, students in the topical condition may be less interested in responses to their posts since they do not expect responses that challenge their statements. The difficulty of navigating the linear discussion board to revisit previous posts may not be a deterrent, since they may be less likely to want to revisit those posts. If students found the spatial discussion board more difficult to use and preferred the familiarity of a linear discussion board, then it is understandable that there were more posts on the linear discussion board for the topical prompt condition.

It should be noted, however, that a high amount of interaction does not necessarily lead to high-order processing (Garrison & Cleveland-Innes, 2005). While it is encouraging to discover increased activity and interaction for certain types of prompts when combined with certain types of discussion boards, it does not indicate that the discussions are more effective. In fact, the lack of similar results for the quality of discussion posts indicated that while there were more posts in certain conditions, there was no difference in the quality of the posts in each condition. It is also important to note that while there was a statistically increase in the number of posts for debates on the spatial discussion board format and more posts on the linear discussion board for topical prompts, the number of posts was still relatively low.

Students were directed to make at least two response posts. The mean number of response posts ranged from 2.07 for the debate posts on the linear discussion board to 2.80 for topical discussions on the linear discussion board. The lower number of posts for debates on the linear board may be due to the difficulty of navigation, as previously discussed. The low number of overall posts is consistent with other studies that showed

that students tend to write only the number of posts that are required (An et al., 2009; Khlaif, Nadiruzzaman, & Kwon, 2017). Points were awarded for completing the discussions, as recommended by Rovai (2003). Previous studies (Aleksic-Maslac, Magzan, & Juric, 2009; Lapointe & Reisetter, 2008) have shown that students may still underestimate the value of the discussion or view the discussion as a redundant task. Requiring students to post a minimum number of posts and responses is a means to an end, not an end unto itself. The minimum post requirement is intended to initiate participation, which might not happen if there were no minimum post requirement (An et al., 2009). However, the requirement for a minimum number of posts alone does not seem sufficient to encourage true interaction and discussion. Future studies may explore ways to help students find value in the discussion beyond the points added to their grade, which may lead to more effective discussions.

Even with a small number of posts, there was a statistically significant interaction between the type of discussion prompt and the discussion board format. Students given the debate prompt posted more on the spatial discussion board, while students given the topical prompt posted more on the linear discussion board. Although more research should be conducted to fully understand the underlying reasons, these results suggest that using spatial discussion boards may result in more posts for some types of discussion prompts, such as debate, while using linear discussion boards may result in more posts for other types of prompts, such as topical. Although care should be taken to not assume that the number of posts alone leads to better discussions, this finding provides a promising lead for future research.

Research Question 2

What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the quality of students' discussion posts?

The quality of discussion posts was measured using the IAM (Gunawardena et al., 1997). The posts made in response to debate prompts were scored statistically significantly higher than posts in response to the topical prompt. This was not surprising since the IAM scores for posts that show dissonance were higher than the scores for posts that show agreement. Posts made in the debate prompt condition are likely to show more dissonance than the topical prompt posts.

Engaging a peer in debate requires a higher level of cognitive processing than agreeing with peers' statements (Gunawardena, Lowe, & Anderson, 1997). This is reflected in the scoring of the IAM. On the IAM scale, a score of 1 is given for "sharing and comparing of information" (see Appendix A). A score of 2 is given for "the discovery and exploration of dissonance or inconsistency among ideas, concepts or statements" (see Appendix A). Since posts that show dissention, as debate posts typically do, are scored higher on the IAM scale, this result indicates that students in the debate condition disagree more often with the previous post than students in the topical condition, which should be expected. Looking only at the debate prompts, there was no statistically significant difference between scores on the linear discussion board (M = 1.51) and spatial discussion board (M = 1.59). Although there was dissent and debate in the topical condition, when students were specifically directed to engage in debate with their peers, there was more dissent. There are potential drawbacks with the use of the IAM, however.

