University of Nevada, Reno

Influence of Online Discussion Initial Posts on Peer Engagement in Response Posts

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ABSTRACT

Engagement in online classes can promote student success but can be met with challenges associated with students feeling isolated from their peers, their instructors, or the course when learning online. Building opportunities for student interaction is one way to combat this isolation. A common activity in online courses that allows for student interaction is the asynchronous discussion; however, discussions do not inherently lead to meaningful engagement among students.

This study aims to determine how students influence the engagement of their peers, so that instructors can better design student interactions that will promote engagement. Specifically, it investigates how the moves that students make in their initial discussion posts influence the behavioral, social, and cognitive engagement of their peers in response posts. Data were collected from asynchronous online discussions then analyzed to determine how the characteristics of initial posts may predict engagement in peer responses. Characteristics of initial posts included the time from the due date the initial post was made, the initial post word count, its reading ease score, its use of first- or second-person language, and its level of cognitive presence.

Results indicate that some characteristics of initial posts do influence the behavioral, social, or cognitive engagement of peers. An initial post's time from due date influenced peer behavioral engagement in the form of whether a response post was made. In terms of peer social engagement, first-person language, reading ease, and word count were found to influence individual categories or indicators of social presence. Finally, an initial post's use of first-person language and its cognitive presence level were found to influence cognitive engagement in peers.

These results suggest that the actions of individual students can influence the engagement of their peers in online discussion boards. On this basis, the characteristics of initial posts that influenced engagement in peer responses should be taken into consideration in the design of online discussion activities.

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CHAPTER ONE: INTRODUCTION

Introduction

This chapter provides an overview of the proposed study. Background information on the topic of engagement in online courses, the theoretical framework of Community of Inquiry, online discussions, and how students engage in those discussions provides a foundation that informs the study. The problem at hand is explained, then the purpose of the study and its research questions are presented. The significance of this study is provided, followed by definitions for terms relevant to the study, and an explanation of limitations of the study. The chapter concludes with a description of how the study is organized.

Background

Online learning is growing rapidly in higher education as institutions try to meet the needs of a student population desiring more options for course and degree offerings. As more online classes are being offered, effective course design has grown as a field of research and application in education. Methods of encouraging student engagement have come into focus as an important consideration in online course design.

Student engagement involves learners actively working within the course and its activities to build understanding of the course content (Hu & Kuh, 2002). Online courses present challenges to engagement, as students may feel isolated from their peers, their instructors, or the course, which may lead them to lose interest or drop the course (Martin, 2019). Student interaction in the online classroom can help students to feel involved with the course content and with the community of learners, which helps to make learning meaningful to students (Russell, Kleiman, Carey, & Douglas, 2009).

Moore (1989) outlined three types of interaction in distance learning: student-to-student, student-to-content, and student-to-instructor. Of these three types, student-to-student interaction has been found to best achieve student learning outcomes (Borokhovski, Tamim, Bernard, Abrami, & Sokolovskaya, 2012). Creating opportunities for students to connect with one another and course content can lead to meaningful interaction and engagement in pursuit of knowledge building.

The Community of Inquiry (CoI) framework provides a lens through which to view the ways students engage as they construct knowledge as part of a learning community. In CoI, students within a social environment negotiate meaning and build understanding as a community of learners working together. Garrison, Anderson, and Archer (1999) applied this framework to online learning, exploring the ways that a community develops in terms of its members' cognitive presence, social presence, and teaching presence. Each presence contributes to a participant's engagement within the community: cognitive presence measures how students construct knowledge based on communication with peers within the community (Garrison et al., 1999); social presence demonstrates how students identify with the community and communicate and build relationships with peers (Garrison, 2009); and teaching presence dictates how learning is designed, facilitated, and directed within the community (Anderson, Rourke, Garrison, & Archer, 2001). Investigating one or more of these presences can provide a window into the ways that students are engaging with content and one another within the community as they build knowledge in their online courses.

To promote student interaction and engagement, instructors and course designers often include online discussions in which students are asked to connect with course

content by answering provided prompts and to engage with peers by reading and responding to the peers' posts. Online discussions make possible student-to-student interaction, providing students a location where they can collaboratively construct knowledge, and "…the opportunity to share ideas, learn from peers and build knowledge collectively, while reading and reflecting on each other's thoughts" (Kent, Laslo, & Rafaeli, 2016, p. 117). Discussions can be seen as a location where students participate in and contribute to a learning community, which can help to foster engagement and deepen student learning.

Online discussions provide an opportunity for students to demonstrate cognitive and social presences, as they construct understanding of course concepts as part of a learning community. Cognitive presence is one characteristic that can be investigated as part of learner engagement in online discussions. Cognitive presence focuses on the extent to which students are able to build knowledge by communicating with their peers within the learning community, and may be detected in four phases (Garrison et al., 1999). The first phase is the triggering phase, which presents students with a problem or area of uncertainty which "triggers" them to begin the process of inquiry. The exploration phase follows, as students explore the problem using their own previous knowledge and experience, as well as that of their peers. The integration phase sees students taking that prior knowledge and applying it to the problem at hand as they try to work toward a solution. The final phase of cognitive presence is resolution, when students come to the solution, and test and defend that solution. Cognitive presence has been found to be an important indicator of student engagement (Kucuk & Richardson, 2019), therefore

scrutinizing online discussions for indicators of these phases of cognitive presence may demonstrate how students are engaging with their learning community.

Social presence can also suggest student engagement within the learning community found in an online discussion. Students demonstrate social presence in how they present themselves as people within the community, including how they communicate and build interpersonal relationships with others (Garrison, 2009). Social presence can be seen in three categories of communication: interpersonal, which includes communication that promotes emotional connection; open, which includes communication that contributes to discourse among members of the learning community; and cohesive, which includes communication that shows the student identifying as part of the group. Social presence helps students to connect as members of the learning community, which helps them to engage with their peers and succeed in the course (Tu & McIssac, 2002). Studying indicators of social presence found in online discussions can provide insight into how students engage with peers and the course.

Both cognitive and social presences can indicate student engagement as students interact as part of a community of learners bent on building knowledge as a group. Since these aspects can help point to student engagement, it is beneficial to know what contributes to their development in online discussions. Previous research has focused on how student actions within their learning communities may demonstrate their own engagement, but less attention has been paid to how student actions may influence the actions of their peers. Within a learning community, no student is an island; members of the community work together to build knowledge, and thus rely on the input of their peers. As such, looking to the actions of students in their initial discussion posts that

influence the responses they receive can shed light on how students promote engagement in their peers.

Student initial posts that provide original contributions to the discussion prompt can be seen as an intermediary between the instructor or course content and the responses of peers. The instructor prompt provides the seed for a conversation, which is begun when students contribute their ideas in initial posts. That conversation is continued when another student reads and responds to the initial post. As such, looking at characteristics of the initial post may predict the engagement of peers in terms of generating a response, and the social and/or cognitive presence demonstrated within that response. Characteristics of initial posts that may influence this engagement include when the initial post is made, the length of the initial post, how easy it is to read, the use of first- or second-person pronouns, and the cognitive presence demonstrated. Each of these traits present in an initial post may subconsciously or consciously influence the peer reader, which may lead to decisions made as to whether and how to respond. A focus on how the work of one student influence the engagement of another may explain how the ties that bind the community are strengthened, and how students may or may not be contributing to the success of their peers.

Problem Statement

In online learning, asynchronous discussions are often used as a method of student-to-student contact and knowledge construction. Online students may feel isolated from their peers or removed from the learning community, leading to loss of interest and issues with student retention (Martin, 2019; Rovai, 2002). Student interaction and engagement in online discussions can help students to feel engaged within the course

content and with the community of learners, which helps to make learning meaningful to students (Russell at al., 2009). The general problem is that online discussions do not inherently lead to meaningful interaction among students, which may negatively affect student retention, motivation, or deep learning. Discussions can be a location for students to communicate, explain their experience or understanding, be exposed to the ideas of their peers, and build knowledge based on their interaction with peers (Garrison, 2011; Driscoll, Jicha, Hunt, Tichavsky, & Thompson, 2012). However, poorly designed discussions may not promote interaction or meaningful communication and may not lead to knowledge construction (Tu & Corry, 2003).

The specific problem is that students are primarily interacting with one another on the discussion board, and that student-to-student interaction can lead to the success or failure of a discussion as a location for communal knowledge building and engagement. The moves that students make in their initial posts may affect how or even if their peers respond. A common design for online course discussions requires that students post an initial response to the instructor's prompt, then read and reply to a specified number of their peers' initial posts. Not all initial posts receive a reply; in this sense, the extent to which an initial post attracts peer response can be seen as its ability to inspire interaction among peers. Further, the responses themselves may contain indicators that reveal how peers engage with their learning community in terms of social and cognitive presence. Hence, the extent to which an initial post promotes the generation of a response, and the social presence or cognitive presence in responses can be seen as its ability to inspire engagement.

Knowing what students include in their initial posts that helps encourage their peers' engagement can help instructors and course designers to better design discussion prompts and training. As such, an investigation into specific attributes of initial discussion posts elucidates what it takes to create a post that inspires peer engagement. There is a need to examine how the moves that students make in their initial responses to instructor prompts, and to the responses of their peers, can lead to greater and more meaningful engagement among students as well as with the content itself.

Purpose of the Study and Research Questions

The overarching purpose of this correlational study is to determine the relationship between initial discussion posts and response post engagement for undergraduate students in online asynchronous discussions. In other words, how do the moves that students make in their initial discussion posts affect the response posts that their peers may provide? Unlike previous research that focuses on engagement of students within the community of learners in terms of their own participation, this study sought to understand how student engagement is affected by the actions of their peers.

Within this overarching purpose, there were three supporting purposes that guided this study. The first was to determine how the characteristics of an initial post from one student may be used to predict whether that initial post will generate a reply from a peer. The second supporting purpose was to investigate how the characteristics of an initial post from one student may affect the social presence that peers display in their responses. The third supporting purpose was to explore how the characteristics of an initial post from one student may affect the level of cognitive presence that peers may reach in their response posts. The independent variables of interest were generally defined as attributes

of initial discussion posts. The dependent variables of interest were generally defined as the generation of responses, as well as the social and cognitive presences detected in those responses.

This quantitative investigation centered on the following research questions:

1. To what extent can the probability of an initial discussion post receiving a response be predicted by that post's time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level?
2. Which of the six initial discussion post predictor variables are most influential in predicting social presence in response posts? Are there any predictor variables that do not contribute significantly to the prediction model?
3. To what extent can the probability of an initial discussion post generating higher levels of cognitive presence in peer responses be predicted by that post's posting time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level?

The independent variables for these questions were characteristics of initial discussion posts: the amount of time the initial post was made before the due date; word count; Fleshe Reading Ease score; the use of first-person pronouns such as "I", "me", and "my"; the use of second-person pronouns such as "you" and "your"; and the highest level of cognitive presence reached in the discussion post. These characteristics are discussed in detail in chapter three.

Significance of the Study

The information gained from this study may be used by online instructors and designers in the creation of online courses that promote engagement. By focusing on online discussions as a location of student interaction, this study provides insight into how aspects of student work may encourage student-to-student interaction and encourage behavioral, social, and cognitive engagement of students as they collaboratively build knowledge. While research in this area often focuses on how engagement points to individual student learning, this study specifically investigated at how the work of students affects the interaction and engagement of their classmates, in effect looking at how students may influence the performance of their peers. By better understanding this, instructors or course designers may adjust the design of their activities to allow for better peer-promoted engagement within the learning community.

Definition of Relevant Terms

Terms and definitions specific to this study that may not be generally understood or are used in specific context for this study are provided:

Online classes: Courses that take place entirely online, in which students never interact face to face.

Asynchronous: Not concurrent or happening in real time. In relation to online courses, asynchronous means that students may not be engaging with course materials or activities at the same time as their peers or instructor.

Engagement: Students actively working within course components and activities in an effort to develop knowledge and understanding of the course content (Hu & Kuh, 2002)

Online discussion: A common activity in online classes in which students respond to a prompt provided by the instructor, then read and reply to the posts of their peers. In this study, online discussions were in written format and took place asynchronously.

Initial post: The discussion post made by a student in response to the instructor's prompt. This requires students to give their own answer to the question posed, without interacting with peers.

Response post: The discussion post made by a student in response to another student's initial post. This requires the student to read and respond to the ideas that their peer discussed in their initial post.

Community of Inquiry (CoI): A learning framework in which students work together to build knowledge within a social environment.

Cognitive presence: A dimension of the CoI framework in which students construct knowledge based on communication with peers.

Social presence: A dimension of the CoI framework in which students project themselves as people within a learning community, including how they identify as participants, communicate with peers, and build relationships.

Limitations of the Study

There were several limitations that impact this study. First, the discussion from which the sample was taken followed a highly prescribed structure. Instead of a whole-class discussion, students were placed into small groups of only four to five students, which rotated each week. This provided a smaller group of options for responses than a full class discussion would have. Students were required to make two initial posts in

answer to between five and nine instructor prompts, then read and respond to at least two of their peers; this provided each student with double the amount of possible initial posts to reply to as compared with a traditional discussion for which students are only required to create one initial post. Each of these structural traits may have affected whom students chose to respond to.

A second limitation for this study was that it gathered data from multiple sections of just one course. For example, some prompts may lead to higher levels of cognitive presence than others; this study focused on the same prompts each week across sections. This may have an impact on the generalizability of this study to other courses that do not include prompts that inspire the same type of response.

A third limitation of this study was that data were collected and coded by only one researcher. While the researcher did take pains to check the reliability of the coding process by undertaking one round of coding then recoding a portion of the data at a later date and comparing the coding choices made (determining intrarater reliability), still only one person participated in the coding process. Had more than one coder participated in the coding process, interrater reliability could have been checked to better demonstrate the reliability of the coding process.

Organization of the Study

This study is organized into five chapters. The first chapter provides an overview of online learning and learning design, student engagement in online classes, a brief introduction to the Community of Inquiry theoretical framework as a lens through which to view student interaction and engagement, and an explanation of online discussions as a location of interaction and engagement in online classes. The problem this research hopes

to address is explained, followed by the purpose of the study and the research questions guiding the study.

The second chapter provides a review of literature in support of this study, including engagement in online learning and the Community of Inquiry theoretical framework, providing information on social and cognitive presences as they relate to engagement in online discussions. Finally, it provides justification for the initial post characteristics that have been investigated.

The third chapter provides details on the methodology of the study, including the research questions and research design, data collection procedures and instrumentation, and a brief introduction to the data analysis that will determine if initial discussion posting characteristics influence the generation of response posts, and the social and cognitive presence of response posts.

The fourth chapter provides a detailed discussion of the data analyses used to investigate how student posts may influence the engagement of their peers, and the results of those analyses. This includes an explanation of how intrarater reliability was checked, and the preliminary examination of data. Each research question is discussed regarding the specific data analysis used and the results of that analysis.

The fifth and final chapter provides a detailed discussion of the results. Discussion for each research question is provided. The study ends with a conclusion that provides a discussion of the larger meaning of these results in relation to engagement in online learning, including recommendations for practice and future research.

Summary

Online courses can seem distant and impersonal, which may make it easier for students to lose interest or disengage entirely. One way to combat the remote feeling of an online class is to promote more student-to-student interaction as a way to better engage students with the course and their peers. Online discussions can provide a location of student interaction with content and peers, but engagement is not guaranteed. Investigating how students act, react, and interact with one another can help shed light on what works and what does not as an engaging learning community is built.

For this study, online discussion posts were used to explore how students influence one another as they interact and participate as members of a learning community. Student work in discussion posts was analyzed in terms of factors that may or may not lead to the interaction and engagement of peers. Significant findings in this study can help to create guidance for teachers and instructional designers to design discussions that invite peer-stimulated engagement.

CHAPTER TWO: REVIEW OF LITERATURE

Introduction

This literature review provides background information and pertinent research in the area of online learning, student engagement, the Community of Inquiry theory, online discussions as a location of student interaction and knowledge construction, and the variables present in student discussion posts that may influence interaction and engagement of their peers. To begin, the state of online learning is provided with an introduction to online instructional design theory and current issues with student retention. A discussion of student engagement provides detail on why engagement is important for learning, especially in terms of online learning. The Community of Inquiry framework is introduced and related to student engagement in terms of social, cognitive, and teaching presences. From here, online discussions are described as a location for student engagement in online learning, with reference to design and structure, knowledge construction, and student interaction. Finally, the characteristics of initial discussion posts that may influence student responses are described and discussed as to interaction and engagement.

Online Learning

Online learning has experienced rapid growth in the twenty-first century, as colleges and universities attempt to better serve students eager for more options for course offerings. Even as face-to-face enrollments have begun to decrease, distance education, which encompasses online learning, had increased for the past fourteen years as of 2018 (Seaman, Allen, & Seaman, 2018). The percentage of all U.S. post-secondary students who enrolled in at least one online course increased from 31.1% in 2016 to

33.1% in 2017 (Allen & Seaman, 2017). Further, university administrations see online offerings as critical to their long-term strategy, with over 77% agreeing in both 2014 and 2015 (Allen & Seaman, 2016). This was before the COVID-19 pandemic, which prompted most institutions of higher education to rapidly transition to much larger online course offerings than in previous terms.

This increase in student interest and online course offerings has brought about an increase in research in the field, as instructors, instructional designers, and administrators seek to create online courses committed to the success of students. Online instructional design concepts offer direction in building meaningful courses. Instructional design theory examines proposed learning situations to determine the best approach to teaching to achieve student learning outcomes. While many models of online instructional design exist, they commonly involve a cyclical process of steps. The ADDIE design model (Branch, 2009; Gagne, Wager, Golas, & Keller, 2005) provides a series of iterative steps that can be used in creating new learning instances. The ADDIE model includes five steps: *Analysis*, in which the problem is identified and outcomes of the instruction are determined; *Design*, in which the trajectory of the instruction is identified, including what must take place in order for learning outcomes to be met; *Development*, in which the specific learning materials and activities are created; *Implementation*, in which instruction takes place, learners interact with learning materials; and *Evaluation*, in which the instruction is reviewed during and at its conclusion to determine how well the learning outcomes were met, and what future changes are necessary. By thoughtfully and intentionally working through each of these steps, instructors or designers can build meaningful and effective online courses. Well-designed courses have been found to be

associated with student satisfaction and learning among online students (Eom & Ashill, 2016).

However, even with carefully planned courses, students are not guaranteed success. Online students drop out of their classes and programs at higher rates than students enrolled in face-to-face classes and programs (Ali & Smith, 2015; Schaeffer & Konetes, 2010). In a small-scale study into online dropout rates, Ali and Smith (2015) found that 17% of students dropped out of the online version of a course, while its face-to-face counterpart saw only a 5% student drop rate. Schaeffer and Konetes (2010) found that a commonly cited factor for student dissatisfaction in their online courses is a feeling of social isolation from their peers, their teachers, and the course in general. One approach to overcome these feelings of isolation and disconnection that online students may feel is to focus on engagement to draw students into the course and learning community.

Student Engagement

Engagement is one of the most important factors in student learning. Engagement refers to how students actively work within course components and activities in an effort to develop knowledge and understanding of the course content (Hu & Kuh, 2002). This active involvement can lead to student achievement of learning outcomes and cognitive development (Ma, Han, Yang, & Cheng, 2015).

The concept of student engagement in learning can be viewed as a multidimensional contract that includes the three areas of behavioral, emotional, and cognitive engagement (Fredricks, Blumenfeld, & Paris, 2004). Behavioral engagement hinges on a student's level of participation, both academic and social. Emotional

engagement is based on students' reactions to the class, their peers, the content, and their instructors, and may include interest, perceived value, boredom, or anger, among other emotions. Cognitive engagement is measured by students' effort in building knowledge or understanding. All three of these areas of engagement may work in concert to promote overall student engagement in learning.

Online courses present unique challenges related to engagement. Online students may feel isolated from their peers and the course and may lose interest (Martin, 2019). Dumford and Miller (2018) found that online courses promoted more engagement in terms of some activities, but face-to-face courses were more likely to promote collaborative learning and quality interactions with others; they posit that the self-directed nature of many online classes can be isolating and does not provide as many opportunities for collaborative learning. Physical distance between students learning online may lessen the feeling of being part of a learning community and contribute to attrition rates (Rovai, 2002). Laffey, Lin, and Lin (2006) found that online classes lack a sense of vitality and spontaneity that can be found in face-to-face classes. These challenges may lead to students losing interest or disengaging from their online classes, which may lead to incomplete assignments, lower grades, or withdrawal from the course.

In the online classroom, students do not have the opportunity to meet in person and may feel removed or distant from their classmates. By focusing on engaging students, instructors and designers can build courses that help to close this distance. Such engagement can help to contribute to a learning community in which students work together to construct knowledge, feel more involved with the course, and become more connected with their peers. The Community of Inquiry framework introduces a lens

through which to view the ways students engage with one another, course content, and their instructors in such learning communities.

Community of Inquiry

Learning theory is an important consideration for both instructors and researchers in the field of education. Different theories of learning abound, and many attempt to explain how we acquire knowledge and how we then connect it to our existing understanding (Buchheister, 2018). The Community of Inquiry (CoI) framework is a theory of learning that can help educators and researchers better approach the question of how students learn as part of a group. In this framework, learners work together in a social environment toward understanding, and participants in the inquiry reach understanding *together*. In this model, students construct knowledge for themselves as with constructivism, within a social environment and in communication with others as with social constructivism, but the CoI framework goes further to require that learners negotiate meaning as a community of learners working together.

Theory Development

The CoI framework can trace its roots to philosopher and mathematician Charles Pierce, working predominantly in the sciences, and John Dewey, who widened the concept out to the general educational setting. Pierce (1955) put forth the idea that it is not possible to reach a single truth individually, but rather learners must work with others to reach understanding; he noted that “We individually cannot reasonably hope to attain the ultimate philosophy which we pursue; we can only seek it, therefore, for the community of philosophers” (p. 229). Only through contact and collaboration with a

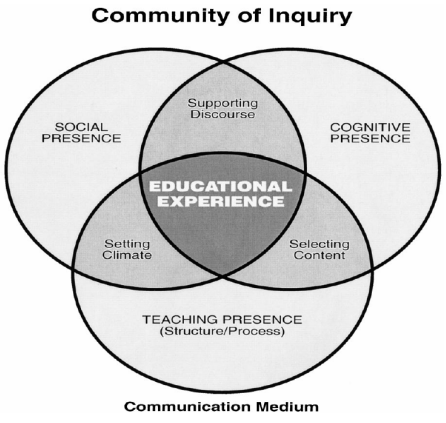
community of peers can a learner build new knowledge, which he would not be able to attain on his own.

John Dewey built further upon this idea of community in learning. His focus was not as much on a single identifiable truth, but on the concept of belief within a social setting (Shields, 2003). For Dewey (1938), a learner seeks the experiences and prior knowledge of his community peers as he builds his understanding, relying on others in the community for confirmation or correction as he progresses. Learners must be in contact with others in order to develop their own understanding, as they use the knowledge of peers to shape their own knowledge.

This framework was then applied to the realm of online learning by Garrison, Anderson, and Archer (1999), who further defined the framework as one arising from participants' cognitive presence, social presence, and teaching presence. Figure 1 shows the elements of the Community of Inquiry as part of an educational experience.

Figure 1

Elements of an Educational Experience (Garrison et al., 1999)



Cognitive presence is the manner by which learners within the community create meaning in collaboration with their fellow community members. Social presence

measures how members "… identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (Garrison, 2009, p. 352). The third aspect, teaching presence, may fall to peers within the community or, more likely, to the instructor guiding the learning activity; this includes the design and presentation of content and the facilitation of the learning activity (Garrison et al., 1999).

The CoI framework sets the scene for higher order thinking through collaboration. Lipman (2003) put forth a collaborative environment in which students are encouraged to participate in "questioning, reasoning, connecting, deliberating, challenging, and developing problem-solving techniques" (p. 14). These actions can lead students to negotiate their understanding within a group, by detecting problems or errors in understanding and challenging accepted ideas, which can lead to deeper learning for participants (Ramsden, 1988). Not only will they provide their own thoughts and ideas, but they will also need to listen to the ideas of their peers, challenging when necessary, and adjusting their own understanding when the explanations or ideas of others are more feasible than their own. They cannot just wait to provide their ideas, but must interact with others, in turn building deeper understanding (Gardner, 1999).

An important consideration of the concept of "community" in the CoI framework does not necessarily mean a physical place, and in fact might be even more important as a consideration in online course design, where a feeling of community may be lacking. The CoI framework focuses primarily on aspects of presence, which, for the online classroom, Picciano (2002) defines as "a student's sense of being in and belonging in a course and

the ability to interact with other students and an instructor although physical contact is not available" (p. 22).

The CoI framework has become one of the most-used theoretical frameworks in the study of online learning (Richardson, Maeda, Lv, & Caskurlu, 2017; Stenbom, 2018). In the first decade following the debut of the theory, many studies focused on content analysis of transcripts from online classes (Castellanos-Reyes, 2020). In the following years, a need developed for a widely accepted instrument to test CoI. The Community of Inquiry framework survey instrument invited student responses related to cognitive, social, and teaching presences (Arbaugh, Cleveland-Innes, Diaz, Garrison, Ice, Richardson, & Swan, 2008). The 34-item instrument was developed in a multi-institutional effort, and was found to be "a valid, reliable, and efficient measure of the dimensions" of the CoI framework (Arbaugh et al., 2008, p. 133). While this student-perception-based instrument grew in popularity, the content-analysis-based research continued to flourish.

Over more than twenty years of research, the CoI framework has provided a foundation for the investigation of how students develop knowledge together, at the intersection of cognitive presence, social presence, and teaching presence. Each dimension plays an important role in how students engage with one another and learn. Further detail on each of the three presences is provided below.

Cognitive Presence

Cognitive presence is defined as the extent to which students within a learning community are able to construct knowledge based on communication with peers within that community (Garrison et al., 1999). Garrison et al. (1999) developed the Practical

Inquiry Model as a sequence of critical inquiry that moves between the public and private worlds as students become aware, deliberate, conceptualize, and practice or build knowledge. The Practical Inquiry Model phases directly correlate to the cognitive presence phases of triggering events, exploration events, integration, and resolution.

Cognitive presence outlines the learner's meaning making through learning scenarios comprised of four stages. The learning scenario begins with the triggering event, or the point at which learners feel a sense of unease or discomfort regarding an idea or concept. The exploration phase follows, wherein learners seek additional or alternate information on the concept. In the integration phase, leaners integrate the information in with their previous understanding into a new concept. Finally, in the resolution stage, learners resolve the issue and overcome the problematic understanding from the first phase (Garrison et al., 1999). At this point, new understanding or knowledge is reached.

More detailed information on each of the phases of cognitive presence can be found below.

Triggering Events

The initial phase of cognitive inquiry presents the learner with a problem or area of uncertainty based on their previous knowledge or experience (Garrison, Anderson, and Archer 2001b). This issue "triggers" the learner to begin the process of cognitive inquiry. Indicators of triggering events include the learner noticing the problem or area of confusion, or expressions of puzzlement. The student may present background information that leads to questions or may lead the discussion in a different direction.

Exploration Events

The next phase of the process invites the learner to explore the problem, both internally within their own previous knowledge and externally by communicating with others to create a better understanding of the problem (Garrison et al., 2001b). In this exploration, the learner begins to build an understanding of the relevant information necessary to solve the problem at hand. This phase may include such exploratory steps as brainstorming ideas, asking questions of oneself or peers, or accessing and sharing information. The student may add more information but does not justify or defend this information in relation to the problem at hand; the student may also offer unsupported ideas or opinions.

Integration

In the third phase in the cognitive inquiry process, the learner takes the information gathered and ideas put forth in the exploration phase and begins to construct understanding or meaning (Garrison et al., 2001b). Here the learner will try to apply those ideas to the problem at hand, testing out how well they fit or do not fit. The student builds on or add to the ideas of their peers, integrate information from sources, and begin to provide justified and supported tentative hypothesis. Evidence that students are working within this phase can be difficult to detect and may best be viewed in terms of the communication within the community (Garrison et al., 2001b).

Resolution

The fourth phase takes the learner from applying ideas and concepts to possible solutions for a problem to the complete resolution of the problem. Evidence of reaching this phase may also be hard to detect but can often be found as learners try to test out

their solution through thought experiments or attempting to build consensus among others within the community (Garrison et al., 2001b). This may take the form of applying the concept to real-world scenarios or testing and defending the solution put forth.

Each phase of cognitive presence requires the learner to engage not only with the content as they build knowledge and understanding, but also with their peers as they act and react to the information shared by other members of the learning community.

Much prior research in cognitive presence has relied on the coding of online discussion posts. Garrison et al. (2001b) developed a tool that could assist instructors and researchers in assessing discourse and reflection by students, based on the need "… to investigate the features of the written language used in computer conferencing that seems to promote the achievement of critical thinking" (Garrison et al., 1999, p. 7). Garrison et al. (2001b) further described the four phases of cognitive presence (triggering events, exploration events, integration, and resolution) by providing indicators that characterized the sociocognitive process that occurs in each phase. The phases, their indicators, and the sociocognitive processes associated with them are outlined in Table 1. The coding scheme was tested in the investigation of three sets of student post transcripts undertaken by two coders. Interrater reliability was evaluated using the coefficient of reliability (CR) and Cohen's (1960) kappa (k), the results of which were CR = .45, .65, and .84; and k = .35, .49, and .74. The k of .74 was deemed suitably high for research breaking new ground, as this study aimed to do.

Table 1

A Coding Model for Assessment of Cognitive Presence Based on Garrison et al. (2001b).

Category	Indicators	Sociocognitive Processes
Triggering Events	Recognizing a problem	Presenting background information that culminates in a question
	Sense of puzzlement	Asking questions Messages that take discussion in a new direction
Exploration Events	Divergence: within online community	Unsubstantiated contradiction of previous ideas
	Divergence: within single message	Many different ideas/themes presented in one message
	Information exchange	Personal narratives/descriptions/facts (not used as evidence to support a conclusion)
	Suggestions for consideration	Author explicitly characterizes message as exploration—e.g., "Does that seem about right?" or "Am I way off the mark?"
	Brainstorming	Adds to established points but does not systematically defend/justify/develop addition
	Leaps to conclusions	Offers unsupported opinions
Integration	Convergence: among group members	Reference to previous message followed by substantiated agreement, e.g., "I agree because..." Building on, adding to others' ideas
	Convergence: within a single message	Justified, developed, defensible, yet tentative hypotheses
	Connecting ideas, Synthesis	Integrating information from various sources—textbook, articles, personal experience
	Creating solutions	Explicit characterization of message as a solution by participant
Resolution	Vicarious application to real world	None
	Testing solutions	Coded
	Defending solutions	

Social Presence

Social presence dictates how learners feel as part of the CoI and may affect their openness to learning. Garrison (2009) defines social presence as "the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (p. 352). It is related to the concept of "immediacy" or behaviors that enhance closeness and interaction (Rourke et al., 2001). Many behaviors that enhance closeness, such as facial expression or eye contact, are not available in a computer mediated environment. However, the indicators of social presence are examples of ways participants still project themselves socially and emotionally in an online course. It should also be noted that social presence does not focus entirely on engagement based on social interaction: it instead focuses on the moves that are made to support an environment that welcomes questions and the contribution of ideas from members of the community (Garrison & Aykol, 2010)

Social presence was originally seen as a necessary component in the development of the CoI framework but tended to be viewed as a one-dimensional construct that dealt with students' sense of belonging, as opposed to one part of a multi-dimensional construct related to cognitive and teaching presences in the pursuit of knowledge building (Garrison, Anderson, & Archer, 2010). Students prioritize a shared identity in terms of the purpose of the course over their own personal identity in terms of interpersonal relationships (Garrison et al., 2010). This promotes the idea that the three dimensions of social presence relate to how students identify with the learning community, how they

communicate within the community, and how they develop interpersonal relationships with others in the community (Garrison, 2009).

These three dimensions of social presence have been used to develop an instrument to code indicators of social presence, based on a literature review undertaken by Garrison et al. (1999). These indicators can be divided into three categories: actions that express interpersonal communication, actions that express open communication, and actions that express group cohesion. Actions that express interpersonal communication are those that may affect student motivation to learn or persevere. Earlier research relied on categories termed emotional expression, open communication, and group cohesion (Garrison, Anderson, & Archer, 2001a), or affective indicators, interactive indicators, and cohesive indicators (Rourke et al., 2001), but have more recently been termed interpersonal communication, open communication, and cohesive communication (Garrison, 2011). Actions that express open communication are those that may affect student relation and trust of one another, and by extension trust of one another's contributions. Actions that help promote group cohesion are those that may affect group member's commitment to meaning making and the unified acceptance of understanding. Further information on the three categories of social presence can be found below:

Interpersonal Communication

This category includes actions that may help initiate a community by promoting emotional connection between participants. This may include use of emoticons or unusual grammar/punctuation (e.g. LOL), self-disclosure of personal information, and use of humor. These moves may indicate students attempting to build trust within the community.

Open Communication

This category includes actions that contribute to discourse between members of the community, in terms of interaction and communication. Students must use open communication in order to interact in a way to successfully work together, which may include asking one another questions, prompting input, negotiating the meaning presented in members' contributions, etc.

Cohesive Communication

This category includes actions that contribute to students identifying and acting as part of the community. Communication aimed at group cohesion within a discussion board may include posts that address members of the discussion group using inclusive pronouns, or the use of phatics or salutations to help build familiarity within the group (Garrison, 2011).

Each category of social presence describes a way that students demonstrate interaction and engagement in the way they communicate with one another as part of a learning community. Much prior research in social presence has relied on the coding of online discussion posts. Rourke et al. (2001) developed a coding model for use in analyzing social presence in terms of behavioral indices and indicators of social interaction in communicative responses, and Garrison (2011) refined this coding model. The classification model was developed by researchers undertaking a theoretical analysis of previous research and coding discussion transcripts, resulting in three categories of social presence that were further described by between three and five indicators per category (Garrison, 2011). The categories, their indicators, and their definitions are outlined in Table 2.

Table 2

A Coding Model for Assessment of Social Presence Based on Garrison (2011).

Category	Label	Definition
Interpersonal communication	Affective expression	Conventional expressions of emotion, or unconventional expression of emotion, include repetitious punctuations, conspicuous capitalization, emoticons
	Self-disclosure	Presents details of life outside of class, or expresses vulnerability
	Use of humor	Teasing, cajoling, irony, understatements, sarcasm
Open communication	Asking questions	Students ask questions of other students or the moderator
	Referring explicitly to others' messages	Direct references to the contents of others' posts
	Complimenting, expressing appreciation, agreement	Complimenting others or contents of others' messages Expressing agreement with others or content of others' messages
Cohesive communication	Vocatives	Addressing or referring to participants by name
	Addresses or refers to the group using inclusive pronouns	Addresses the group as we, us, our, group
	Phatics, salutations	Communication that serves a purely social function; greetings, closures

Two indicators from the Social Presence model were removed: "continuing threads" and "quoting from others' messages" are technical aspects of the discussion

forum, which do not constitute decisions made by students in terms of their interactions with peers (Kovanović, Gašević, Joksimović, Hatala, & Adesope, 2014; Lee, 2014).

Teaching Presence

The third aspect of the CoI framework is teaching presence, which includes the instructor's role and course design. Characteristics of teaching presence draw from management, intervention, and direct instruction, where necessary, to create a situation that is most conducive to learning (Garrison et al., 1999). Importantly, this facet of CoI instruction directly influences the other two elements (cognitive presence and social presence). The instructor's course design and management make possible the activities wherein student cognitive presence can be demonstrated, and social presence can be grown. In planning and teaching a class based around the CoI framework, instructors clearly design activities in which students interact and are prompted to demonstrate the presences necessary for a successful CoI. The instructor also plans out and implements direct instruction, in the form of what information is provided and how, in order to provide a place for students to begin from as they grow their own understanding. Finally, the instructor continues to serve as the guide, as they intervene when necessary, providing guidance and additional information to make sure students stay on track.

Teaching presence can help to balance the cognitive and social aspects of learning in a CoI scenario. Characteristics of teaching presence draw from management, intervention, and direct instruction, where necessary, to create a situation that is most conducive to learning (Garrison et al., 1999). In the realm of intervention as an aspect of teaching presence, online course design can plan for the instructor's place within online discussions. Students value an instructor's presence in online discussions, not only in

their design but in their facilitation. Instructors should intervene where necessary, helping to keep discussion on track and encourage participation (Hosler & Arend, 2012). The instructor can ensure that the information being shared by discussion members is true and appropriate, stepping in when incorrect information pops up and helping to point students back in the correct direction.

Intersection of Presences

The CoI framework does not suggest that the three presences work independently to encourage knowledge construction; rather the presences overlap and interact as the community develops. Early research in CoI tended to focus on each individual presence, leading Garrison and Arbaugh (2007) to decry the lack of focus on how the presences relate to one another, specifically at the intersection of social and cognitive presences.

Social presence was, from the beginning of CoI, discussed as an important concept related to cognitive presences. Garrison et al. (1999) explained social presence as a "support for cognitive presence, indirectly facilitating the process of critical thinking carried on by the community of learners" (p. 89). Higher levels of social presence led to better quality of cognitive presence (Lee, 2014), while student perceptions of social presence can predict student perceptions of cognitive presence. Aykol and Garrison (2011) emphasize the role of social presence in creating a welcoming and supportive environment in which cognitive presence may cultivate. Students require a secure and trusting climate in order to participate and move confidently through the levels of cognitive presence (Garrison & Akyol, 2013). A cohesive group of learners may be developed through social presence, leading to more comfort with sharing opinions, ideas, and suggestions, and asking questions (Tirado, Maraver, Hernando Gomez, & Harris,

2016). These exchanges may lead to more triggering, exploration, and integration events (Tirado et al. 2016).