The IAM scores ranged from 1 to 5; however, in this study no post received a score higher than 3, regardless of the type of discussion board used or the type of discussion prompt given. This is consistent with the findings of many other studies that found that students do not generally progress to higher levels of co-construction of knowledge in discussion boards on their own (Lucas, Gunawardena, & Moreira, 2014; Zhao, Liang, & Liu, 2016). It may be that the discussions did not continue over a long enough period of time for students to work through the process to achieve higher levels (Richardson & Ice, 2010); however, it is unlikely that the discussions would have continued without prompting and encouragement, given that most students did not post more than the minimum of two responses.

The IAM works best when students work together to generate new knowledge, which they are unlikely to do without specific guidance and direction toward that goal (Buraphadeja & Dawson, 2008). Neither the topical nor debate prompt asked students to come to agreement or create a solution to a problem, so the fact that they did not reach the higher levels of cognitive processing, as measured by the IAM, should not be surprising. With the range of scores on the IAM reduced from 1 to 3, the tool may lack the sensitivity to identify more subtle differences that may exist.

Although not ideal for this study, the IAM was chosen after reviewing other possible tools. The Cooperative Principle Rating Scale (Ho & Swan, 2007) was initially considered because of the multiple ways it evaluates discussion board posts. Four separate values are scored for each post, which include Quality, Quantity, Relevance, and Manner. However, this tool was set aside as a possible rubric because it has not appeared in any published studies since it was published in 2007 and sufficient reliability and

validity data is lacking. In addition, educationally valuable talk (Uzuner, 2007) was considered. It has been used frequently and is easy to score, which results in consistently high interrater reliability. However, with only two possible scores (educationally valuable talk or educationally less valuable talk), the tool was not sensitive enough for this study. The IAM was finally decided upon because it is the most commonly used tool for measuring the quality of discussion boards (Lucas et al., 2014; Weltzer-Ward, 2011) and had been used in a previous study to examine the potential of spatial discussion boards (Case, Crooks, & Cheon, 2012). Despite its popularity, the IAM has not been evaluated for reliability and validity. A better tool for evaluating the quality of discussion board content is needed for future research in this area. Weltzer-Ward (2011) found 56 different tools used between 2002 and 2010 for measuring quality of discussion board posts, but most of them have not been used more than a few times. To best assess the effectiveness of different interventions attempting to improve discussion board quality, a high-quality consistent tool is needed.

Research Question 3

What are the effects of discussion board format (linear vs. spatial) and discussion prompt (debate vs. topical) on the quality of students' synthesis of discussion posts?

There were no statistically significant differences found related to the synthesis papers. This is most likely due to the fact that, in general, students earned low scores on the papers, resulting in low variation among scores. This may be a result of students' unfamiliarity with writing synthesis papers or poor instruction.

The overall scores on the synthesis papers were low, with an average score of 1.2 out of a possible 3. Although students were given instructions on how to write a synthesis

paper and provided with additional online resources for more information, overall all students struggled with writing a paper that truly synthesized information instead of just summarizing it. The instructions, however, were brief and students were not given an opportunity to practice writing synthesis papers or get feedback before writing the papers that were scored and used in the study. It was assumed that graduate students had experience with writing synthesis papers, which may not have been a valid assumption. When asked whether the linear or spatial format was easier to synthesize on the post-survey, one student commented, "No difference. I'm still trying to understand what a synthesis paper is." Future studies should examine students' ability to synthesize information and provide more thorough guidelines on how to write synthesis papers. In addition, practice or preliminary synthesis papers should be assigned so students can receive guidance and feedback on writing them before data are collected.

The spatial discussion board format should make it easier to synthesize information (Hegarty, 2011). When asked the question, "Was it easier to write your synthesis papers when your discussion was on ProBoards or WiseMapping, or was there no difference? Explain your answer," some students indicated that it was easier when using ProBoards. Some students liked the ease of seeing information arranged and organized in the spatial format: "On WiseMapping, it was easier because I had a chance to see all discussions at the same time," and "It was easier to write the synthesis paper when using WiseMapping. ProBoards is cumbersome to navigate for me. I had to go back and forth several times to follow each thread for the synthesis." This preference was not universal, however, as one student felt that students wrote longer posts on the linear discussion board, which made synthesis easier.