On the other hand, some research argues against the correlation between social and cognitive presence. Social presence can play a very important part in the development of a learning community, but students are not in a course for purely social reasons; they are there instead to achieve a common goal (Garrison & Arbaugh, 2007). Interaction alone does not necessary indicate engagement, and students may demonstrate indicators of cognitive presence without interaction with peers (Garrison & Cleveland-Innes, 2005). Further, there is little research in the area of cognitive presence effect on social presence. Does communication demonstrating higher phases of cognitive presences tend to present higher or lower levels of social presence? How does the cognitive presence presented in one student's communication within the group influence the social presence in the responses of their peers?

Community of Inquiry in Action

The Community of Inquiry framework lends itself neatly to solid online course design, as it helps subject matter experts, designers, instructors, and administrators develop courses that draw students in and challenge them to collaboratively construct knowledge. This collaborative student interaction in the online classroom can help students to feel engaged with the course content and with the community of learners, which helps to make learning meaningful to students. One popular activity in online learning is the asynchronous online discussion, which invites students to interact with peers as they grapple with course concepts, working to build understating together. These

online discussions provide a prime location to view the development and outcomes of a Community of Inquiry in action.

Online Discussions

Online discussions are interactive activities in which students communicate and build knowledge with one another in an online space. To better understand their history and development to the format we know today, it is necessary to consider the history of online learning. Online courses originally grew out of the tradition of correspondence courses, moving from written correspondence in the late nineteenth century to radio, television, audio, and video as methods of instruction; in this time the transfer of knowledge was generally one-directional, and collaboration and community-building between students was not a focus (Schindler & Burkholder, 2014). In the late twentieth century, educational theories in constructivism and social constructivism grew in popularity, influencing how learning was designed to include more opportunities for students to engage with one another in the pursuit of building knowledge. Also in this time, technology made possible different platforms for communication between students, including tools such as email and chatrooms (Schindler & Burkholder, 2014). As the tools available in online learning matured, so did their application in these learning environments, and now the online discussion board is a mainstay of online course activity design.

Today, online discussion activities may take any of the many formats available based on current tools. They may be text, audio, or video based; they may be small group or whole class; they may be open-ended or require that students take specific roles. The asynchronous nature of the discussions means that students are not required to be logged

on at the same time, and instead can leave messages for one another to read or view at each student's individual convenience. Although online discussions do not provide exactly the same type of contact as in-person interactions, they do make possible student collaboration and exchange of ideas (Driscoll et al., 2012).

The purpose of online discussions is to encourage communication between students, where they can explain their experience or knowledge, and interact with others in order to construct greater understanding (Garrison, 2011). Vai and Sosulski (2016) describe a common format for online discussions as follows:

1. The instructor creates the discussion forum by posting a prompt for the entire class or smaller groups of students within the class.
2. Students reply to the instructor's prompt with their answers.
3. Students read and respond to their classmates' answers to the prompt.

Online Discussion Design

Online discussions may take any number of formats, and the decisions made about the design may have major impacts on the success or failure of the activity. Martyn (2005) makes a solid point in saying, "Productive discussion does not happen automatically—it must be planned" (p. 61). How the discussion is designed determines what is required in the student posting and replies to classmates and the timeline for submissions, which can dictate the level of engagement students may feel with the discussion and course. A number of design considerations are outlined below.

Learning Management System Capabilities

Most online classes take place within a learning management system (LMS), which provides an online environment for the transmission of content, interaction

between students, submission of assignments, and tracking and posting of grades (Ghilay, 2017). Common LMS in use today include Canvas by Instructure, BlackBoard, DesireToLearn, Moodle, Sakai, among many others. Each of these LMS examples include some form of asynchronous online discussion forum, where students can post responses to instructor prompts, which can then be viewed by classmates and replied to. As instructors begin to design discussions, they must consider what the LMS discussion board is capable of: how do students reply to one another? How does the discussion appear visually, making it easier or harder to track student entries in conversations? Can students attach files, post links, or include images? Is there a setting that prohibits students from seeing their peers' posts until they have posted themselves? The answer to each of these questions has an effect on how students interact with the discussion content and their peers, and may influence their overall engagement with the discussion and learning community.

Structure

How the discussion is structured is one of the most important design considerations. Will the instructor post a specific prompt that all students must answer? Will there be multiple prompts, from which the students can choose one to answer? Will there be no instructor prompt at all, giving students all the control to post their thoughts about the given topic? Will students reply to one another? What time frame should the discussion follow?

Students tend to find more structured discussions to be more meaningful (Jacobi, 2017). A structured time frame for posting, reviewing the posts of peers, then replying to peers' posts has been found to be a positive experience for students, who report that they

can respond with more insight with this additional time for reading and reflecting before replying (Jacobi, 2017). While time between posting and responding is found to be helpful, the number of responses to peers may cause problems: drawing from real-world discussion forums, if too many posts populate the discussion board, students have been found to simplify their posts, or not post at all (Jones, Ravid, & Rafaeli, 2004). Instructors must find a balance between encouraging as much interaction as possible, without asking so much of students that they give up. Additionally, while structure is appreciated, getting too specific on characteristics such as post length and required citations might lead to less discussion (Gilbert & Dabbagh, 2005). Providing specific structure guidelines is recommended but finding the right balance of structural requirements is necessary to promote meaningful student interaction and engagement with the learning community.

Group Size and Composition

Instructors must consider exactly who will be involved in the discussion in attempting to design for the highest level of interaction and achievement of learning outcomes. Should the entire class participate together, in one large group? Should students be split off into smaller groups? If so, how should the groups be divided: at random, or in specific groupings?

Kim (2013) found that small-group discussions lead to more interactivity than large-group discussions; additionally, class-wide discussions tended to promote student posts that did not reference or link to other student posts, demonstrating less engagement with the larger group. Abuseileek (2012) drilled down even further, finding that groups with five students performed better than groups with two to four students or with six to

seven students in terms of communication and engagement. Fernández (2007) put forth that small, heterogenous discussion groups in which students are required to respond to all members led to learners feeling that their peers were actually reading their posts. Jacobi (2017) noted that students reported they found it easier to keep up with their peers' posts in smaller group discussions. In some cases, the purpose of the discussion may dictate the preferred groups size: project-based discussions may work best with three to five students, while brainstorming discussions may work better with groups as large as ten students (Davisi, 2015).

One more design possibility is including both small and large group discussions in the course of a week, module, or unit. In such a format, students work together in small groups to determine a collective answer to the prompt, then come together with the larger group or whole class to share in a second discussion. Such interweaving of levels of discussion has been found to positively influence the development of community (Ouyang & Scharber, 2017).

Interaction Direction

With student interaction as a goal of online discussion, the instructor must consider not just the quantity and timing of student responses to one another, but also the quality. Many discussions include directions for peer response, disallowing short and somewhat meaningless responses such as "I agree" or "Great post!" While this sort of direction does give students some idea of what is acceptable—or not—the lack of detail on what *does* count as an acceptable response may leave students lost. Providing a model discussion posting with responses in the syllabus or in an early discussion can help to

show students a concrete example of what is expected that they can base their future posts and responses to peers on.

Another method to elicit quality student responses is to be directive in what student responses should include. Instead of instructions such as “Please reply to at least two peers’ posts by Sunday at 11:59 p.m.”, the instructor could provide specific directions on what that reply should include. Davisi (2015) suggests directing students to find connections between their own posts and those of peers, reacting to a peer’s post that does not agree with their own posting, providing additional information or resources to add to a peer’s post, or helping to solve a problem that a peer’s post may include. By giving students a better idea of how they should react to their peers’ posts, the instructor makes clear the quality of interaction expected.

Online discussions provide numerous avenues to help students to build engaging learning communities in online courses. Poorly designed discussions may not elicit student interaction or communication and may not encourage student learning (Tu & Corry, 2003). Well-designed discussions can promote learning within the community, as students encounter problems in their knowledge and work with others in their learning environment to solve those problems and construct new understanding. This design contributes to the achievement of the overarching goals of online discussions, in support of the development of learning communities.

Goals of Online Discussions

While online discussions serve many purposes, their broad goals directly support the Community of Inquiry framework: providing a location where students can interact with peers in order to collectively construct knowledge.

Knowledge Construction in Online Discussions

Many instructors employ online discussions as part of their online courses in an effort to encourage students to work together to construct knowledge and achieve learning outcomes. This can be seen as a representation of the theory of social constructivism, which indicates that learners construct knowledge through interaction with others, by exchanging ideas and negotiating understanding socially (Lin, Liu, Chiu, & Yuan, 2001). Vygotsky (1978) put forth the idea of a Zone of Proximal Development (ZPD), or "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined by problem solving under adult guidance or in collaboration with more capable peers" (p. 86). Online discussions create a place where collaboration with peers in pursuit of deeper understanding is possible. Interacting with a group in an online discussion can help students work together to construct understanding in terms of the discussion prompt, problem, or project. Kent et al. (2016) note that students are "…afforded the opportunity to share ideas, learn from peers and build knowledge collectively, while reading and reflecting on each other's thoughts" (p. 117). The online discussion setting makes possible the exchange of information and ideas between students, encouraging students to find connections between and among the posts of their peers (Kent et al., 2016). Knowledge construction should be a goal of all learning activities, of course, but in terms of online discussions specifically, they provide a place where students can engage with others in a way that is not possible in other online assignments.

Perhaps more directly measurable than the larger concept of knowledge construction, the effect of online discussion participation on the achievement of learning

outcomes by students interacting with one another is an important consideration in their use. Rovai and Barnum (2003) reported that discussions prompted students to think critically about course concepts, and that the level of interaction among students was a predictor of learning. Ke (2013) found that in discussions in which groups had to work together to reach a consensus on the discussion prompt's answer, a high level of interaction among group members was associated with critical thinking, which fell in line with the objectives of the activity. Student engagement with peers and knowledge building can lead to greater learning outcomes.

Student Interaction in Online Discussions

Online discussions provide the opportunity for and environment where students can interact with their peers, the course content, and their instructor in an effort to achieve the set learning outcomes. Moore (1989) outlined three types of interaction in distance learning: student-to-student, student-to-content, and student-to-instructor. Anderson (2003) found that student-to-student interaction was necessary for learning from the constructivist theory viewpoint, and that student-to-student interaction develops the skills necessary for collaboration. Bernard, Borokhovski, Wade, Tamim, Surkes, and Bethel (2009) undertook a meta-analysis of the topic, outlining the history of interaction considerations in distance learning, finding that the combination of student-to-student and student-to-content interactions was the strongest in promoting learning. Student interaction is an important consideration in online course design, and its successful integration can lead to higher levels of engagement and performance for class members.

The value of student-to-student interaction in online discussions has many facets. Among the most important is the belief that student learning takes place when students

interact with one another, being exposed to the ideas and interpretations of others and even teaching each other (Driscoll et al., 2012). Providing students with a location where they can work with peers, as opposed to the instructor as takes place with lectures or with grading and feedback, can give students the opportunity to hear from different voices, or receive different explanations or examples than what may have been provided by the instructor alone (Doo & Bonk, 2020). Creating a space for student-to-student interaction is a key goal of designing online courses that include discussions.

Another goal of online discussions is the ability to encourage all students to participate in class, perhaps even more so than they would be able to or would want to in a face-to-face class. By requiring students to post in an online discussion, instructors or designers are giving each student the floor to make their thoughts known, and to demonstrate their understanding or knowledge. In a face-to-face class, there is only so much time in a class discussion for students to speak, meaning that not every student would have the opportunity to contribute. Further, some students may be nervous to speak, or feel too much pressure to make connections on the spot; the time available in a face-to-face discussion may not give students enough time to reflect about a topic (Meyer, 2003). Online discussions allow students the time to contemplate their answers before posting, and provide more detail and well-thought-out responses (Brierton, Wilson, Kistler, Flowers & Jones, 2016; Meyer, 2003). Including discussions in online course design can help to give students a space to participate perhaps more than they would have in another activity or in their face-to-face classes.

The goals of online discussions feed directly into a larger purpose: that of increasing student engagement with their learning community and course content. The

development of a successful learning community can help to foster engagement and deepen student learning. Online discussion participation can provide a way for students to engage with the course and one another. To better understand how students achieve the goals of online discussions, it is helpful to consider *how* students engage with one another and content, and how that engagement might be measured.

Indicators of Engagement in Online Discussions

Student engagement should serve as a goal in all learning, but is especially important online, where students can feel disconnected from peers and the class or learning community as a whole. Fredericks, Blumenfeld, and Paris (2004) provide a three-component model for student engagement, based on behavioral, emotional, and cognitive engagement concepts. Each of these components can provide a way of viewing how engagement is demonstrated and promoted in online discussions.

Behavioral Engagement: Student Posts and Responses

Behavioral engagement can be gauged based on a student's level of participation in an online discussion. This participation may be academic or social and is necessary in achieving learning outcomes (Fredericks et al., 2004). At the most basic level, behavioral engagement can be seen by a student's achieving of the stated discussion requirements: providing an initial post and a certain number of responses to peers.

Additional indicators of behavioral engagement may can also contribute to a fuller picture of how students engage in online discussions. For example, the amount of time students spend on activities can indicate engagement (Goggins & Xing, 2016), as can student log ins and views of the discussion board (Dennen, 2008). Further, the amount of time students spend reading the posts of their peers can indicate engagement,

as students seek messages to respond to, find a model format of discussion post to base their own post on, to avoid repeating ideas or concepts posted by other peers, and to learn more about the topic (Dennen, 2008).

Many of these indicators of behavioral engagement are not as easily detected and measured. While log in information and "time on page" can be gathered from LMS analytic data, it may not be perfectly reliable as an indication of student activity: students may log in and visit different areas of the course, or may navigate to a page then walk away from the computer without actually interacting with that page. Student time spent on an activity or in reading may require student self-report information, which may not be reliable. One clear indicator of a student's engagement in a discussion is their posting of responses to the posts of their peers. In order to respond to a post, a student must read and to some degree reflect on that post's content in relation to the responder's understanding of the concept. Continuing discussion threads, similar to continuing spoken discourse, is necessary in the creation of a learning community, by embodying an exchange of ideas and social communication (Zingaro & Oztok, 2012). As such, a student posting a response to a peer's initial post can indicate a level of behavioral engagement.

Emotional Engagement: Social Presence

Emotional engagement is based on students' reactions to the class, their peers, the content, and their instructors, and may include interest, perceived value, boredom, or anger, among other emotions (Fredericks et al., 2004). Further, it can be viewed as identification with or belonging to a learning community (Fredericks et al., 2004). In other words, emotional engagement centers on how students affectively interact with learning, their learning environment, or their learning community. Emotional engagement

then can be seen as related to social presence, which has been defined as "the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (Garrison, 2009, p. 352), or, more succinctly, as "degree to which participants feel affectively connected to one another" (Kozan & Richardson, 2014, p. 69).

Social presence can help students to feel more like members of their learning community, helping them to engage with their peers and succeed in the course (Tu & McIssac, 2002). Research has shown that student perception of social presence can be related to interaction, satisfaction, and learning, all of which play into a student's feeling of engagement and connectedness with their community of learners.

Social presence can influence how and how much students engage with their peers. Wei and Chen (2012) note that student perception of social presence may affect how comfortable they are in interacting with peers. Doo and Bonk (2020) explain the ability of social presence to reduce students' feelings of isolation in online learning, which can lead to a shift in student preference towards more active and engaging interactions within their learning community. Oyarzun, Stefaniak, Bol, and Morrison (2018) found that higher levels of social presence correlated with higher quality of student interaction. Further, Swan and Shih (2005) note that students who perceived high levels of presence in their peers also themselves projected high levels of social presence, specifically in the areas of self-disclosure, building toward community, and building on their peers' ideas. This may indicate that the existence of social presence may promote a give and take, further engaging students with the course and one another.

Engagement may be reflected in social presence in that higher levels of social presence tend to affect student learning. Cobb (2009) found social presence to be a key component to student perception of quality in an online learning experience. Swan and Shih (2005) found that students reporting high social presence believed they learned more than their peers who perceived lower levels of social presence. Social presence can have a positive impact on learning interaction, with improvements in social presence correlating with improvements in performance (Wei & Chen, 2012).

Social presence may indicate a greater level of engagement based on student satisfaction. Oyarzun et al. (2018) found a strong effect of the level of student social presence on student satisfaction. Bulu (2012) note that students were more satisfied with their online learning experience when they perceived greater social presence in their courses. Hostetter and Busch (2006) detail positive student perceptions of social presence in their online courses in relation to their perceived satisfaction with their learning. Swan (2002) found that student perception of social presence accounted for 35% of their overall satisfaction with their course.

This engagement may lead to a higher likelihood of students persisting in their online learning courses. Boston, Diaz, Gibson, Ice, Richardson, and Swan (2009) analyzed over 28,000 student records and surveys and found that indicators of social presence accounted for a significant variance in student re-enrollment in future terms within an online program.

In the design of online discussions, the aspect of group cohesion can be encouraged by the way students are instructed to interact with one another to complete the activity. For example, a discussion in which students interact in a small group first,

reaching a consensus then presenting to the larger class, requires some amount of group cohesion. Communication aimed at group cohesion within a discussion board may include posts that address members of the discussion group using inclusive pronouns, or the use of phatics or salutations to help build familiarity within the group (Garrison, 2011).

Students must use open communication to interact in a way to successfully work together, which may include asking one another questions, prompting input, negotiating the meaning presented in members' contributions, etc. Instructors or designers may consider providing specific instructions as to how students should communicate with peers in terms of number of required responses, and directions on how to quote or refer to their classmates' posts. Examining student posts for indicators of social presence can provide some level of understanding of how students are emotionally engaging with the discussion, the class, and the learning community.

Cognitive Engagement: Cognitive Presence

Cognitive engagement can be gauged based on a student's effort in building knowledge. In an online discussion, this engagement can be seen by students "seeking, interpreting, analyzing, and summarizing information; critiquing and reasoning through various opinions and arguments; and making decisions" (Zhu, 2006, p. 455). The concept of cognitive presence and its four phases can reasonably be applied to online discussions in terms of cognitive engagement. Kucuk and Richardson (2019) found cognitive presence to be an important indicator of student engagement and encourages students to be more deeply involved in their own knowledge construction. By focusing on cognitive

engagement in terms of cognitive presence as seen in student work, it may be possible to see where they are or are not engaged with the content, their peers, or the class overall.

Online discussions can provide a location for students to engage with the course content and their peers to move through the phases of cognitive presence. One design consideration that may promote the development of cognitive presence and engagement is the careful planning and explanation of discussion protocols. Zydney, deNoyelles, and Kyeong-Ju Seo (2012) noted that the specific protocols allowing students to choose their own topics but requiring response to their peers led to greater collaborative development of cognition, as compared to a control group without protocols, whose cognition was of a more individually developed nature. By requiring that students post and respond to others, discussions promote collaborative exploration and integration again, as students work together to reach the resolution stage in a discussion event.

An important characteristic of online asynchronous discussions is that students are provided with a greater opportunity to thoughtfully contribute than they may in their face-to-face classes, where there may not be enough time for all students to participate. Additionally, students have the opportunity to carefully consider and craft their ideas before sharing with the class (Meyer, 2003; Tolu, 2013). This may be crucial to the exploration and integration steps of the process of critical inquiry: by giving students the time to think, research, and explain themselves clearly, the discussion can bring together student ideas and promote collaborative knowledge construction.

As an indicator of cognitive engagement, the level of cognitive presence that a discussion post attains can provide additional detail about how a student is engaging in that discussion. Research in the area of cognitive presence has provided mixed results in

terms of the levels of cognitive presence reached in online discussions. Garrison et al. (2001) found that students were not reaching the integration and resolution phases as often as the triggering and exploration phases: 8% of message reached the triggering phase, 42% the exploration phase, 13% the integration phase, 4% the resolution phase (the remaining 33% were classified as "other"). Kanuka, Rourke, and Laflamme (2007) had similar findings, with 10.84% of message reached the triggering phase, 53.32% the exploration phase, 26.05% the integration phase, 9.79% the resolution phase. Both Garrison et al. (2001b) and Kanuka et al. (2007) hypothesize that this may have been due to discussion design: some discussion activities lead to higher levels of cognitive presence, while others did not prompt students to engage in thought at those higher levels. The exploration phase is consistently found to be the most-reached level of cognitive presence in online discussions, with integration following at a distant second place, followed by the triggering phase, and the resolution phase generally falling at dead last with a very small percentage of representation in the discussion messages under study (Garrison et al., 1999; Kanuka et al., 2007; Shea, Hayes, Vickers, Gozza-Cohen, Uzuner, Mehta, Valchova & Rangan, 2010).

More recent research has found the integration level may be more commonly detected (Akyol & Garrison, 2011; Galikyan & Admiraal, 2019), which demonstrates student engagement at the level of knowledge construction. Reaching the higher levels of cognitive presences, integration and resolution, is important not only as an indication of how students are engaging in the discussion, but also have been found to be significant predictors of student final grades (Galikyan & Admiraal, 2019).

Looking to the cognitive presence that a post contains can provide information about the level of engagement the student has with the discussion and the learning community.

Engagement Design: Teaching Presence

In this study, teaching presence did not serve as a direct focus in viewing how student discussion posts encourage the engagement of their peers, but it should be noted that teaching presence affects the discussion posts that students make, and can influence the level of social or cognitive presences in those posts. Teaching presence in the form of discussion design can have a large effect on how students interact. The structure of the discussion in terms of direction to respond to peers will obviously affect how students read and respond to one another: if they are asked to read and reply to two classmates, with no other direction, both cognitive and social presences may be low in those responses as they may be short, or may not include meaningful content. Additionally, the instructor-provided prompts may lead students to higher levels of cognitive presence, or may ask students to provide more personal information that would lead to different aspects of social presence. Further, an instructor's direction on the tone and writing on discussion boards may urge students to use more academic, removed language that may affect the social presence of student responses. Finally, an instructor's participation or intervention in a discussion may help or hinder students in reaching higher levels of cognitive presence. In this way, teaching presence may still influence how students interact on discussion boards, even without a clear manifestation in the posts themselves.

Online discussions provide a location for viewing student engagement in terms of its three components put forth by Fredericks et al. (2004): behavioral, emotional, and

cognitive. These can be investigated in discussion posts in terms of student participation as seen in response posting activities, social presence indicators detected, and cognitive presence levels reached. How students act and interact within the learning community can contribute to one or more of the engagement components. But how might the work of one student influence the work of another student within the learning community, in terms of engagement? An in-depth look at characteristics of student work may help researchers to better understand how students promote interaction and engagement in terms of the presences they encourage in their peers.

Student-to-Student Influence on Engagement in Online Discussions

While the Community of Inquiry framework suggests that students work together to construct knowledge, attention is usually paid to individual student contributions and how they affect the individual student outcomes, as opposed to how students influence one another within the community. However, students should always be influencing and be influenced by their peers in online discussions; they bring their own ideas and experience to the discussion where those ideas and experiences are shared with peers. Students then take the information provided by their peers to build their own understanding. Looking at how the moves that students make in their own discussion posts affects their peers' engagement can take this one step further, by looking at how students promote interaction and social and cognitive presences in the response posts their peers make.

Much of the research on student-to-student influence in the literature has focused on the concept of peer-facilitation. This generally means that students take on the role of discussion leader that is usually filled by the instructor, by posting questions to inspire

conversation amongst their peers. Looking at how students approach the role of moderator can be helpful in considering how the actions of one student may impact the actions of others. Chen, Lei, and Cheng (2019) studied peer facilitation in terms of student-provided discussion questions and their effect on the cognitive presence achieved by in their peers' responses. They investigated posts in terms of peer-facilitation techniques finding that summarizing and re-voicing, providing information, and using positive social cues significantly correlated with higher-level thinking. Hew and Cheung (2008) looked at what student moderators were doing that helped promote interaction in the discussion board by eliciting response. They looked specifically at seven discussion facilitation strategies: giving own opinions or experiences, questioning, showing appreciation, establishing ground rules, suggesting new direction, personally inviting people to contribute, and summarizing, and found that Socratic questioning and sharing personal opinions or experiences were the most frequently used (Hew & Cheung, 2008).

While peer facilitation in terms of student-moderated discussion boards has been studied in some detail, less attention has been paid to the concept of peer facilitation made in non-peer-moderated discussions. How do the actions of students in their own posts contribute to or influence the responses of their peers? Some research has focused on the length of discussion threads as an indication of student-promoted interaction: what takes place in posts made within the thread may affect how many responses are provided, and thus how long the thread grows. Zingaro and Oztok (2012) investigated discussion posts for traits such as posting date, whether the post was written by an active or inactive participant, the word count of the post, whether the post was written by a student or the instructor, whether the post contained a question, and the reading ease score of the post.

They found that posts that are more likely to elicit a response are from earlier in the week, are easier to read, contain at least one question, or had a larger word count (Zingaro & Oztok, 2012).

Chen and Huang (2019) studied student prestige in online discussions, finding that high prestige students tended to receive more replies than their low-prestige peers. Students in the high-prestige group tended to post earlier than students in the low-prestige group, and posts within that group were more closely distributed in terms of posting times; additional variables including post length, presence of questions, and readability did not differ significantly between the high- and low-prestige groups (Chen & Huang, 2019).

Chen and Chiu (2008) investigated the "flow" of online discussions by looking into the effect earlier messages had on later messages, specifically in terms of agreement/disagreement, knowledge content, social cues, personal information, and whether a post elicited a response or not, finding that these five dimensions of earlier messages can affect subsequent messages.

A successful learning community sees students working together to construct knowledge; as such, all participants are influencing the work of their peers in some way. Looking to the characteristics of student work that may contribute to engagement can help to elucidate how the moves that students make can influence the work of their peers.

Discussion Post Characteristics

The ways that students act and interact in online discussion posts may provide some insight into peer-promoted engagement. Generally, a student's initial post is their own individual thoughts or ideas in relation to the instructor-posted prompt; a response

post requires that students read the thoughts and ideas of their peers then formulate a response that is in at least some way related to the peer's post. As such, characteristics of the initial post may influence peer responses. A number of attributes of initial discussion posts may influence both whether a post generates a response, and the social or cognitive presence exhibited in that response post. The following traits of initial discussion posts were investigated in this study.

Post Time from Due Date

One important initial post characteristic that may influence responses from classmates is when it is posted. Depending on the deadlines set forth by the instructor, specific due dates may be in place for initial posts separate from response posts. In this case, students may be directed to post their initial message earlier in the week, then return to the discussion board later in the week to read and reply to peers' posts. Of course, some students may choose to post their initial message early in the week, and then read and reply to the existing initial posts of peers directly after. This may lead to the temporal aspect of the initial post generating more replies. Fortunately, the online discussion board time stamping feature makes it easier to track when posts were made (Mercer, 2008).

Students can only read and reply to posts that exist at the point at which they are ready to begin making replies. This means that messages posted earlier in the week, when there are fewer messages available, may generate more response than posts made later in the week, when there are many more messages available (Pena-Schaff & Nicholls, 2004; Zingaro & Oztok, 2012). This may only affect those students who are trying to complete their required number posts (one initial and two responses, for example) all in one sitting, or before the final reply post deadline.

For students who space out their initial post and replies, there may be other factors that affect their likelihood of a reply. For one, students may have viewed some initial posts earlier in the week, and return later to post their replies; here, they may choose to use the unread flag as an indicator of new messages they should view. Hewitt (2003) found that 82% of students tended to read posts that were marked as unread, and that it was less common for students to return to messages they had already read earlier in the week. In opposition to Zingaro and Oztok (2012), Hewitt (2003) found that students tended to reply to newer messages rather than older ones, meaning those initial posts that had been made closer to when the student returned to the discussion board to post their own replies. Blanchette (2011) found that discussion interaction generally took place as a shorter period of concentrated activity, which was then followed by little activity or a complete fall off of responses.

It's possible, though, that this has more to do with the spatial organization of the discussion board: If the newer posts are at the top of the page, students may be more likely to view and respond to them; if initial posts are presented in the order in which they were made, with earlier posts at the top of the page, then responses may be more common for those that were made earliest in the week.

Word Count

Another characteristic of an online discussion board posting that may influence peer response is its length. Messages may be measured in terms of characters, words, or lines, but the overall intention is to define how long the individual unit is. While some instructors include a minimum length for discussion posts, there is still much variation in how much students choose to write. On an online discussion board, the message length

can be seen visually before a peer even decides to read it, which may affect which posts are read and replied to.

The research on the post length's effect on its likelihood of generating a response is mixed. Joyce and Kraut (2006) found that longer messages on newsgroup online message boards attracted a response more often than shorter messages, although this may be indicative of readers only skimming the original posting in educational contexts (Hewitt, Brett, & Peters, 2007). Zingaro and Oztok (2012) found that longer messages were more likely to generate a response and hypothesize that longer messages include more ideas that peers could respond to than shorter messages.

On the other hand, Ho and Swan (2007) argue that long posts may contain too many ideas for a simple response. Further Hewitt, Brett, and Peters (2007) found that if a posting is longer than 500 words, 64.9% of students in their study said they'd be less likely to finish reading the post. Ho and Swan (2007) found that students were more likely to respond to shorter posts, possibly due to the time and patience required to get through the message in order to reply.

Another consideration in terms of post length is what it may say about the author or communicate to readers. In terms of cognitive presence, Joksimovic, Gasevic, Kovanovic, Adesope, and Hatala (2014) found word count to be a predictor of higher levels of cognitive presence. Abe (2020) notes that word count is a predictor of overall academic success and hypothesizes that this may be due to a level of conscientiousness: students who spend more time studying for quizzes and completing other work are also likely to put more effort into their discussion posts.

Reading Ease

Another initial post trait that may influence peer response is how easy it is for the post to be read. A post that is easier for students to read may attract more readers and more responses; posts that students perceive as harder to read may be bypassed in favor of those that they believe get the point across more easily.

The Flesch Reading Ease Readability score indicates how difficult a piece of writing is to read in English, based on averages of sentence length and word length. The Flesch Reading Ease Readability provides a text with a score between 1-100: higher scores indicate that the passage is easier to read, while lower scores indicate more difficulty. Scores between 90-100 indicate that a passage is very easy, scores between 80-89 indicate that it is easy, scores between 70-79 indicate that it is fairly easy, scores between 60-69 indicate that it is standard, scores between 50-59 indicate that it is fairly difficult, scores between 30-49 indicate that it is difficult, and scores between 0-29 indicate that it is very confusing (Readability Formats Website, 2014).

The test uses sentence length (average of length of sentence in words) and word length (average number of syllables per word) to indicate how difficult the reading may be. The specific mathematical formula is:

$$RE = 206.835 – (1.015 \times ASL) – (84.6 \times ASW)$$

Where

RE = Readability Ease

ASL = Average Sentence Length (i.e., the number of words divided by the number of sentences)

ASW = Average number of syllables per word (i.e., the number of syllables divided by the number of words)

(Readability Formats Website, 2014).

Hewitt and Peters (2007) studied interactivity in online courses by looking at the number of reply messages written divided by the total number of messages written and found that courses with high average Flesch Reading Ease scores had the highest interactivity. However, at the individual message level, Zingaro and Oztok (2012) found only a marginal effect of the message's Flesch Reading Ease score on the likelihood of a message generating a response.

Zingaro and Oztok (2012) suggest that messages that are easier to read may more easily facilitate communication and connection between students, making the argument that courses high in social presence may contain more messages that are easier to read.

First- and Second-Person Language

Another characteristic of initial posts that may influence peer responses is the use of first- and second-person language within the body of the message. First-person language includes "I"," me", and "my". Second-person language includes "you" and "your." Tausczik and Pennebaker (2010) note that the use of pronouns can indicate the quality of personal relationships, by showing how people are referred to both within and outside of an interaction. Mayer, Fennell, Farmer, and Campbell (2004) cite cognitive theory of multimedia learning in noting that personalization of teaching materials can lead to increases in student interest, which then leads to the student putting forth more cognitive effort, which may result in deeper learning.

The use of first- and second-person language may be affected by a student's experience in college-level writing. As the use of pronouns is less common in academic writing, Carroll (2007) hypothesizes that a decline in their usage may be impacted by students moving away from the use of personal experiences and instead relying on researched evidence to help make their arguments. Formality of writing in initial posts may affect their peers' desire to respond, as it may contribute to the feeling of distance between students and respondents (Tu & McIsaac, 2002). The use of personal pronouns has been studied in terms of student academic performance: lower usage of personal pronouns is related to higher academic performance (Pennebaker, 2011), while students using a higher percentage of first-person pronouns tended to be lower performing (Robinson, Navea, & Ickes, 2013). This may relate to the quality of work presented in the initial post, which may influence any response it would generate.

Lowenthal and Dunlap (2020) found personal pronouns to be in the top twenty most used words in their investigation of online discussions: "I" ranked highest in use, followed by "you"; "we" and "your" were also found to be used frequently. In terms of teaching materials, the use of the second person "you" and "your" may lead to students to deeper learning. Mayer et al. (2004) note that "using the self as a reference point increases the learner's interest," which then helps to open the learner up to further cognitive processing. The use of first-person plural pronouns such as "we", "us", or "our" may indicate a measure of group identity, and in fact the use of such pronouns is included in the CoI theoretical framework for the social presence category of cohesive communication.

How students express themselves in their communications can demonstrate their own cognitive and social presences as members of their learning community. The characteristics of initial discussion posts explained above may impact those presences, both in their own communiques and in the responses that they prompt in their peers. While many of these characteristics have been investigated in terms of how they relate to learning or interaction, there is a lack of research into how these traits may affect the development of a CoI in relation to cognitive and social presences in student responses.

Additional Considerations in Student Initial Post Creation

While the above characteristics of initial posts provide clear data to investigate in terms of how students are communicating their understanding of course concepts on the discussion board, there are a number of additional considerations that may influence what or how they write. While these considerations are not investigated as part of this study, they do provide additional ways that students craft their initial posts, which in turn may influence the responses of their peers.

Cultural Approaches to Writing in Discussions

While all students in a given online class will be asked to participate in the assigned online discussion, in response to the same prompts, not all students have the same writing or language skills or even approach to writing and argumentation. Like all students, those from diverse backgrounds must negotiate meaning and determine how best to present their understanding in the online discussion, but they may face additional challenges in terms of making themselves understood or tapping in to the unwritten "rules" of student-to-student interaction in the language or culture of the classroom. Unfortunately, the writing strategies and rhetorical features employed by multilingual

writers in online discussion boards is an area about which limited research is available (Hopewell & Escamilla, 2014).

Unlike a live discussion in a face-to-face class, asynchronous online discussion boards afford all students the time to consider prompts and thoughtfully construct their initial and response posts. This allows students to formulate thoughts that integrate different points of view or cultural experiences (Marttunen & Laurinen, 2011). Further, the asynchronous nature of discussions can help to ease apprehensions of students for whom English is not their native language who may be nervous or embarrassed to speak aloud without adequate preparation (Govender, Mtshali, & Maistry, 2020). However, even with this additional time, students from diverse backgrounds may encounter issues in crafting their discussions posts. The linguistic patterns of writers may be influenced by their cultural background, and they may employ different writing conventions based on that background that may make meaning harder to ascertain for their peers. Such differences may run the gamut of rhetorical choices in writing, "from paragraph organization and argumentation to the use of linking words and the incorporation of citations" (Damary & Pryadilina, 2017, p. 86.). Further challenges related to cultural differences of students include "linguistic misunderstandings, misunderstandings of cultural context cues, and online participation differences" (Pudikova, Kurilova, Movchun, Medvedeva, & Kochetkova, 2019, p. 48). While interaction with peers on the discussion board affords all students the ability to deepen their understanding by viewing the ideas and experiences of others, differences in writing conventions may make or break a student's decision to read and reply to a peer, or how they might craft that response based on what they have read in the initial post.

Student Choice in Initial Posts

Another consideration that influences how students craft their initial posts, which may in turn influence the responses of their peers, is the idea of student choice. In many discussions, including those investigated as part of this study, the instructor provides a number of discussion prompts from which students can choose to respond. The choice made by one student in their initial post lays the groundwork for the responses of their peers: by choosing one prompt over others, the initial poster is starting the conversation, providing their own understanding upon which peers can further develop ideas or knowledge in the topic area.

How do students choose which prompt or prompts to respond to? Often, students choose the question that they feel they are most confident or interested in; that is, they answer questions for which they feel they have something to say (Cheung, Hew, & Ng, 2008; Hewitt, 2005). Students may also choose prompts to respond to that they find most interesting or relevant to the course or their program of study (Cheung et al., 2008; Fung, 2004; Masters & Oberprieler, 2004). These choices can directly influence the decisions of peers on which initial posts to reply to. If the initial prompt was one that required students to display deep knowledge of the concept, then response posts may necessitate similarly deep knowledge in order to continue the conversation. If the initial post prompt was interesting to the initial poster, the response poster may also be interested in the topic, or may have developed interest based on what the initial poster had to say. Further, a prompt that receives no initial posts in answer to it is essentially an avenue of discussion that has been shut down before it even begins: if no students choose to answer a given prompt, then no peer responses are possible in that topic area. In this way, the

choices made by students in their initial post prompt selection can directly influence the decisions about whether to reply or what to include in their replies.

Theoretical Framework

This study seeks to examine how online discussions can succeed as location of student engagement. The theories underlying this study include the ADDIE instructional design model (Branch, 2009; Gagne et al., 2005), the multidimensional model of student engagement (Fredricks et al., 2004), and the Community of Inquiry framework (Garrison et al., 1999).

The growth of online learning has prompted stakeholders to examine how to build online courses that promote student success. The ADDIE model of instructional design is one approach to creating such courses, guiding instructors and designers to move through the following steps in course design: Analysis, Design, Development, Implementation, and Evaluation (Gagne et al., 2005; Branch, 2009). Progressing through the ADDIE model allows course builders to determine what is needed in a learning scenario, design course content and assessments, develop the necessary materials, implement the learning event, and then evaluate the success of the learning event in meeting these needs. The intention is to build a course that helps students meet the learning objectives and succeed in the course, but this model alone cannot guarantee that these goals will be met.

Considering how students engage with the content and their peers can play an important role in the design of effective online courses. A focus on promoting engagement in the analysis, design, and development phases of the ADDIE model can lead to stronger course design. In these phases, instructors and designers may take into consideration the multidimensional model of student engagement put forth by Fredericks

et al. (2004), which views student engagement in terms of three components working together. These are behavioral engagement, emotional engagement, and cognitive engagement, all of which students can demonstrate in course actions and activities. An awareness of these components can help the instructor or designer to build course materials and activities that help students to develop and display each type of engagement.