While some of the comments provided by students indicated that they found synthesizing easier when using the spatial discussion board, there were no statistically significant findings related to their ability to write synthesis papers. This is likely due to insufficient communication of expectations for the papers as well as the lack of experience and skill students had in writing synthesis papers.

Research Question 4

What are the effects of discussion board format (linear vs. spatial) and time (before or after exposure) on student perceptions of discussions?

Because only five students completed both surveys (12 for the pre-survey and seven for the post-survey), only descriptive statistics were used. The low response rate maked it difficult to draw meaningful conclusions, but the following section will review score means and student comments. The students who responded seemed to find the linear board easier to use and more useful for discussions. They reported enjoying the discussions, though they did not find them effective collaboration tools. Additionally, there seemed to be some social presence developing, which might have strengthened over time. However, because the data could not be analyzed statistically, these descriptive data hints should be considered cautiously. This appears to be a rich area for future research.

It is likely that students did not complete the surveys because they were not required to do them, and no points were awarded toward their grade for completion. This tendency to only do what is required and what counts toward the grade has been found in previous studies with discussion board posts (An et al., 2009; Rovai, 2003), so a similar effect likely occurred with the surveys. If similar surveys are used in future studies,

points should be awarded toward students' grades or other incentives provided to encourage students to complete them.

The following section will look at the responses on the surveys as suggestions of student opinions, but these results cannot be weighed heavily, given the extremely small participation.

Ease of use. Students seemed to find the linear discussion board easier to use than the spatial discussion board. This is likely because the linear format was familiar, even if the specific tool was unfamiliar. This study purposefully chose a linear discussion board tool that students were unlikely to have used before, to reduce the effects of familiarity. However, it appears that even though the specific tool was new to students, the format was familiar and comfortable. This is supported by comments such as "[ProBoards] is very familiar, like a regular forum site" and "I like that [ProBoards] is very similar to the discussion boards in Blackboard." It may not be possible to find a linear discussion board that would be different enough to reduce the effects of familiarity. A better approach might be to familiarize students with the spatial discussion board format before collecting data.

Usefulness. Students were asked to rate how useful they felt the discussion board format was for hosting discussions and learning. The scores for usefulness fell mostly in the *Disagree* to *Neutral* range, suggesting that students did not find discussion boards useful for learning. This echoes findings from other studies (Aleksic-Maslac et al., 2009; Lapointe & Reisetter, 2008). There was a slight preference for the linear discussion board, with a few scores falling in the *agree* to *strongly agree* range. The familiarity of the linear discussion board format may have led students to find it more useful.

Attitude. Students were asked if they enjoyed interacting with other students in the discussion boards. Most of the scores fell into the *neutral, agree,* and *strongly agree* range, which suggests that students enjoyed interacting with each other in the discussions. This echoes the findings of previous studies (Bassett, 2011; Rovai, 2007; Vonderwell, Liang, & Alderman, 2007). Enjoying the interaction is a step towards building community.

Collaboration. Students were asked whether the tool made it easier to get to know and collaborate with other students. The scores on this measure were mostly in the *disagree* to *agree* range, indicating that the students did not feel strongly one way or another about the ability of the discussion boards to serve as a collaboration tool. This is not surprising since they were not asked to collaborate during any of the classroom activities and, therefore, would have little to base their ratings on.

Social presence. Students were asked whether they felt a sense of community and felt comfortable interacting with other students in the discussions. Most scores were in the *neutral* to *agree* range, suggesting that students were somewhat comfortable interacting with one another on the boards, but there was not a strong sense of community. This may have developed if the study had taken place over a longer period of time.

Overall, during this study, student perceptions seemed to favor the linear discussion board over the spatial discussion board. They found the linear format easier to use, which is likely a result of their familiarity with the format. Students found it more useful for hosting discussions but, overall, students did not like either format for this purpose. Students enjoyed interacting with each other on both formats, though scores for

the linear format were higher. Neither format was considered very useful for collaboration, though the liner format scored higher. Additionally, some evidence of social presence was noted in both formats, with the linear format once again scoring higher. Overall, students seemed to favor the linear board, though this may have changed if the study had taken place over a longer period of time, giving students the opportunity to become more comfortable and familiar with the spatial format.