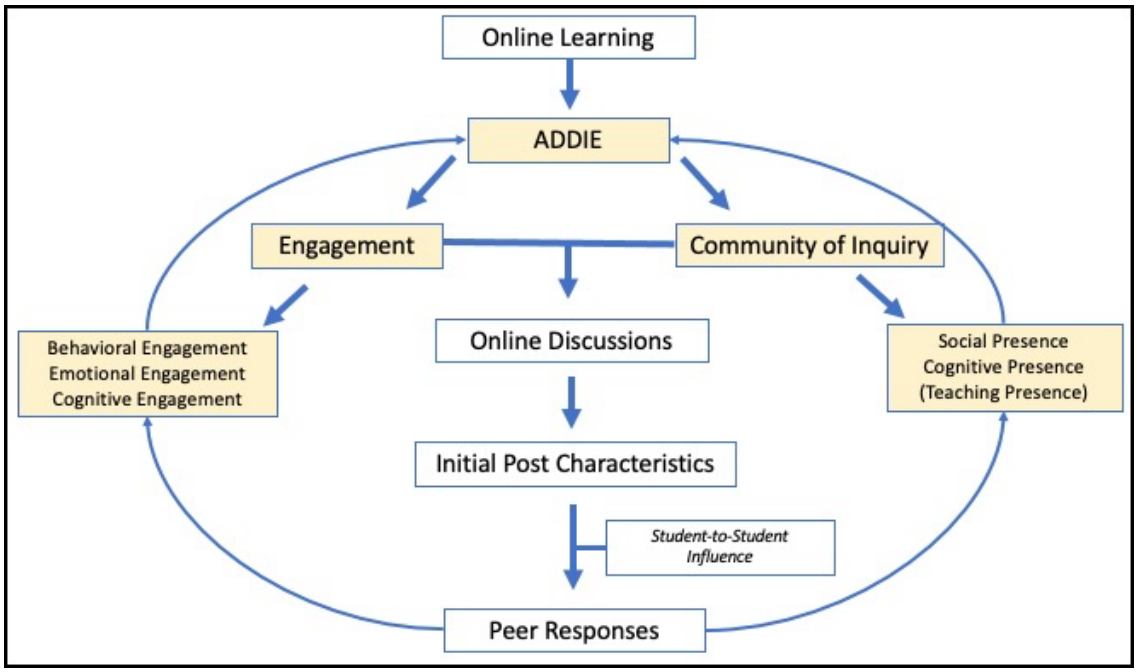
Further, considering exactly *how* students build knowledge can help the instructor or designer to better analyze needs, design learning, and develop materials and activities. The Community of Inquiry framework put forth by Garrison et al. (1999) views learning as students acting within a social environment to negotiate meaning and build understanding as a community of learners working together. Three dimensions contribute to the creation of such a learning community: participants' social presence, cognitive presence, and teaching presence. Instructors and designers working within the ADDIE model can apply the CoI framework as a method to promote student engagement and knowledge building. As such, considering what actions and activities will assist students in building and displaying the presence dimensions can play into the needs analysis, design, and development steps of the ADDIE model.

This study investigated how students demonstrate the three components of engagement and two presences of the CoI framework (social and cognitive presences) in their discussion board posting. Specifically, how the work of one student influences the responses of their peers, in terms of engagement and CoI presences, was scrutinized. By studying student responses that reflect engagement in terms of the three dimensions outlined by Fredericks et al. (2004), and participation in a learning community in terms of

the CoI framework presented by Garrison et al. (1999), I hope to provide a lens through which instructors and designers can evaluate the success of the learning activity. This evaluation would serve as the final step in the ADDIE model, providing instructors or designers with valuable insight as they start the ADDIE model anew by analyzing student needs based on the engagement and learning demonstrated in these student responses. Figure 2 presents the theoretical framework visually.

Figure 2

Theoretical Framework



Purpose of the Study

Online discussions are often used by instructors to promote student-to-student interaction and engagement. By providing a location in the course where students can build understanding of course content by interacting with their peers, online discussions make it possible for students to develop a learning community and construct knowledge

socially with the help of others. This can lead to greater engagement in the class, which can affect student retention, satisfaction, and learning outcomes. However, not all discussions lead to meaningful interaction or engagement among students. There is a need to determine what takes place in a discussion that may better encourage engagement and communal knowledge construction. An examination of the moves that students make in their discussion posts may prove valuable in exploring how students engage with their peers.

It is necessary to determine what peer engagement means in terms of student participation in online discussions. This study viewed engagement in terms of the three components set forth by Fredericks et al. (2004): behavioral, emotional, and cognitive. Behavioral engagement was viewed in terms of student participation: do students post replies or not? Something about the initial post will either attract or repel a peer as they determine whom to reply to. By eliciting a response post, an initial post has engaged the peer with the discussion taking place. Indicators of cognitive engagement and emotional engagement in a discussion include the existence and extent of cognitive and social presences detected in student responses. These indicators demonstrate how the peer attempts to contribute to the construction of knowledge within the greater learning community.

In seeking to understand the moves that students make in their discussion participation, describing characteristics of initial posts can help lay the groundwork for an investigation into how students influence the work of their peers. Looking into initial posts in terms of posting time, length, reading ease, use of personal pronouns, or cognitive presence takes into account a number of traits that may influence peer

responses. The way these traits are presented in a student's initial post may promote engagement and communal learning of peers by generating a response, or by the existence and level of social and cognitive presences in the responses.

The purpose of this study was to determine the relationship between initial discussion posts and peer responses, specifically in terms of how the characteristics of those initial posts may influence the responses that their peers provide. The existence and contents of these responses can demonstrate the engagement of peers within the learning community. As such, investigating initial posts in terms of the reactions taking place in responses can give us an idea of how students influence the engagement of their peers. Chapter 3: Methods outlines the steps taken in achieving this purpose.

Summary

This chapter provided a review of literature, presenting background information and research in student engagement, the Community of Inquiry theoretical framework, online discussion design and goals, and the variables present in student discussion posts that may influence interaction and engagement of their peers. Specific information was provided in support of the variables chosen to be part of this study: cognitive presence, social presence, and characteristics of initial discussion posts that may influence peer response. The next chapter covers the research design methodology and process related to the research questions.

CHAPTER THREE: METHODS

Introduction

The purpose of this exploratory, quantitative, non-experimental study was to examine the relationship between student initial post characteristics and the generation of response posts, and on the social and cognitive presence of those response posts in asynchronous online discussions as part of fully online undergraduate course at a mid-sized research university. In order to do this, data was collected from discussions in two fully online course sections and coded in terms of initial and response post characteristics under inspection. This data was analyzed to determine how the characteristics of initial posts may predict aspects of responses from peers, including whether a response was elicited, and the social and cognitive presences in the responses associated with each initial post. Engagement with peers and the course content can be detected by the generation of a response, and by the demonstration of social and cognitive presences in student responses; as such, it is important to know what characteristics of initial posts most influence these presences in peer responses.

This chapter describes the methods used in exploring how initial posts may influence peer responses, including the research questions and research design. Chapter 3 also outlines data collection procedures and instrumentation. This chapter concludes with information on the data analysis that determine if initial discussion posting characteristics influence the generation of response posts, and the social and cognitive presence of response posts.

Research Questions and Design

This study sought to answer three research questions related to the impact of specific moves made by students in their initial discussion posts on their peers' responses. A correlational research design was used to attempt to answer these questions.

Research Questions

The research questions for this study were:

RQ1: To what extent can the probability of an initial discussion post receiving a response be predicted by that post's time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level?

RQ2: Which of the six initial discussion post predictor variables are most influential in predicting social presence in response posts? Are there any predictor variables that do not contribute significantly to the prediction model?

RQ3: To what extent can the probability of an initial discussion post generating higher levels of cognitive presence in peer responses be predicted by that post's posting time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level?

The following were the null hypotheses:

$H0_1$: There is no significant prediction of an initial post **receiving a response** post by that post's time from due date, word count, reading ease score, use of first-person pronouns (I, me, my), use of second-person pronouns (you, your), or cognitive presence level.

$H0_2$: There is no significant linear relationship between **social presence** in response posts and the initial post's time from due date, word count, reading ease score, use of first-person pronouns (I, me, my), use of second-person pronouns (you, your), or cognitive presence level.

$H0_3$: There is no significant prediction of an initial post generating a response reaching a higher level of **cognitive presence** post by that post's time from due date, word count, reading ease score, use of first-person pronouns (I, me, my), use of second-person pronouns (you, your), or cognitive presence level.

Research Design

A nonexperimental correlational research design was used to determine if characteristics present in student initial posts could be used to predict whether the post would stimulate responses from peers. A nonexperimental design was chosen because the researcher did not have control to manipulate the variables being studied, and thus was only observing outcomes that happened naturally (Morgan & Renbarger, 2018). Random assignment into control or treatment, or intervention or comparison, groups was not possible with the data source available. This correlational design studied nonmanipulated variables to find out whether a relationship exists between them (Lobmier, 2010).

This research design was chosen because it attempts to explore possible correlational relationship between independent variables and a dependent variable on an occasion in which the researcher is unable to control the independent variable.

Participants and Sampling

The following section provides details on the participants and sampling method that were employed in this study.

Participants

For the purpose of this study, a dataset was obtained from two sections of a required undergraduate core course that took place online at a midsized public Research 1 university in a western state in 2020-2021. A nonrandom sample (i.e., a convenience sample) of around 1500 discussion post messages was used in the study, representing all students who participated in two online sections of Core Humanities 212 in the fall 2020 and spring 2021. Nonrandom sampling is often used in educational research because random sampling is not possible (Rovai, Baker, & Ponton, 2013). In the case of this study, the sample was a convenience sample because it was readily available to the researcher due to her previous work relationship with the courses' instructor.

All students at the university are required to take two courses from a four-course series as part of the university core curriculum. The course prerequisites include Freshman Composition II, which is usually completed in the first or second semester of a student's freshman year; as such this course is at the 200-level, it can be assumed that most students were at the sophomore level or higher in their university experience. The course chosen for this study (Core Humanities 212: Science, Technology, and Society in the Modern Era) offers more of a focus on science and technology than its counterpart class (Core Humanities 202: The Modern World); as such, participants tend to come from STEM-related majors.

Sample

For the purpose of the study, individual students did not serve as the cases to be examined; rather, discussion post threads served as the case under analysis. This included each initial post and any subsequent responses to that initial post as a single case. This

sample is characterized as a convenience sample because it has been selected from data that were readily available to assess trends in specific populations (Fowler, 2002).

All initial posts served as cases for research question one, which examined what aspects of an initial post may lead to the generation of a response post. A sample of 1028 initial posts were analyzed for research question one. These posts were examined and coded for the following features: the amount of time before a due date a post was made; word count; reading ease; the use of first-person language such as “I”, “me,” and “my”; the use of second person language such as “you” or “your”; the highest level of cognitive presence achieved in the initial post.

Only initial posts that generated response posts served as cases for research questions two and three. A sample of 630 initial posts that generated response posts were analyzed for research question two and research question three. Response posts were coded for the density of social presence indicators and the highest level of cognitive presence achieved in the response post.

Procedures

The following procedures were undertaken in completing the proposed study.

Course Setting

Courses were delivered fully online in a completely asynchronous format using the Canvas learning management system. Between 25-35 students were enrolled in each section, both of which followed the same course template including the syllabus, reading and lecture content, assignments, assessments, and discussions. The same instructor taught both sections and took part in the overall design of the course; additionally, this

instructor had over five years of online teaching experience. Students earned three credit hours for successfully completing the course.

The course for this study was chosen because it is an option for a core curriculum requirement, and thus contains a cross section of the larger student population. As mentioned above, the course chosen for this study has a science and technology focus, and may attract more students majoring in STEM fields, although the course is open to all students. With multiple sections following the same online discussion design and using the same discussion prompts, a large N was possible. Finally, access to the discussion data was readily available in the learning management system.

Discussion Requirements

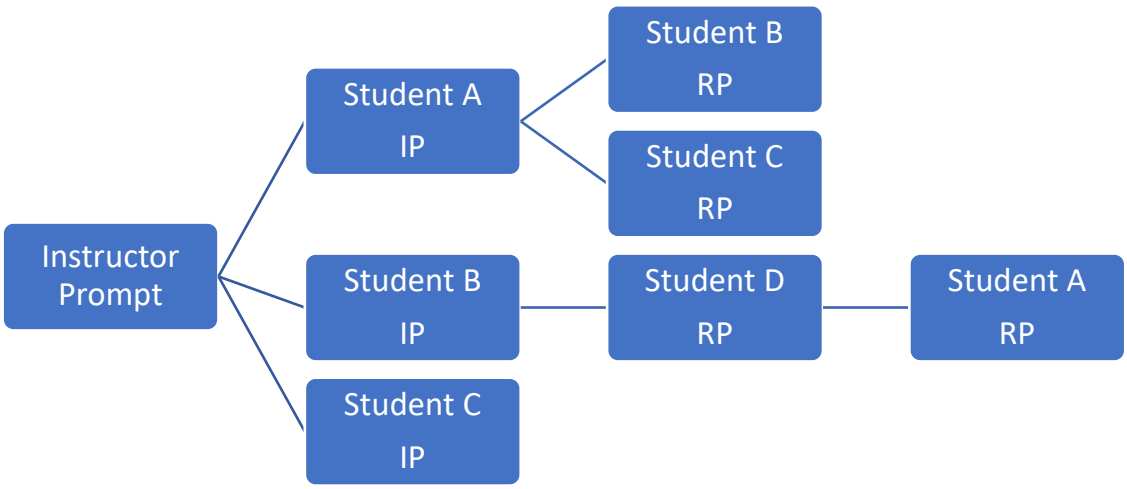
Asynchronous discussions were required of all students in ten weeks of the twelve-week semester for both sections. Students were assigned small discussion groups of between four and five students each, with group membership changing each week. Students were provided between five and nine options for pre-determined prompts to respond to, of which they had to choose two to answer in two separate discussion posts by 11:59 p.m. on Thursdays. Students then were required to review and reply to at least two classmates' posts in response to different prompts than they had answered themselves, on the discussion board by 11:59 p.m. on Sundays. Each group was required to discuss at least four different questions; groups that did not achieve this were docked 5 points from their discussion scores for the week. The discussion prompt included the following message aimed at pushing students to post earlier in the week: "Helpful tip: The earlier you post each week, the more options you'll have in which questions you choose to answer with textual evidence." Discussion participation was worth 25 points

each week (2% of the class total grade), or 250 points overall (25% of the class total grade). Initial posts were worth 7.5 of the points each, and each response post was worth 5 points.

With such a structure of discussion, some student initial posts generated one or more peer responses, while some initial posts did not generate any response. Additionally, some student response posts generated a response from peers, continuing the conversation begun by yet another peer's initial post. Figure 3 displays three types of threads that could occur. In this example, there are seven student posts. Student A's initial post generated two responses. Student B's initial post generated only one response, but that response also generated a response. Student C's initial post did not generate any peer responses.

Figure 3

Sequence and Number of Posts Made by a Student in Response to an Instructor Prompt.



Each rectangle represents a post. IP stands for initial post in response to the instructor prompt, and RP stands for response post for response to a student initial post.

Data Collection

Data collection was approved after submitting an IRB application and gaining approval. Data was collected from online sections after the conclusion of all semesters included in the study. Student grades were already assigned, and students no longer had access to the course sites. All discussion posts were downloaded from the Canvas LMS using the "Canvas-Discussions-Get_Entries" userscript developed by Dr. Brian Reid. The Tampermonkey for Chrome browser add-on was used to access the userscript. Once installed, the userscript was be utilized by entering the course site on Canvas, navigating to the Discussions index page, and clicking the "Userscript: Get Discussion Entries" button at the top or bottom of the page, and selecting "Generate one file with responses to topics" option.

A Microsoft Excel file was created that contained all posts from all discussion forums within the class. The Excel sheet contained information for each discussion post, including the course identification number, the topic (discussion forum) identification number, the topic (discussion forum) title, the discussion type (in this case, all discussions were threaded), entry (or post) identification number, the initial post author, the initial post, the initial post word count, the reply post identification number, the reply post author, the reply post, and the reply post word count. The Excel sheet contained a row for each post; initial posts only contained data related to the initial post itself, while response posts were included on a row with the initial post to which the response post is responding to. Non-content-based discussions (such as introductions, icebreakers, and extra-credit activities) were removed. Once the Excel spreadsheets were prepared in this manner, data coding took place.

Measurement and Instrument

A content analysis of individual student discussion posts was undertaken to translate discussion data into quantitative form for data analysis. This study used each initial post as one unit of analysis. Rourke et al. (2001) recommend choosing a unit of analysis "that multiple coders can identify reliably, and simultaneously, one that exhaustively and exclusively encompasses the sought-after construct" (p. 17). Options for unit of analysis include sentence, paragraph, message, or thematic levels, although the more granular units may make it difficult for a coder to identify the full intent of the statement (Garrison, Cleveland-Innes, Koole, & Kappelman, 2006). Individual discussion posts, or the entire message created by a student, were chosen as the unit of analysis for this study because they were easily demarcated from one another, and present the author's decisions related to content and length (Garrison et al., 2001b).

In this study, initial posts and response posts were analyzed and their characteristics measured and coded. Initial discussion posts were coded for the amount of time before a due date a post was made; word count; reading ease; the use of first-person language such as "I", "me," and "my"; the use of second person language such as "you" or "your"; the highest level of cognitive presence achieved in the initial post; and whether the initial post generated a response post. Response posts were coded for the density of social presence indicators and the highest level of cognitive presence achieved in the response post.

Content Analysis

Each student discussion post underwent content analysis in order to convert the written communication of the post into numeric variables that could be statistically

analyzed. It is possible to convert data that do not naturally take the numerical form, such as feelings or beliefs, into numbers for use in quantitative research (Muijs, 2011). Content analysis can be defined as "a research methodology that builds on procedures to make valid inferences from text" (Anderson et al., 2001), which should strive for accuracy, precision, objectivity, replicability and validity. A content analysis of discussion transcripts relies on the researcher reviewing all written text and coding for the specific variables under investigation.

Using content analysis, each discussion message was examined for the variables under study. Each post was reviewed to identify variables, then measured and coded for each variable present within the post. Initial content analysis was completed using all data collected from initial posts and response posts. After roughly two months, the same researcher revisited the data to check the reliability of the initial round of coding. For both the initial posts and response posts, 15% of the total number of posts were randomly selected and recoded. This resulted in 155 initial posts and 147 response posts being recoded. Coding results from the initial coding period were compared to the results from the second coding period, then analyzed to determine the intrarater reliability.

Density Score Calculation

In order to more easily compare variable values between posts of different lengths, some variables were coded then calculated in order to find a density score. Density scores are calculated by taking the count of instances of each variable within each post, dividing that count by the total number of words in the post, and multiplying by 1000 (Rourke et al., 2001). This yields a unit of incidents per 1,000 words. This creates an expression that is more easily comparable between posts, as the value of the

count may have been skewed by the differences in length of posts. Density scores were calculated for each social presence indicator, as well as first-person language and second-person language.

Density scores have been used to calculate social presence in many studies (Lowenthal & Dunlap, 2020; Rourke et al., 2001; Swan & Shih, 2005), but the concept can be applied to any variable for which individual counts are sought to be compared amongst cases that may present at varying lengths. While there is no evidence of the use of density scores in analyzing first- or second-person language in the literature, it has been employed in this study to help compare these variables where present in posts of varying lengths. Equation 1 details the calculation for density scores.

$$Density\ score = \frac{instances}{post\ word\ count} \times\ 1000 \qquad \text{(Equation 1)}$$

For example, for the social presence indicator "Open Communication: Asking questions," if a student asked three separate questions, this would count as three instances. The calculation for the example post above would be three divided by 158, multiplied by 1000. This would give a density score of 18.99. Another example is that, in a post that is 158 words long, if a student uses the word "I" in seven instances, this would be seven divided by 158, multiplied by 1000. This would give a density score of 44.30. For social presence indicators, the entire indicator would count as one instance.

Initial Post Coding

All initial discussion posts were coded for the following variables. A description of each variable and how it was coded is provided below:

Post Time from Due Date

In this study, "post time from due date" is the time measured in minutes counting from the point at which a student posts a message to the time of the required due date time. When an initial post was made in relation to the stated due date may influence responses from peers. If a post is made early in the week, well before the due date, then it has more time to be viewed by other students. Earlier in the week, there are fewer posts for students to choose from to respond to, meaning those initial posts may get more replies than initial posts made closer to the due date (Pena-Schaff & Nicholls, 2004; Zingaro & Oztok, 2012). It may also be possible that students prefer to respond to more recently made posts (Blanchette, 2011; Hewitt, 2003). An important consideration is how the discussion timeline of posts is presented visually: if newer posts are at the top of the page, they may generate more responses just by being the first readers see. The discussion board investigated in this study was chronologically organized, with initial posts appearing in the order they were made (older posts first). Responses to each initial post were also organized chronologically, with the first response after the initial post was made visually appearing directly after the initial post, though slightly indented.

Discussion post times were tracked by the learning management system. The post time from due date was calculated using the post time obtained using the "Canvas-Discussions-Get_Entries" userscript. Each discussion forum has specific deadlines for initial posts (Thursdays by 11:59 p.m.) and response posts (Sundays by 11:59 p.m.). The time that a post was made was be subtracted from the specific deadline for that week's discussion and converted into minutes. Posts made after the deadline were given a negative value. The "post time from due date" variable is continuous data.

Word Count

In this study, "word count" is the number of words in a discussion post. The number of words in an initial post may influence peer responses. The length of the initial post may draw more or fewer responses, based on how peers react to the initial post: if it is long, peers may decide it will take too much time to read and respond to; on the flipside, they may be attracted to a longer post that has more content or ideas that they may base their response on (Zingaro & Oztok, 2012). A shorter post may be more attractive because it can be read and reflected upon more quickly (Ho & Swan, 2007), or it may not contain enough information for the responding student to connect with. The word count of the initial post was included as a predictor variable in this study because it may provide information on how the length of a message influences its responses: this may provide instructors with evidence to set a minimum or maximum word count for discussion assignments.

The word count for each initial post was tabulated by Canvas and accessed using the "Canvas-Discussions-Get_Entries" userscript. The word unit is counted as a group of letters with spaces on either side of it. This may lead to minor errors, if students combine words without a space between them, as might be found with a typo or misspelling. The "word count" variable is continuous data.

Reading Ease

In this study, "reading ease" is the Fleshe Reading Ease score for the discussion post, which is calculated using sentence length and word length to indicate how difficult the reading may be. How easy an initial post is to read and comprehend may influence peer responses. Students are required to read through and reflect on the points made in their peers' initial discussion posts; as such, the readability of initial posts may influence

who chooses to read and respond to them. Those that use a simpler writing structure may communicate their ideas in a way that readers can more easily digest, which may in turn promote further interactive communication (Zingaro & Oztok, 2012). On the other hand, posts that use more developed writing structures may be clearer or present information in a more organized manner, which may attract more responses.

The value for the reading ease variable was calculated using the built-in spelling and grammar checking tool in Microsoft Word. The discussion post was copied to the clipboard, then pasted into a blank Microsoft Word document. Under the Review menu, the Spelling and Grammar tool was opened. Once all spelling and grammar errors were reviewed, a "Readability Statistics" window opened that provided information on counts, averages, and readability scores for the open document. The Flesche Reading Ease score was found here and entered into the data tracking spreadsheet. The "reading ease" variable is continuous data.

First- or Second-Person Language

In this study, "first-person language" and "second-person language" are separate variables that were measured and coded with density scores calculated from the count of each variable within a discussion message. The use of first- or second-person language in an initial post may also influence the responses made by peers. First-person singular language includes "I", "me," or "my", and second-person language were calculated by counting the instances of the words "you," or "your" within the discussion post. The use of personal pronouns can help place the writer as a person within the community, as well as demonstrate how the student views or relates to peers. Further, the use of personal pronouns may lead to more informal writing, which may influence the social distance felt

by peers (Tu & McIsaac, 2002). In the courses under investigation here, no directions were provided as to the use of personal pronouns, so students could choose for themselves whether to use them or to remain in the more impersonal third-person.

First-person language was calculated separately from second-person language. First-person language was calculated by counting the instances of the words “I”, “me,” or “my” within the discussion post; second-person language was calculated by counting “you” and “your”. Values for first-person and second-person language were calculated as density scores, using the density score calculation explained in Equation 1. This created a percentage that is more easily comparable between posts, as the value of the count may have been skewed by the differences in length of posts. The “first-person language” and “second-person language” variables were continuous data.

Cognitive Presence

In this study, “cognitive presence” was measured and coded according to the highest level of cognitive presence a message reached. Each initial post was reviewed and coded for cognitive presence. Cognitive presence outlines the learner’s meaning making through learning scenarios comprised of four stages. The learning scenario begins with the triggering event, or the point at which learners feel a sense of unease or discomfort regarding an idea or concept. The exploration phase follows, wherein learners seek additional or alternate information on the concept. In the integration phase, leaners integrate the information in with their previous understanding into a new concept. Finally, in the resolution stage, learners resolve the issue and overcome the problematic understanding from the first phase (Garrison et al., 1999). At this point, new

understanding or knowledge is reached. The level of cognitive presence reached in an initial post may influence peer responses.

Content analysis of the initial discussion posts was undertaken using the four categories of cognitive presence (triggering, exploration, integration, and resolution). The instrument for coding indicators of cognitive presence was developed using Garrison et al.'s (2001b) Indicators of Cognitive Presence. The coding model is divided into four categories (one for each level of cognitive presence), containing between two and six indicator labels each, and provides information about the sociocognitive processes behind each indicator label. Table 1 provides a coding model for assessing cognitive presence for this study.

Some messages may include evidence of more than one cognitive presence event, as learners move through the phases of cognitive processing. For the purpose of coding, only one phase was counted for each case. As outlined by Garrison et al. (2001b), each case was "coded up" to the highest level of cognitive presence achieved in the message if multiple levels are found to be present in a single message. This means that only one score for cognitive presence was given per post, and that score described the highest level achieved.

Table 3

Coding Model for Assessment of Cognitive Presence

Phase	**Code**
No cognitive presence detected	0
Triggering event	1
Exploration event	2
Integration	3
Resolution	4

The “cognitive presence” variable is categorical data. Table 3 shows the coding for each phrase of cognitive presence total.

Responses Generated

In this study, “responses generated” was measured and coded according to whether an initial post elicited a response. Initial posts that received no responses from peers were coded as 0. Initial posts that generated one or more responses were coded as 1. The “responses generated” variable is categorical data. Table 4 shows the coding for responses generated.

Table 4

Coding Model for Assessment of Responses Generated

Response	Code
No response generated	0
Response generated	1

Response Post Coding

All response discussion posts were coded for the following variables. A description of each variable and how it was coded is provided below:

Social Presence

In response posts, “social presence” was measured and coded with density scores calculated from the count of each social presence category, indicator, and a social presence total within a discussion message. Each response post was reviewed and coded for social presence. Social presence dictates how learners feel and act as part of the CoI and may affect their openness to learning. Indicators of social presence can be divided into three categories: actions that express interpersonal communication, actions that

express open communication, and actions that express cohesive communication. Actions that express interpersonal communication are those that promote emotional connection between members of the community. Actions that express open communication are those that may affect student relation and trust of one another, and by extension trust of one another's contributions. Actions that help promote group cohesion are those that may affect group member's commitment to meaning making and the unified acceptance of understanding (Garrison, 2011).

Content analysis of the response discussion posts was undertaken using the three categories of social presence (interpersonal communication, open communication, and cohesive communication). The instrument for coding indicators of social presence was developed using Garrison's (2011) Indicators of Social Presence, which is displayed in Table 2, and provides a coding model for assessing social presence for this study. The coding model is divided into three categories containing three indicator labels each and provides definitions for each indicator label.

Each discussion response post was reviewed and coded by the count of twelve social presence indicators, from the three social presence categories (interpersonal, open, and cohesive). A count was given for each indicator, then the counts for each indicator within a category were added together to determine the category count. Finally, all category counts were combined to determine the social presence total.

Values for each indicator, category, and the social presence total were calculated using the density score calculation (see Equation 1). The count of instances of each within each post was divided by the total number of words in the post, and multiplied by 1000 (Rourke et al., 2001). This created a percentage that is more easily comparable

between posts, as the value of the count may have been skewed by the differences in length of posts.

Table 5 shows the coding for each indicator, category, and social presence total.

Table 5

Social Presence Variables and Measurement

Social Presence Event
Interpersonal Communication: Expression of emotions
Interpersonal Communication: Use of humor
Interpersonal Communication: Self-disclosure
Open Communication: Referring explicitly to others' messages
Open Communication: Asking questions
Open Communication: Complimenting, expressing appreciation, expressing agreement
Cohesive Communication: Vocatives
Cohesive Communication: Addresses or refers to the group using inclusive pronouns
Cohesive Communication: Phatics, salutations
Interpersonal Communication total
Open Communication total
Cohesive Communication total
Social Presence total
Measurement
All indicators were coded according to the density score per message.

Each response post's coded information related to its correspondent initial post and was categorized as a characteristic of the initial post for the sake of data organization. If an initial post had more than one response post, the social presence density scores for each indicator, category, and the SP total for all responses to that initial post were averaged. The initial post data included one score the encompassed the average of all of its responses.

Cognitive Presence

As with initial posts, each response post was reviewed and coded for cognitive presence, according to the coding model developed by Garrison et al. (2001b). This

coding model is displayed in Table 6. As with initial posts, only one phase of cognitive presence was counted for each response post. The response post was "coded up" to the highest level of cognitive presence detected, if multiple levels were found within the same post.

As such, only one score for cognitive presence was given per post, and that score described the highest level achieved. Table 6 shows the coding for the highest level of cognitive presence achieved in a response message.

Table 6

Initial Coding Model for Assessment of Cognitive Presence in Responses Posts

Phase	Code
No cognitive presence detected	0
Triggering event	1
Exploration event	2
Integration	3
Resolution	4

After coding of response posts for cognitive presence was completed, a second round of coding translated the coding information into two levels: messages displaying a higher level of cognitive presence, which encompasses the integration and resolution phases, and messages displaying a lower level of cognitive presence, which encompasses triggering events and exploration events, as well as messages in which no cognitive presence can be detected. This division of cognitive presence into higher and lower levels is based on previous research that has found most discussion messages reaching the exploration phase (lower-level) and integration phase (higher-level) of cognitive presence, with the triggering phase (lower-level) and resolution phase (higher-level) being much less represented (Garrison et al., 1999; Kanuka et al. 2007; Shea et al., 2010;

Vaughan & Garrison, 2006). As such, the two lower-level phases were combined and the two higher-level phases were combined to create two categories (lower level = 0 and higher level = 1) for data analysis. Table 7 shows the coding for lower-level and higher-level cognitive presence.

Table 7

High-Low Coding Model for Assessment of Cognitive Presence in Response Posts

Phase	Code
Lower-level Cognitive Presence:	0
No cognitive presence detected	
Triggering event	
Exploration event	
Higher-level Cognitive Presence:	1
Integration	
Resolution	

Each response post's coded information related to its correspondent initial post and was categorized as a characteristic of the initial post for the sake of data organization. If an initial post had more than one response post, the cognitive presence score for all responses to that initial post were averaged. The initial post data included one score that encompasses the average of all of its responses.

Summary Table of Coding

Table 8 provides a summary of coding for all variables that were used in analyses for research questions one, two and three. The able includes initial post (time from due date, word count, reading ease, first person language, second person language, and cognitive presence), response post characteristics (social presence and cognitive

presence), how these variables were measured, and the type of data they were coded as (categorial or continuous).

Table 8

Summary Table of Coding for All Variables and Measures

Variable	Measures	Data Type
Initial post variables		
Word Count	Number of words in post	Continuous
Reading Ease	Fleshe Reading Ease Score	Continuous
Post Time-from-Due-Date	Time in minutes between post and due date/time	Continuous
First-Person Language	Density score	Continuous
Second-Person Language	Density score	Continuous
Cognitive Presence	No CP detected = 0 Triggering event = 1 Exploration event = 2 Integration = 3 Resolution = 4	Categorical
Response post variables		
Social Presence		
Interpersonal: Expression of emotions	Density score	Continuous
Interpersonal: Use of humor	Density score	Continuous
Interpersonal: Self-disclosure	Density score	Continuous
Open: Referring explicitly to others' messages	Density score	Continuous
Open: Asking questions	Density score	Continuous
Open: Complimenting, expressing appreciation, expressing agreement	Density score	Continuous
Cohesive: Vocatives	Density score	Continuous
Cohesive: Addresses or refers to the group using inclusive pronouns	Density score	Continuous
Cohesive: Phatics, salutations	Density score	Continuous
Interpersonal Communication total	Density score	Continuous
Open Communication total	Density score	Continuous
Cohesive Communication total	Density score	Continuous
Social Presence total	Density score	Continuous
Cognitive Presence Levels	Low-Level = 0 High-level = 1	Categorical

Data Analysis

Data analysis was undertaken for each of the three research questions. Routine pre-analysis data screening took place before the regression analyses began, including screening data for missing data and outliers. In order to answer research question one, a binary logistic regression analysis was undertaken in order to determine whether an initial post's word count, time from due date, reading ease score, use of first-person pronouns (i.e., "I", "my", "me"), use of second-person pronouns (i.e., "you", "your"), or cognitive presence level could predict the probability of the post stimulating interaction in terms of more responses from peers. In order to answer research question two, a multiple regression analysis was undertaken in order to determine whether those same characteristics in initial posts could predict the existence of social presence indicators in the response posts. In order to answer research question three, a binary logistic regression analysis was undertaken in order to determine whether those same characteristics in initial posts could predict a response post's level of cognitive presence (lower-level or higher-level). IBM SPSS Statistics, version 27 for Mac was used for all statistical calculations. Further discussion of data analysis procedures will take place in chapter 4.

Summary

This chapter described the methods that were used in completing this study. The three research questions were provided, followed by their null hypotheses, then a description of the research design that was employed to attempt to answer them. Participants and the sampling method that were used to gather data were then explained. The procedures to complete the data collection were then outlined, including the study setting, discussion requirements, and data collection steps. Measurement and

instrumentation were then discussed, including how content analysis was applied, and explanations for each variable to be investigated. Finally, an explanation of the data analyses that was undertaken to answer each of the three research questions was provided.

CHAPTER FOUR: DATA ANALYSIS AND RESULTS

Introduction

This exploratory, quantitative, non-experimental study examined the influence of student initial post characteristics on the generation of response posts, and on the social and cognitive presence of those response posts in asynchronous online discussions as part of fully online undergraduate course at a mid-sized research university. This chapter describes the analysis of data in terms of how the characteristics of initial posts may predict aspects of responses from peers, including whether a response is elicited, and the social and cognitive presences in the responses associated with each initial post. It begins with a discussion of the results of reliability analysis, which is followed by a preliminary examination of the data, and the necessary data screening and assumption-checking processes for each research question. The data analysis procedures for each question are outlined, then results for each research question based upon statistical tests are discussed.

Results of Reliability Analysis

An intrarater reliability analysis using the Kappa statistic was conducted to measure agreement for variables between the two coding periods. The reliability test was done with the following variables: initial post cognitive presence, response post social presence indicators (including Interpersonal: Expression of emotions, Interpersonal: Use of humor, Interpersonal: Self-disclosure, Open: Referring explicitly to others' messages, Open: Asking questions, Open: Complimenting, expressing appreciation, expressing agreement, Cohesive: Vocatives, Cohesive: Addresses or refers to the group using inclusive pronouns, Cohesive: Phatics, salutations), and response post cognitive presence. Table 9 shows the intrarater reliabilities for the coding periods regarding these variables.

Values of Kappa between .40 and .59 are considered moderate, between .60 and .79 are considered substantial, and above .80 are considered outstanding (Landis & Koch, 1977). Based on this guideline, the levels of agreement between the two coding periods regarding the variables were generally very good.

Table 9

Levels of Agreement between Coding Periods

Variable	Kappa Coefficient	*p*-value
Initial post cognitive presence	.692	<.001
Interpersonal: Expression of emotions	.783	<.001
Interpersonal: Use of humor	.588	<.001
Interpersonal: Self-disclosure	.689	<.001
Open: Referring explicitly to others' messages	.756	<.001
Open: Asking questions	.865	<.001
Open: Complimenting, expressing appreciation, expressing agreement	.742	<.001
Cohesive: Vocatives	.950	<.001
Cohesive: Addresses or refers to the group using inclusive pronouns	.854	<.001
Cohesive: Phatics, salutations	.981	<.001
Response post cognitive presence	.726	<.001

Alpha Level

The decision to accept or reject the null hypothesis is dependent on determining the probability of the outcome found by the test. The *p* value provides information on the probability of this result or more extreme happening by chance or by influence: a low *p* value tells the researcher that the result was improbable if the null hypothesis were true (Capraro & Yetkiner, 2018). For all analyses described below, an α level of .05 was used to indicate the threshold probability that was acceptable for this study. If the *p* value is less than the α level, then the null hypothesis is rejected.

Preliminary Examination of the Data

Routine pre-analysis data screening took place before the regression analyses began, including screening data for missing data and outliers. All data was reviewed for missing data, which the existence of could have skewed analyses incorrectly. Since the data was compiled from the available original data source, any variables missing data were tracked down and entered.

Preliminary Examination of Data for Research Question One

Research question one employed a data set that included only initial post information. The original data set included 1028 cases. The dependent variable for this data set was the initial post's generation of a response; this dichotomous variable was coded as 0: did not generate a response or 1: generated a response. Independent variables included an initial post's time from due date, word count, reading ease score, first person language usage, second person language usage, and cognitive presence.

After screening for missing data, this data set was screened for outliers. Extreme values on the predictor variables were examined for outliers, which were then deleted from the sample. Any cases with a Mahalanobis value exceeded the chi-square criterion ($\chi^2_{(3)} = 22.458$ at $p = .001$) were eliminated from the sample; 33 cases were removed from the data set, leaving 995 cases to be analyzed.