Implications

Discussion boards are the most common way for students to interact with each other in online courses. However, many studies have indicated that true, meaningful discussions that result in co-creation of knowledge generally do not occur (Darabi, Arrastia, Nelson, Cornille, & Liang, 2011; Zhao et al., 2016). While many studies have examined ways to improve the quality of discussions within the traditional linear format (Bradley,Thom, Hayes, & Hay, 2008; Darabi et al., 2011; deNoyelles, Zydney, & Chen, 2014), some studies, including this one, have explored alternatives. Most of these alternatives, however, have resulted in linear text-based discussions such as Facebook posts (Jumaat & Tasir, 2016; Schroeder & Greenbowe, 2009) or wikis (Ioannou & Artino, 2009; Tu, Blocher, & Gallagher, 2010). This study is unique in exploring a spatially-based format.

The most promising result of this study is the finding that students interacted more with each other on the spatial discussion board format when they were given a debate prompt and more often on the linear discussion board when given the topical prompt. Although high amounts of interaction do not indicate higher post quality or more effective discussions (Garrison & Cleveland-Innes, 2005), this result nonetheless

suggests that the spatial discussion board format may be an effective tool for certain types of discussions, especially those that require higher cognitive load. Based on student comments, at least some students found it easier to get a feel for the conversation with the spatial format, though the survey indicated that students found the familiar linear format easier to use. It is likely that there is no best, one-size-fits-all format for student interaction in an online course. Further exploration into the use of spatial discussion boards and different types of discussion prompts is warranted and would let instructors choose the best tool for their goals.

Limitations of the Study

This study has several limitations including a low number of participants, measurement tools, assignments, and software tools.

Participants

One of the limitations of this study is the low number of students that completed all of the assignments. Although all activities, except for the perception survey, were scored homework assignments, only 12 of the 20 students completed all the synthesis papers, 15 completed all discussion board discussions, and five completed both the pre- and post-survey. The latter is the most concerning and makes it impossible to draw meaningful conclusions from the survey data.

The low completion rate of the surveys is not surprising since no points were awarded for their completion. Rovai (2003) said that students are less likely to participate in discussion boards if participation is not calculated into their grades. It is probable that the same applies to other types of assignments and that more students may have completed both surveys if they had earned points toward their grade for completing them.

The low number of complete data is a limitation of using archival data. If participation rates had been monitored during data collection, students could have been reminded or prompted to complete assignments and surveys.

Measurement Tools

The rubric for the synthesis paper was created by the author after reviewing several sample rubrics found online. While the rubric has face validity, it has not been formally evaluated for reliability and validity. Possible scores ranged from 0 to 3, providing a 4-point range. A scale with more potential scores, such as a 5- or 7-point range, would be more sensitive to variations.

The questionnaire was created for a previous study (Case et al., 2012). However, it has not been analyzed for validity and reliability. Each subscore of the survey (ease of use, usefulness, collaboration, attitude, and social presence) has only three questions that contribute to its score. An expanded survey with more questions contributing to each subscore might be more sensitive. A revised measure, assessed for reliability and validity, should be considered for future studies.

The IAM is a well-established tool, although no formal validity and reliability testing has been done. Although there is a 5-point scale (1–5), no student scored higher than 3, which is consistent with previous studies. This effectively reduces it to a 3-point scale. Once again, the limited range of scores may not be sensitive enough to reflect differences.

Overall, the range of scores on the measurement tools used was limited. Tools with a larger range of scores may be more sensitive to any differences between conditions.

Assignments

The synthesis paper assignment was a problem, as students seemed to have needed more direction and instruction in how to write a synthesis paper. With an average score of 1.2 out of a possible 3, there was not enough variation in scores to determine if the discussion board format made a difference. Instructions that clearly state expectations and assignments early in the semester that provide students with feedback on their syntheses would improve this aspect of the study.

The discussion board assignment also had problems. Four discussions were held, giving students only one discussion in each condition (linear/topical, linear/debate, spatial/topical, and spatial/debate). This resulted in only one data set per condition and allowed students limited exposure to the new, spatial format, as they only participated in two discussions in that format. Had students participated in more discussions in each condition, the data sets would have been more robust.

Time

This study took place over approximately eight weeks. This may not have been long enough to allow students to become comfortable with the unfamiliar spatial discussion board. The potential benefits of a spatial format may have been negated by the awkwardness and uncertainty of using an unfamiliar tool. Had students had more time to explore and become familiar with the spatial discussion board format, they may have felt more positive about it and some of the benefits may have manifested more clearly. More time could also allow for the collection of additional data, as mentioned above.

Software

The mind mapping software was not ideal for use as a discussion board. Although there were collaboration features that allowed multiple people to edit a single mind map, the website did not automatically record which student made contributions. It also did not prevent students from accidentally editing or deleting other students' posts. This is a limitation of using a software package designed for a use other than the one required.

Using software that is not part of a learning management system (LMS) also has drawbacks. An LMS often provides additional information that could be useful in exploring how students interact with the assignments. For example, some of the potential data includes the date and time of posts, how long students spend on the site, and whether they go back to edit posts. While the linear discussion board did note the date and time of posts, none of the other potentially helpful data were recorded using tools outside of an LMS.

Recommendations for Future Research

Future research should address the limitations of this study. Primarily, a better tool for spatial discussion board format should be explored. New social interaction tools are being created every day, which could provide an alternate way of providing student interaction. Until software designed specifically for this purpose is developed, these tools should be explored. The ideal tool should have features that easily identify contributions made by each student and limit editing to each student's contributions.

More sensitive rubrics should be found or developed. Although the IAM is one of the most popular tools being used to evaluate discussion board posts, students consistently fail to reach the higher levels of co-construction, limiting the actual range of

scores to 1–3 instead of 1–5. Similarly, more sensitive and validated tools for measuring the quality of synthesis and student perceptions should be used. Because many students are unfamiliar with writing synthesis papers, if the ability to synthesize is being measured, time should be spent on teaching this skill to students prior to collecting data.

To increase the data set, students should be monitored to make sure they are completing all assignments and be reminded or prompted when an assignment is missing. All assignments and activities should be awarded points toward the final grade to encourage students to complete them. Expanding the duration and number of participating students would further strengthen the data analysis potential.

Of course, future studies should continue to explore the results of this study to confirm and expand on the effects found. Future studies should focus on the increased spatial board interactions with debate prompts and increased linear board interactions with topical prompts. Different types of discussion boards may work better for some types of discussions. Future studies could combine techniques that promote high-order cognitive processing with various discussion board formats to further explore possible interactions. For example, studies could use a moderator to help guide students into questioning and challenging the moderator and other students (Ghadirian, Fauzi, & Ayub, 2017; Hou, Chang, & Sung, 2011) or provide discussion board prompts that explicitly instruct students to solve a problem or come to consensus (Heo, Lim, & Kim, 2010; Wang, Woo, & Zhao, 2009). Using these techniques, which seemed to promote high-order cognitive processing, along with various formats for discussion board, may show that different discussion board formats work better for different types of discussions.

Although this study has had limited results, traditional linear, text-based discussion boards are still not effective. Therefore, attempts to improve student interaction should continue.

Conclusion

This study was designed to explore the potential of a spatial discussion board as an alternative to common linear discussion boards. In addition, two types of discussion board prompts, topical and linear, were used to explore whether the boards would be more useful for one type of prompt over the other. To measure the usefulness of the discussion boards, this study looked at the amount of interaction among students, the quality of the discussion board posts, and the quality of synthesis papers based on the information posted in the discussion. Students were also asked a number of questions to garner their opinions of the discussion board formats.

The results of this study indicated that students post more frequently on the spatial discussion board format when given a discussion board prompt. The results also indicated that students post more frequently on the linear discussion board format when given a topical prompt, although the quality of the posts were not statistically significantly different among conditions. The quality of posts was better for the debate prompts overall, but there was no statistically significant difference between the types of discussion board. There was no statistically significant difference on students' ability to synthesize the discussion between the two different formats. And finally, students generally preferred the linear discussion board format over the spatial discussion board format across student perception categories.