Assumptions for multiple regression analysis were also evaluated. The table of regression coefficients (see Table 10) indicate that multicollinearity was not violated because tolerance statistics for all six IVs were greater than .1.

Table 10

Tolerance Statistics for Independent Variables for Research Question One

Variable	Tolerance
Time from due date	.982
Word count	.904
Reading Ease	.870
First-person language	.881
Second-person language	.941
Initial post cognitive presence	.906

The independent variables were not normally distributed. However, according to Tabachnick and Fidell (2007) and Vanatta Reinhart and Mertler (2016), assumptions about the distribution of predictor variables are not required in logistic regression for successful analysis.

Preliminary Examination of Data for Research Question Two

Research question two employed a data set that included only those initial posts that generated a response. This data set included characteristics present in the initial post, as well characteristics of the responses that the initial post generated. For those initial posts that generated more than one response, the values of the characteristics of the responses were averaged so that one value for all response posts was provided for its correspondent initial post.

The original data set included 630 cases. The dependent variable for this data set was the density scores of social presence detected in response posts, which was presented as continuous data. Independent variables included an initial post's time from due date, word count, reading ease score, first person language usage, second person language usage, and cognitive presence.

After screening for missing data, this data set was screened for outliers. Extreme values on the predictor variables were examined for outliers, which were then deleted from the sample. Any cases with a .458alanobis value exceeded the chi-square criterion ($\chi^2_{(3)} = 22.458$ at $p = .001$) were eliminated from the sample; 22 cases were removed from the data set, leaving 608 cases to be analyzed.

Assumptions for multiple regression analysis were also evaluated. The regression coefficients for each variable of each multiple regression analysis indicate that multicollinearity was not violated because tolerance statistics for all six IVs were greater than .1. Linearity, homoscedasticity, and normality were also investigated, but were minorly violated. Moderate violations of these assumptions do not invalidate the regression, but may weaken the analysis (Tabachnick & Fidell, 2007). Additionally, moderate violations of normality will not negatively affect the regression (Tate, 1992 as cited in Vanatta Reinhart & Mertler, 2016).

Preliminary Examination of Data for Research Question Three

The data set for research question three set included characteristics present in the initial post, as well characteristics of the responses that the initial post generated. Research question three specifically looked at how the initial post characteristics may relate to response post cognitive presence. For those initial posts that generated more than one response, the values of the response post cognitive presences were averaged so that one value for all response posts was provided for its correspondent initial post. In order to categorize these values into either low cognitive presence or high cognitive presence, any averaged values less than 2.4 were coded as 0 (low cognitive presence), and any values over 2.5 were coded as 1 (high cognitive presence).

The original data set included 630 cases. The dependent variable for this data set was the average cognitive presence detected in response posts for its correspondent initial post; this dichotomous variable was coded as 0: lower cognitive presence or 1: higher cognitive presence. Independent variables included an initial post's time from due date, word count, reading ease score, first person language usage, second person language usage, and cognitive presence.

After screening for missing data, this data set was screened for outliers. Extreme values on the predictor variables were examined for outliers, which were then deleted from the sample. Any cases with a Mahalanobis value exceeded the chi-square criterion ($\chi^2_{(3)} = 22.458$ at $p = .001$) were eliminated from the sample; 21 cases were removed from the data set, leaving 609 cases to be analyzed.

Multicollinearity among the independent variables was also evaluated. The table of regression coefficients (see Table 11) indicate that multicollinearity was not violated because tolerance statistics for all six IVs were greater than .1.

Table 11

Tolerance Statistics for Independent Variables for Research Question Three

Variable	Tolerance
Time from due date	.994
Word count	.985
Reading Ease	.883
First-person language	.994
Second-person language	.978
Initial post cognitive presence	.994

The independent variables were not normally distributed. However, according to Tabachnick and Fidell (2007) and Vanatta Reinhart and Mertler (2016), assumptions

about the distribution of predictor variables are not required in logistic regression for successful analysis.

After the preliminary examination of data for each research question's data set, analysis of data for each question took place. The results of these analyses are provided for each research question below.

Research Question One

A binary logistic regression analysis was used to analyze the data for research question one, which was *To what extent can the probability of an initial discussion post receiving a response be predicted by that post's time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level?* This research question used the complete sample of initial discussion posts to determine, among all the variables present in initial posts, which are most influential in determining whether that initial post will generate a response.

Data Analysis for Research Question One

For the data analysis of research question one, a binary logistic regression was conducted. Logistic regression analysis can be used to develop an equation to predict the value of one dichotomous dependent variable from a combination of independent variables (Vannatta Reinhart & Mertler, 2016). Equation 2 shows the logistic regression model equation.

$$\ln\left(\frac{\hat{Y}}{1-\hat{Y}}\right) = b_0 + b_1x_1 + b_2x_2 + \ldots b_nx_n \qquad \text{(Equation 2)}$$

In Equation 2, $\hat{Y}$ is the probability of an initial post generating a response based on a nonlinear model resulting from the best linear combination of predictors (Vannatta

Reinhart & Mertler, 2016). $x_1, x_2 \ldots x_n$ are the predictor variables. b_0 is the constant, or the predicted value of the DV when all IVs are equal to zero. $b_1, b_2 \ldots b_n$ are the coefficients generated from the logistic regression, representing the value at which the DV will change when the IV changes.

In this study:

- $\hat{Y}$ = the DV, or interaction stimulation (0 = no responses to initial posting, 1 = one or more responses to initial posting)
- X_1 = IV1: Word count (exact count of words in initial posting)
- X_2 = IV2: Time from due date (exact count of minutes from due date of initial posting)
- X_3 = IV3: Reading ease score
- X_4 = IV4: First-person language (density score)
- X_5 = IV5: Second-person language (density score)
- X_6 = IV6: Cognitive presence (density score)
- b_0 = the constant

Results for Research Question One

For this analysis, the independent variables were entered into a binary logistic regression to test for significance in predicting whether an initial post would generate a response. Responses were coded into two groups: no response (0) or response (1). The independent variables time from due date, word count, reading ease score, first person language, and second person language were all coded as continuous data; the independent variable cognitive presence was coded as categorical data.

Results from the logistic regression showed that the model with one variable, an initial post's time from due date, was significant ($\chi^2_{(1)} = 33.592$, $p = <.001$), indicating that this model significantly predicts group membership. The model accounted for about 4.5% of the variation in the response variable (Nagelkerke $R^2 = .045$), indicating that this model significantly predicts group membership. The Hosmer and Lemeshow Goodness-of-Fit Statistic of 7.666 ($p = .467$) was not significant, indicating that the hypothesis that the model provides a good fit of data should be accepted. Specifically, 24 out of 388 unsuccessful cases (6.2%), 599 out of 607 successful cases (98.7%), and a total of 623 out of 995 cases (62.6%) were correctly predicted by the model.

Wald is the measure of significance of β and indicates the significance of each variable on its ability to contribute to the model. As shown in Table 12, the Wald chi-square value is significant for the time from due date variable, meaning that variable is included in the model equation. As shown in Table 12, the odds ratio for the time from due date variable is 1.00, meaning there is an increase in the odds of an initial post generating a response when the time from due date value increases by 1. β is the unstandardized regression coefficient, which indicates the effect that the independent variable entered into the model has on the dependent variable. The β weight for the time from due date variable was determined to be .000; this is a very small coefficient in the model equation, perhaps beyond the third decimal. However, even though the value is small, the variable does significantly contribute to the prediction model.

Table 12

Coefficients for Final Model Predicting Initial Post Response Generation

Variable	*β*	SE	Wald Chi-Square	DF	*p*	Odds Ratio
Time from due date	.000	.000	27.803	1	<.001*	1.000
Constant	.327	20.852	1	<.001	1.387	.327

Note. * indicates significance at $p = <.05$

Variables not entered into the equation include word count ($\chi^2_{(1)} = .201$, $p = .654$), reading ease ($\chi^2_{(1)} = 1.319$, $p = .251$), first-person language ($\chi^2_{(1)} = 1.034$, $p = .309$), second-person language ($\chi^2_{(1)} = .748$, $p = .387$), and initial post cognitive presence ($\chi^2_{(1)} = 1.328$, $p = .249$).

A one-way MANOVA analysis was conducted where the type of initial post (those that generated a response and those that did not) was the independent variable, and the dependent variables were the six initial post variables (time from due date, word count, reading ease score, first person language, second person language, and cognitive presence). The purpose of this one-way MANOVA was to further explore whether there are significant mean differences in the initial post variables (as measured by the combination of the six variables) between initial posts that generated responses and those did not generate a response, and for each of the six variables, whether there are significant mean differences between the two types of the initial posts (those that generated a response and those that did not). Because the only significant variable (time from the due date) in the logistic regression received a very small weight ($\beta = .000$, that is, smaller than .001), further analysis was undertaken to determine whether the means of

the time from due date variable for the two types of initial posts significantly differed from each other.

The Box's Test of Equality of Covariance Matrices for this analysis was not significant ($F = 1.199$, $p = .239$), meaning that equal variance could be assumed. MANOVA results indicate that the means of the combined initial post variables (Wilks Lambda = .963, $F_{(1, 984)} = 6.348$, $p = <.001$, $\eta^2 = .037$) are significantly different between the two types of initial posts (with and without responses generated). Analysis of variance (ANOVA) was conducted on the six initial post variables as a follow-up test to MANOVA. Time from due date was significant ($F_{(1, 982)} = 32.340$, $p = <.001$, partial $\eta 2 = .032$). Word count ($F_{(1, 982)} = .036$, $p = .850$, partial $\eta 2 = .000$), reading ease ($F_{(1, 982)} = 21.563$, $p = .212$, partial $\eta 2 = .002$), first-person language ($F_{(1, 982)} = .364$, $p = .547$, partial $\eta 2 = .000$), second-person language ($F_{(1, 982)} = .507$, $p = .477$, partial $\eta 2 = .001$), and cognitive presence ($F_{(1, 982)} = 1.093$, $p = .296$, partial $\eta^2 = .001$) were not significant. The results were consistent with that from the logistic regression. Table 13 presents means and standard deviations for time from due date by responses generated or not. The mean of time from due date for the initial posts that generated responses ($M = 752.73$) is higher than that did not generate response ($M = 234.19$).

Table 13

Means and Standard Deviations for Time from Due Date by Responses Generated or Not

	Time from due date	
Response coded	**Mean**	**SD**
No responses generated	234.1933	1503.6243
Responses generated	752.7331	1334.5057

Results for Research Question Two

A multiple linear regression analysis was used to analyze the data for research question two, which was *Which of the six initial discussion post predictor variables (i.e., time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level) are most influential in predicting social presence in response posts?* For this research question, equations predict the value of social presence scores in response posts.

Data Analysis for Research Question Two

For the data analysis of research question two, multiple linear regression was conducted. Multiple regression analysis can be used when a quantitative variable needs to be studied in relation to any other factor (Cohen, 2002). Multiple linear regression analysis can be used to develop an equation to predict the value of a dependent variable from a combination of independent variables (Vannatta Reinhart & Mertler, 2016). With multiple linear regression, it is possible to find the overall fit of the model, and also the relative contribution of each independent variable.

Equation 3 shows the multiple linear regression equation.

$$\hat{Y} = b_0 + b_1x_1 + b_2x_2 + \dots b_nx_n \quad \text{(Equation 3)}$$

In Equation 3, $\hat{Y}$ is the criterion variable to be predicted. $x_1, x_2 \dots x_n$ are the predictor variables. b_0 is the predicted value of the DV when all IVs are equal to zero. $b_1 \dots b_n$ are the coefficients generated from the logistic regression, representing the value at which the DV will change when the IV changes.

In this study,

- $\hat{Y}$ = the DV, or the specific social presence indicators or categories, or the social presence total
- X_1 = IV1: Word count (exact count of words in initial posting)
- X_2 = IV2: Time from due date (exact count of minutes from due date of initial posting)
- X_3 = IV3: Reading ease score
- X_4 = IV4: First-person language (density score)
- X_5 = IV5: Second-person language (density score)
- X_6 = IV6: Cognitive presence (dummy variable)
- b_0 = the constant

The multiple regression analysis was undertaken for each of the social presence categories, as well as for social presence overall.

- $\hat{Y}_1$ = Social presence communication total
- $\hat{Y}_2$ = Interpersonal communication total
- $\hat{Y}_3$ = Open communication total
- $\hat{Y}_4$ = Cohesive communication total

Further multiple regression analyses were undertaken for each social presence category's individual indicators. This means that

- for the Interpersonal communication category, multiple regression analyses were undertaken for $\hat{Y}_{2a}$ (Interpersonal: Expression of emotions), $\hat{Y}_{2b}$ (Interpersonal: Use of humor), and $\hat{Y}_{2c}$ (Interpersonal: Self-disclosure).

- for the Open communication category, multiple regression analyses were undertaken for $\hat{Y}_{3a}$ (Open: Referring explicitly to others' messages), $\hat{Y}_{3b}$ (Open: Asking questions), and $\hat{Y}_{3c}$ (Open: Complimenting, expressing appreciation, expressing agreement)
- for the Cohesive communication category, multiple regression analyses were undertaken for $\hat{Y}_{4a}$ (Cohesive: Vocatives), $\hat{Y}_{4b}$ (Cohesive: Addresses or refers to the group using inclusive pronouns), and $\hat{Y}_{4c}$ (Cohesive: Phatics, salutations).

Multiple regression analyses of the social presence category indicators found significant models of prediction for the following indicators:

- $\hat{Y}_{2a}$ = Interpersonal: Expression of emotions
- $\hat{Y}_{2c}$ = Interpersonal: Self-disclosure
- $\hat{Y}_{3a}$ = Open: Referring explicitly to others' messages
- $\hat{Y}_{4c}$ = Cohesive: Phatics, salutations

Table 14 provides a summary of variables used in the multiple regression analyses for research question two.

Table 14

Summary of Variables Used Multiple Regression Analyses for Research Question Two

Variable	Reg. 1	Reg. 2	Reg. 3	Reg. 4	Reg. 5	Reg. 6	Reg. 7	Reg. 8
Word Count	X_1	X_1	X_1	X_1	X_1	X_1	X_1	X_1
Reading Ease	X_2	X_2	X_2	X_2	X_2	X_2	X_2	X_2
Post Time-from-Due-Date	X_3	X_3	X_3	X_3	X_3	X_3	X_3	X_3
First-Person Language	X_4	X_4	X_4	X_4	X_4	X_4	X_4	X_4
Second-Person Language	X_5	X_5	X_5	X_5	X_5	X_5	X_5	X_5
IP: Cognitive Presence	X_6	X_6	X_6	X_6	X_6	X_6	X_6	X_6
Social presence total	Y_1							
Interpersonal total		Y_2						
Interpersonal: Expression of emotions			Y_{2a}					
Interpersonal: Self-disclosure				Y_{2c}				
Open total					Y_3			
Open: Referring explicitly to others' messages						Y_{3a}		
Cohesive total							Y_4	
Cohesive: Phatics, salutations								Y_{4c}

Results for Research Question Two

For this analysis, the dependent variable is the social presence density detected in response posts and the independent variables are the initial post characteristics of time from due date, word count, reading ease score, first-person language density score, second-person language density score, and initial post cognitive presence score.

The multiple regression analysis was undertaken for each of the social presence categories, as well as for social presence overall. The results of these analyses are provided below.

Social Presence Total Regression Results

Multiple regression was conducted to determine how well each independent variable (time from due date, word count, reading ease score, first person language, second person language, and initial post cognitive presence) predicts the social presence detected in response posts.

Table 15

Coefficients for Final Model Predicting Social Presence

Variable	*β*	***t***	***p***	**Partial *r***
Post time from due date	6.090	.094	.925	.004
Word count	-.016	-1.391	.165	-.057
Reading ease	-.048	-.661	.509	-.027
First-person language	.021	.304	.761	.012
Second-person language	.183	1.277	.202	.052
Initial post cognitive presence	-.179	-.102	.919	-.004
Constant	47.845	8.003	<.001	

Regression results indicate that the no independent variables contribute significantly predict social presence total ($R^2 = .007$, $F_{(1,607)} = .662$, $p = .680$). A summary of regression coefficients is presented in Table 15 indicates that none of the six independent variables significantly contributed to the model.

Interpersonal Communication Regression Results

Multiple regression was conducted to determine the accuracy of the independent variables (time from due date, word count, reading ease score, first person language,

second person language, and initial post cognitive presence) predicting the Interpersonal Communication detected in response posts. Regression results show that the overall model significantly predicts Interpersonal Communication (R^2 = .016, $F_{(1,607)}$ = 9.944, p = .002), indicating 1.6% of variance in Interpersonal Communication in response posts is associated with the linear model.

Table 16

Coefficients for Final Model Predicting Interpersonal Communication

Variable	***β***	***t***	***p***	**Partial *r***
Post time from due date	.065	1.617	.106	.066
Word count	-.011	-.272	.785	-.011
Reading ease	-.005	-.117	.907	-.005
First-person language	.073	3.153	.002*	.127
Second-person language	.007	.180	.857	.007
Initial post cognitive presence	.026	.639	.523	.026
Constant	3.455	6.919	.<.001	

Note. * indicates significance at p = <.05

A summary of regression coefficients is presented in Table 16 indicates that one (first-person language) of the six variables significantly contributed to the model. First-person language in initial posts significantly contributes to the interpersonal communication score in response posts (β = .073, t = 3.153, p = .002). Interpersonal Communication density score in responses increased .073 units for each unit of increase in first-person language density in initial posts. Partial r (.111) is the partial correlation between first-person language and Interpersonal Communication, while controlling for the influence of the other independent variables. The 95% confidence interval for $\boldsymbol{\beta}$ is between .028 and .119.

As the regression model significantly predicted the Interpersonal Communication category overall, further multiple regression analyses were undertaken for each of its

indicators to determine if a model could significantly predict the individual indicator presence from the initial post characteristics. Of these, regression models were found that significantly predicted the scores for the indicators Interpersonal Communication: Express emotion and Interpersonal Communication: Self-disclosure in response posts.

Regression results indicate that the overall model significantly predicts Interpersonal Communication: Express emotion (R^2 = .009, $F_{(1,607)}$ = 5.557, p = .019) , indicating .9% of variance in Interpersonal Communication: Express Emotion in response posts is associated with the linear model. A summary of regression coefficients presented in Table 17 indicates that one (time from due date) of the six variables significantly contributed to the model.

Table 17

Coefficients for Final Model Predicting Interpersonal Communication: Express Emotion

Variable	*β*	***t***	***p***	**Partial *r***
Post time from due date	.000	2.357	.019*	.095
Word count	-.031	-.762	.447	031
Reading ease	.043	1.063	.288	.043
First-person language	.040	.974	.330	.040
Second-person language	.001	.019	.985	.001
Initial post cognitive presence	.010	.243	.808	.101
Constant	1.472	6.993	<.001	

Note. * indicates significance at p = <.05

Time from due date in initial posts significantly contributes to the Interpersonal Communication: Express emotion score in response posts (β = .000, t = 2.357, p = .019). With a β weight determined to be .000, the model is still significant, but uses a very small coefficient in the model equation. Based on the data available, it is not clear what a one unit increase in the initial post's time from due date will result in in terms of increase in Interpersonal Communication: Express emotion density score in responses, but it will be

smaller than .1. Partial *r* (.094) is the partial correlation between time from due date and Interpersonal Communication: Express emotion, while controlling for the influence of the other independent variables. The 95% confidence interval for ***β*** is between .0001 and .001.