Future studies should explore the effect of the spatial discussion board format combined with the debate prompt as well as other types of prompts. Discovering that different discussion board formats are more conducive for certain types of discussion board prompts would assist faculty in encouraging productive and effective online discussions.

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APPENDICES

Appendix A

Interaction Analysis Model (Gunawardena, Lowe & Anderson, 1997)

Level	Definition	Examples
1	Sharing and comparing of information.	A. A statement of observation or opinion. B. A statement of agreement from one or more participants. C. Corroborating examples provided by one or more participants. D. Asking and answering questions to clarify details of statements. E. Definition, description, or identification of a problem.
2	The discovery and exploration of dissonance or inconsistency among ideas, concepts or statements.	A. Identifying and stating areas of disagreement. B. Asking and answering questions to clarify the source and extent of disagreement. C. Restating the participant's position and possibly advancing arguments and considerations in its support by references to the participant's experience, literature, formal data collected, or proposal of relevant metaphor or analogy to illustrate point of view.
3	Negotiation of meaning/co-construction of knowledge.	A. Negotiation or clarification of terms. B. Negotiation of the relative weight to be assigned to types of argument.

		C. Identification of areas of agreement or overlap among conflicting concepts. D. Proposal and negotiation of new statements embodying compromise/ co-construction.
4	Testing and modification of proposed synthesis or co-construction.	A. Testing proposed synthesis against "received fact" as shared by the participants or their culture. B. Testing against cognitive schema. C. Testing against personal experience. D. Testing against formal data collected. E. Testing against contradictory testimony in literature.
5	Agreement statement(s)/applications of newly constructed meaning.	F. Summarization of agreement(s). G. Application of new knowledge. H. Metacognitive statements by participants illustrating their understanding that their knowledge or way of thinking (cognitive schema have changed as a result of the conference interaction.

Appendix B

Synthesis Rubric

0	1	2	3
Mostly summary instead of synthesis. There are separate summaries of ideas, but no integration or theme identified.	There's an attempt at synthesis by combining ideas, but no theme or original conclusions identified.	Evidence of integration, theme identified, conclusions made but do not show original thought.	Evidence of integration, theme identified, and conclusions made which demonstrate original thought.

Appendix C

Perception Survey

At each administration, students will be given two versions of the quantitative survey (one for ProBoards and one for WiseMapping) and one version of the qualitative questions, asking for feedback on both tools.

Please respond to the following statements based on your experiences using the **Proboards** discussion boards (or **Wisemapping** tool). Using the following scale, rate how well each item describes your experience.
1= Strongly Disagree (SD), 2=Disagree (D), 3 =Neutral (N), 4= Agree (A), 5 =Strongly Agree (SA)

	Statements	Strongly disagree ◄ Neutral ► Strongly agree				
		11	22	33	44	55
1	I could easily post messages.	1	2	3	4	5
2	I could easily read other postings.	1	2	3	4	5
3	I could easily understand the overall themes and direction of the group discussion.	1	2	3	4	5
4	The discussion tool improved my ability to learn.	1	2	3	4	5
5	The discussion tool provided an efficient way to discuss the readings.	1	2	3	4	5
6	The discussion tool would be useful in future courses.	1	2	3	4	5
7	The discussions were enjoyable.	1	2	3	4	5
8	I enjoyed interacting with other students.	1	2	3	4	5
9	The discussions were a good idea.	1	2	3	4	5
10	The discussion tool provided a useful collaboration tool.	1	2	3	4	5
11	The discussion tool enabled me to interact collaboratively.	1	2	3	4	5
12	The discussion tool enabled me to easily get to know other students.	1	2	3	4	5

13	The discussion tool enabled me to feel a sense of online community.	1	2	3	4	5
14	The discussion tool enabled me to feel comfortable participating in the discussions.	1	2	3	4	5
15	The discussion tool enabled me to feel comfortable interacting with other students in the discussions.	1	2	3	4	5

1. What did you like about:
    a. Proboards
    b. WiseMapping
2. What challenges did you experience when using:
    a. Proboards
    b. WiseMapping
3. What instructional advantages do you see in using:
    a. Proboards
    b. Wisemapping
4. Which format, if either, made it easier to write your synthesis paper? Why? *
5. Other comments?

*This question was only asked at the second administration of the survey.

Scoring

Measure	Survey Items
Ease of Use	1, 2, 3
Usefulness	4, 5, 6
Attitude	7, 8, 9
Collaboration	10, 11, 12
Social Presence	13, 14, 15

Appendix D

Discussion Prompts

Each discussion prompt has four versions, ProBoards/WiseMapping and Topical/Debate.

Discussion 1 - Topical

When you go to the ProBoards (WiseMapping) forum for your group, you should see six topics, each representing one of the definitions discussed in the readings.

Your task is to create a thread on two of the definition topics with your thoughts/opinions. Some things to consider are how definitions have changed over time, historical or cultural changes that might have influenced the definitions, or changes in technology or educational theories that may have influenced the definition. These are just ideas, you can write about other things that may have occurred to you.

In the heading of your node, provide a short title (3-5 words). For example, "Focus on Design".

Respond to at least two classmates' posts.

Discussion 1 – Debate

When you go to the ProBoards (WiseMapping) forum for your group, you should see six topics, each representing one of the definitions discussed in the readings.

Your task is to select the definition that **best represents your view** of the field and create a thread with your post that indicates a) why you think the definition is the best, and b) what you would add or remove from the definition to make it even better.

In the subject heading of your post, provide a short title (no more than 7 words) followed by (P) to indicate a positive feeling toward the definition. For example, “Focus on Design (P)”.

Next, find the definition that you **disagree** with most. Create a thread with your post that indicates a) why you think the definition is inadequate, and b) what you would add or remove from the definition to improve it.

In the subject heading of your post, provide a short title (3-5 words) followed by (N) to indicate a negative feeling toward the definition. For example, “Too Long (N)”.

Finally, reply to at least two classmates whose opinions **differ from yours**. Address their points with counter-arguments of your own. Keep it courteous, and do not take disagreements personally, since the assignment goal is to debate pros and cons with your classmates.

If no one has a post you disagree with, play Devil’s Advocate and take an opposing position, presenting the counter-arguments of someone who did disagree.

Discussion 2 - Topical

There are two topics in this discussion, Traditional ID Models and Whole Task ID Models. (Read Chapter 2 of the text for more information about these two different approaches to instructional design).

Your task is to create a thread under each topic with your thoughts/opinions. Some things to think about are how each model might be applied to different situations, the types of learners that might do better with one or the other, or how other factors

would influence the choice of model. These are just suggestions to get you started, you may write about anything that occurred to you while reading.

Give your post a short title, 3-5 words. For example, **Using Traditional Models.**

Respond to at least two classmates' posts.

Discussion 2 – Debate

There are two topics in this discussion, Traditional ID Models and Whole Task ID Models.

Decide which approach you **agree** with most and create a thread under that topic indicating why you think this approach is best.

In the subject heading of your post, provide a short title (3-5 words) followed by a number indicating how strongly you agree with this approach. Use the following scale to represent your level of agreement:

1 = Disagree Very Strongly

2 = Disagree Strongly

3 = Disagree

4 = Neither Agree nor Disagree

5 = Agree

6 = Agree Strongly

7 = Agree Very Strongly

Here is an example of a subject heading and corresponding rating for a message post: **Traditional Approaches are Best (6)**

Next, create a thread under the topic associated with the approach to instructional design that you **disagree** with the most. Indicate why you think this approach is inferior.

In the subject heading of your post, provide a short title (3-5 words) followed by a number indicating how strongly you disagree with this approach. Use the same 7-point scale that you used in the previous task for your rating.

Here is an example of a subject heading and corresponding rating for a message post: **Whole-Task Approach is Inferior (2)**

Finally, reply to at least two classmates whose opinions **differ from yours**. Address their points with counter-arguments of your own. Keep it courteous, and do not take disagreements personally, since the assignment goal is to debate pros and cons with your classmates.

If no one has a post you disagree with, play Devil's Advocate and take an opposing position, presenting the counter-arguments of someone who did disagree.

Discussion 3 – Topical

For this discussion, you will post on ProBoards (WiseMapping).

There are two topics in this discussion, Constructivism and Objectivism.

Your task is to create a thread under each topic with your thoughts/opinions. Some ideas might be different subjects that might affect which approach you take, or other variables such as age of learner, expertise, etc. These are just ideas to get you started, you can write about anything that occurred to you regarding these approaches.

In the subject heading of your post, provide a short title (3-5 words).

Respond to at least two of your classmates.

Discussion 3 – Debate

For this discussion, you will post on ProBoards (WiseMapping).

There are two topics in this discussion, Constructivism and Objectivism.

Decide which approach you **agree** with most and create a thread under that topic indicating why you think this approach is best.

In the subject heading of your post, provide a short title (3-5 words) followed by a number indicating how strongly you agree with this approach. Use the following scale to represent your level of agreement:

1 = Disagree Very Strongly

2 = Disagree Strongly

3 = Disagree

4 = Neither Agree nor Disagree

5 = Agree

6 = Agree Strongly

7 = Agree Very Strongly

Here is an example of a subject heading and corresponding rating for a message post: **Constructivism Reflects Reality (6).**

Next, create a thread under the topic associated with the approach to instructional design that you **disagree** with the most. Reply to the thread indicating why you think this approach is inferior.

In the subject heading of your post, provide a short title (3-5 words) followed by a number indicating how strongly you disagree with this approach. Use the same 7-point scale that you used in the previous task for your rating.

Here is an example of a subject heading and corresponding rating for a message post: **Objectivism Doesn't Make Sense (2).**

Finally, reply to at least two classmates whose opinions **differ from yours**. Address their points with counter-arguments of your own. Keep it courteous, and do not take disagreements personally, since the assignment goal is to debate pros and cons with your classmates.

If no one has a post you disagree with, play Devil's Advocate and take an opposing position, presenting the counter-arguments of someone who did disagree.

Discussion 4 – Topical

You will be using ProBoards (WiseMapping) for this discussion.

There are six topics in the discussion, each representing one of the theories discussed in the readings.

Your task is to create a thread under two of the topics with your opinions/thoughts. Some things to think about include how preferences for one model or another has changed over time, which one might be best for different subjects, or learner characteristics that might fit one theory over another. These are just ideas to get you started, you may write about anything that occurred to you while learning about the theories.

In the subject heading of your post, provide a short title (3-5 words). For example, "Gagne's Great!"

Respond to at least two of your classmates.

Discussion 4 – Debate

You will be using ProBoards (WiseMapping) for this discussion.

There are six topics in the discussion, each representing one of the theories discussed in the readings.

Your task is to select the theory that you are **most positive** about and create a thread under that topic indicating a) what aspects of the theory are most appealing to you, and b) how, in your view, those positive aspects will improve learning.

In the subject heading of your post, provide a short title (3-5 words) followed by (P) to indicate a positive feeling toward the definition. For example, "Gagne's Great! (P)".

Next, create a thread under the topic associated with the learning and/or instructional theory that **least represents** your view of how learning occurs, indicating a) what aspects of the theory are inadequate, and b) how those aspects will impair learning.

In the subject heading of your post, provide a short title (3-5 words) followed by (N) to indicate a negative feeling toward the definition. For example, "Merrill's Mad! (N)".

Finally, reply to at least two classmates whose opinions **differ from yours**. Address their points with counter-arguments of your own. Keep it courteous, and do not

take disagreements personally, since the assignment goal is to debate pros and cons with your classmates.

If no one has a post you disagree with, play Devil's Advocate and take an opposing position, presenting the counter-arguments of someone who did disagree.

Appendix E

Synthesis Paper Instructions

Choose a theme that came up from this week's discussion and write a 1-2 page synthesis paper. Be sure to synthesize the information and not just provide a summary. A good resource for guidance on writing synthesis papers can be found at https://www.msu.edu/~jdowell/135/Synthesis.html#techniques.