Regression results indicate that the overall model significantly predicts Interpersonal Communication: Self-disclosure (R^2 = .015, $F_{(1,607)}$ = 9.403, p = .002) indicating 1.5% of variance in Interpersonal Communication: Self-disclosure in response posts is associated with the linear model. A summary of regression coefficients is presented in Table 18 indicates that one (first-person language) of the six variables significantly contributed to the model. First-person language in initial posts significantly contributes to the Interpersonal Communication: Self-disclosure score in response posts (β = .050, t = 3.066, p = .002). Interpersonal Communication: Self-disclosure density score increased .050 units for each unit of increase in first-person language density. Partial *r* (.124) is the partial correlation between first-person language and Interpersonal Communication: Self-disclosure, while controlling for the influence of the other independent variables. The 95% confidence interval for ***β*** is between .018 and .081.

Table 18

Coefficients for Final Model Predicting Interpersonal Communication: Self-disclosure

Variable	*β*	***t***	***p***	**Partial *r***
Post time from due date	.034	.840	.401	.034
Word count	.015	.373	.709	.015
Reading ease	-.049	-1.164	.245	-.047
First-person language	.050	3.066	.002*	.124
Second-person language	.016	.389	.697	.016
Initial post cognitive presence	.034	.841	.401	.034
Constant	1.860	5.360	<.001	

Note. * indicates significance at p = <.05

Open Communication Regression Results

Multiple regression was conducted to determine the accuracy of the independent variables (time from due date, word count, reading ease score, first person language, second person language, and initial post cognitive presence) predicting the Open Communication detected in response posts. Regression results indicate that the no independent variables contribute significantly predict open communication total (R^2 = .004, $F_{(1,607)}$ = .419, p = .867). A summary of regression coefficients is presented in Table 19 indicates that none of the six independent variables significantly contributed to the model.

Table 19

Coefficients for Final Model Predicting Open Communication

Variable	*β*	*t*	*p*	Partial *r*
Post time from due date	2.809	.063	.950	.003
Word count	-.002	-.199	.842	-.008
Reading ease	-.015	-.288	.773	-.012
First-person language	-.048	-1.015	.310	-.041
Second-person language	.123	1.233	.218	.050
Initial post cognitive presence	-.161	-.132	.895	-.005
Constant	20.798	4.996	<.001	

Further multiple regression analyses were undertaken for each of the Open Communication category's indicators to determine if a model could significantly predict the individual indicator presence from the initial post characteristics. Of these, a regression model was found that significantly predicted the presence of the indicator Open Communication: Referring explicitly to others' messages. Regression results indicate that the overall model significantly predicts Open Communication: Referring explicitly to others' messages (R^2 = .009, $F_{(1,607)}$ = 5.238, p = .022) indicating .9% of

variance in Open Communication: Referring explicitly to others' messages in response posts is associated with the linear model. A summary of regression coefficients is presented in Table 20 indicates that one (reading ease) of the six variables significantly contributed to the model. Reading ease in initial posts significantly contributes to the Open Communication: Referring explicitly to others' messages score in response posts (β = -.041, t = -2.2892, p = .022). Open Communication: Referring explicitly to others' messages density score decreased .041 units for each unit of increase in reading ease score. Partial r (-.092) is the partial correlation between reading ease and Open Communication: Referring explicitly to others' messages, while controlling for the influence of the other independent variables. The 95% confidence interval for $\boldsymbol{\beta}$ is between -.077 and -.006.

Table 20

Coefficients for Final Model predicting Open Communication: Referring Explicitly to Others' Messages

Variable	β	***t***	***p***	**Partial *r***
Post time from due date	.004	.087	.931	.004
Word count	.023	.581	.561	.024
Reading ease	-.041	-2.289	.022*	-.092
First-person language	-.041	-.971	.332	-.039
Second-person language	-.001	-.017	.986	.001
Initial post cognitive presence	.041	1.102	.312	.041
Constant	6.380	6.512	<.001	

Note. * indicates significance at p = <.05

Cohesive Communication Regression Results

Multiple regression was conducted to determine the accuracy of the independent variables (time from due date, word count, reading ease score, first person language, second person language, and initial post cognitive presence) predicting the Cohesive

Communication detected in response posts. Regression results indicate that the overall model significantly predicts social presence (R^2 = .012, $F_{(1,607)}$ = 7.213, p = .007), indicating 1.2% of variance in Cohesive Communication in response posts is associated with the linear model. A summary of regression coefficients is presented in Table 21 indicates that one (word count) of the six variables significantly contributed to the model. Word count in initial posts significantly contributes to the Cohesive Communication score in response posts (β = -.013, t = -2.686, p = .007). Cohesive Communication density score decreased .013 units for each unit of increase in word count. Partial r (-.108) is the partial correlation between word count and Cohesive Communication, while controlling for the influence of the other independent variables. The 95% confidence interval for $\boldsymbol{\beta}$ is between -.022 and -.003.

Table 21

Coefficients for Final Model Predicting Cohesive Communication

Variable	β	***t***	***p***	**Partial *r***
Post time from due date	-.051	-1.242	.215	-.050
Word count	-.013	-2.686	.007*	-.108
Reading ease	-.037	-.909	.363	-.037
First-person language	-.013	-.329	.742	-.013
Second-person language	.024	.588	.557	.024
Initial post cognitive presence	-.020	-.478	.633	-.019
Constant	21.620	20.017	<.001	

Note. * indicates significance at p = <.05

As the regression model significantly predicted the Cohesive Communication category overall, further multiple regression analyses were undertaken for each of its indicators to determine if a model could significantly predict the individual indicator presences from the initial post characteristics. Of these, a regression model was found that significantly predicted the presence of the indicator Cohesive Communication:

Phatics, salutations. Regression results indicate that the overall model significantly predicts Cohesive Communication: Phatics, salutations (R^2 = .018, $F_{(1,607)}$ = 11.048, p = <.001), indicating 1.8% of variance in Cohesive Communication: Phatics, salutations in response posts is associated with the linear model. A summary of regression coefficients is presented in Table 22 indicates that one (word count) of the six variables significantly contributed to the model. Word count in initial posts significantly contributes to the Cohesive Communication: Phatics, salutations score in response posts (β = -.009, t = 3.324, p < .001). Cohesive Communication: Phatics, salutations density score decreased .009 units for each unit of increase in word count. Partial r (-.134) is the partial correlation between word count and Cohesive Communication: Phatics, salutations, while controlling for the influence of the other independent variables. The 95% confidence interval for $\boldsymbol{\beta}$ is between -.014 and -.003.

Table 22

Coefficients for Final Model Predicting Cohesive Communication: Phatics, Salutations

Variable	β	***t***	***p***	**Partial *r***
Post time from due date	-.037	-.924	.356	-.037
Word count	-.009	-3.324	<.001*	-.134
Reading ease	-.044	-1.093	.275	-.044
First-person language	-.023	-.580	.562	-.024
Second-person language	-.010	-.253	.800	-.010
Initial post cognitive presence	-.004	-.099	.921	-.004
Constant	11.201	19.172	<.001	

Note. * indicates significance at p = <.05

Results for Research Question Three

A binary logistic regression analysis was used to analyze the data for research question three, which was *To what extent can the probability of an initial discussion post generating higher levels of cognitive presence in peer responses be predicted by that*

post's posting time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level? For this research question, the equation predicts the probability of an initial discussion post's generation of a peer response post's display of low-level or high-level cognitive presence.

Data Analysis for Research Question Three

For the data analysis of research question three, a binary logistic regression was conducted. Logistic regression analysis can be used to develop an equation to predict the value of one dichotomous dependent variable from a combination of independent variables (Vannatta Reinhart & Mertler, 2016). The logistic regression model equation is the same as in Equation 2.

$$\ln\left(\frac{\hat{Y}}{1-\hat{Y}}\right) = b_0 + b_1x_1 + b_2x_2 + \ldots b_nx_n \qquad \text{(Equation 2)}$$

In Equation 4, $\hat{Y}$ is the probability of an initial post generating a response based on a nonlinear model resulting from the best linear combination of predictors (Vannatta Reinhart & Mertler, 2016). $x_1, x_2 \ldots x_n$ are the predictor variables, $x_1, x_2 \ldots x_n$ are the predictor variables. b_0 is the constant, or the predicted value of the DV when all of the IVs are equal to zero. $b_1, b_2 \ldots b_n$ are the coefficients generated from the regression, representing the value at which the DV will change when the IV changes.

In this study:

- $\hat{Y}$ = the DV, or the level of cognitive presence of the response post (0 = lower-level, 1 = higher level)
- X_1 = IV1: Word count (exact count of words in initial posting)

- X_2 = IV2: Time from due date (exact count of minutes from due date of initial posting)
- X_3 = IV3: Reading ease score
- X_4 = IV4: First-person language (density score)
- X_5 = IV5: Second-person language (density score)
- X_6 = IV6: Cognitive presence in initial post (density score)
- b_0 = the constant

The interpretation of the binary logistic regression analysis for this research question followed that which was outlined for the binary logistic regression analysis for research question one, above.

Results for Research Question Three

Binary logistic regression was conducted to determine which independent variables are predictors of the level of cognitive presence demonstrated in response posts. For this analysis, the dependent variable is the response post cognitive presence level (0 = low-level; 1 = high-level) and the independent variables are the initial post characteristics of word count, time from due date, reading ease score, first-person language density score, second-person language density score, and initial post cognitive presence score.

Results from the logistic regression showed that the model with two variables, an initial post's first-person language and cognitive presence, were found to be significant ($\chi^2_{(1)} = 11.449$, $p = .003$), indicating that this model significantly predicts group membership. The model accounted for about 2.5% of the variation in the response variable (Nagelkerke $R^2 = .025$). The Hosmer and Lemeshow Goodness-of-Fit Statistic of 5.059 ($p = .751$) was not significant, indicating that the hypothesis that the model

provides a good fit of data should be accepted. Specifically, 229 out of 325 initial posts reaching lower levels of cognitive presence (70.5%), 102 out of 283 initial posts reaching higher levels of cognitive presence (36%), and a total of 331 out of 608 cases (54.4%) were correctly predicted by the model.

Wald is the measure of significance of β and indicates the significance of each variable on its ability to contribute to the model. As shown in Table 23, the Wald chi-square values are significant for the first-person language and initial post cognitive presence variables, meaning these variables are included in the model equation. However, the odds ratio for first-person language (.986) indicated little change in the likelihood of achieving higher cognitive presence, while the odds ratio for initial post cognitive presence (1.440) indicated a greater change in the likelihood of achieving higher cognitive presence. β is the unstandardized regression coefficient, which indicates the effect that the independent variable entered into the model has on the dependent variable. The β weight for the first-person language variable was determined to be -.014, a very small coefficient in the model equation. The β weight for the initial post cognitive presence variable was determined to be .364.

Table 23

Coefficients for Final Model Predicting Higher Response Post Cognitive Presence

Variable	β	***Wald***	***Df***	***p***	**Odds Ratio**	**95% CI of β**	
						Lower	**Upper**
First-person language	-.014	5.359	1	.021	.986	.974	.998
Initial post cognitive presence	.364	5.101	1	.024	1.440	1.049	1.975
Constant	-.781	3.476	1	.062	.458		

Variables not entered into the equation include time from due date ($\chi^2_{(1)} = 1.020$, $p = .313$), word count ($\chi^2_{(1)} = 2.589$, $p = .108$), reading ease ($\chi^2_{(1)} = 1.013$, $p = .314$), and second-person language ($\chi^2_{(1)} = .101$, $p = .750$).

Summary of Results

Three research questions were investigated to determine how initial discussion post characteristics could predict engagement in the response posts made by peers. Each question had at least one significant result. For research question one, which focused on whether initial post characteristics could predict whether the initial post would generate a response, the variable time from due date significantly contributed to the prediction model. For research question two, which focused on whether initial post characteristics could predict density scores of social presence, the variable first-person language significantly contributed to the prediction models for Interpersonal Communication total, and Interpersonal Communication: Self-disclosure; the variable time from due date significantly contributed to the prediction model for Interpersonal Communication: Express emotion; the variable reading ease significantly contributed to the prediction model for Open Communication: Referring explicitly to others' messages; the variable word count significantly contributed to the prediction models for Cohesive Communication Total and Cohesive Communication: Phatics, salutations. For research question three, which focused on whether initial post characteristics could predict whether the the response post would demonstrate higher or lower cognitive presence, the variables first-person language and initial post cognitive presence significantly contributed to the prediction model. These findings are presented in Table 24 and Figure 4.

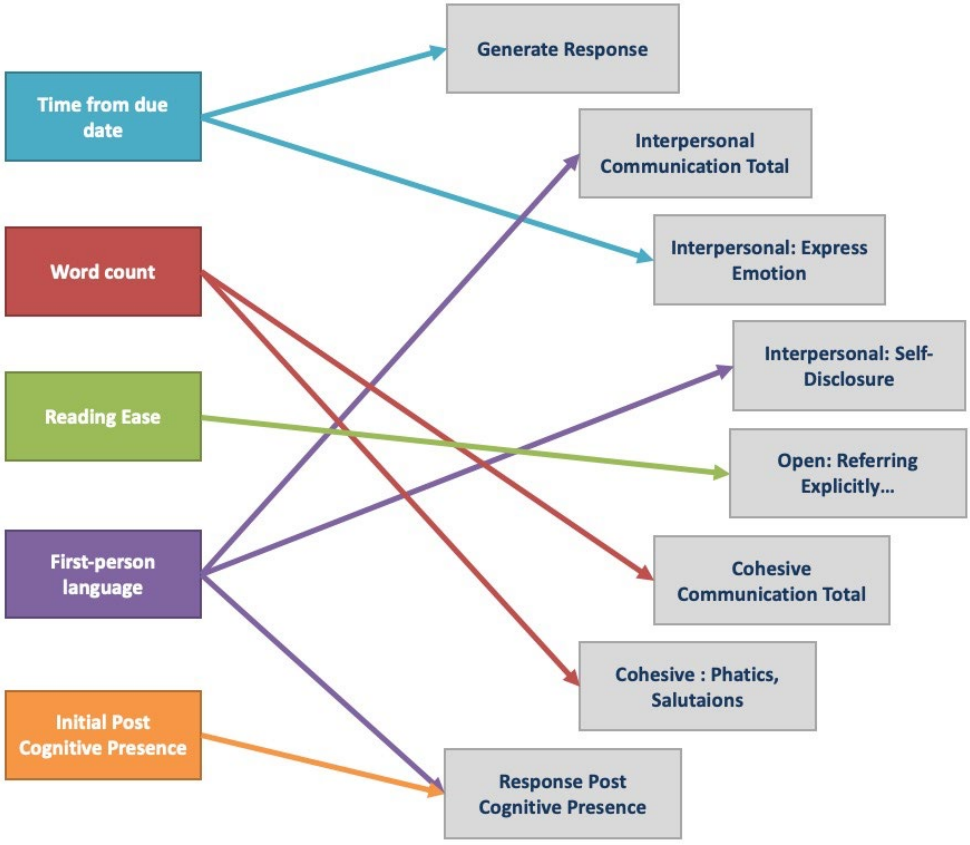
Table 24

Summary Table of Results for Each Research Question

Dependent variable (DV)	**Variables that significantly contributed to prediction model ($p < .05$)**
Research Question One	
Response generated (0 = no, 1 = yes)	Time from due date
Research Question Two	
Social Presence total	None
Interpersonal Communication total	First-person language
Interpersonal Communication: Express Emotion	Time from due date
Interpersonal Communication: Self-Disclosure	First-person language
Open Communication total	None
Open Communication: Referring explicitly to others' messages	Reading ease
Cohesive Communication Total	Word count
Cohesive Communication: Phatics, salutations	Word count
Research Question Three	
Higher cognitive presence	First-person language Cognitive presence

Figure 4

Summary of Significant Results



Summary

This chapter provided the results of data analyses of research questions investigating how the characteristics of initial posts may predict aspects of responses from peers, including whether a response is elicited, and the social and cognitive presences in the responses associated with each initial post. Results of the reliability analysis found that data coding was reliable. The results of preliminary examination of the data for each question were provided, followed by detailed results for each question. A discussion of the meaning of these results will take place in chapter 5.

CHAPTER FIVE: DISCUSSION AND CONCLUSION

Introduction

This chapter begins with a summary of the current study, and then provides further discussion of the findings from each of the three research questions as they relate to previous research in the field. Finally, the conclusions of these results are discussed, followed by limitations of this study and recommendations for practice and future research in this area.

With the growth of online learning in recent years, the area of student interaction and engagement has become an essential concern of course design. Students in online courses face more challenges to feel connected with the course, their instructor, and their peers, which may lead to issues of retention or student success in the course (Martin, 2019; Rovai, 2002). Incorporating activities that encourage student-to-student interaction, such as online discussions, can help students to feel engaged with a learning community as they build knowledge. However, not all discussions will lead to meaningful interaction among students. Determining what happens in student discussions that fosters engagement can help instructors and designers better approach discussion design to promote these features.

The purpose of this research was to study the possible relationship between student initial discussion post features and the response posts of their peers, specifically in terms of the generation of response posts, and on the social and cognitive presence of those response posts in asynchronous online discussions. In order to investigate the influence of student posts on the posts of their peers, data were collected from discussions from two semesters of a fully online course. Initial posts were examined and

coded in terms of six features: the time the post was made from the discussion due date, the word count, the reading ease score, the use of first-person pronouns, the use of second-person pronouns, and the cognitive presence level reached in the initial post. These characteristics were investigated to determine whether they could predict the likelihood of an initial post generating a response, and the levels of social or cognitive presence that could be detected in those responses.

Behavioral Engagement: Discussion of Findings from Research Question One

Research question one investigated the influence of student initial post features on the behavioral engagement of their peers, which was demonstrated by the initial post receiving a response. Research question one was *To what extent can the probability of an initial discussion post receiving a response be predicted by that post's time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level?* The data analysis procedure used to answer this question was binary logistic regression, in which the six initial post characteristics served as independent variables that were investigated to determine whether they contributed to a model that could predict whether or not an initial post would generate a response. No combination of the six independent variables could significantly predict an initial post's generation of a response. The initial post's time from due date was found to be a significant predictor in the generation of a response, but with a β value of .000, the weight of that influence is quite small. A one-way MANOVA analysis was conducted to further explore whether there are significant differences in the initial post variables (as measured by the combination of the six variables) between initial posts that generated responses and those did not generate any response.

The only variable that was found to significantly predict an initial post's generating a response was that initial post's time from due date. This means that an initial post that is made further before the initial post due date has a slightly higher likelihood of receiving a response than an initial post that is made later in the discussion period. This may be due to the fact that by being posted earlier in the week, an initial post has more opportunities to be viewed and responded to by peers (Pena-Schaff & Nicholls, 2004; Zingaro & Oztok, 2012). As students log in to the discussion board to complete their initial posts, they may also review the posts already made by peers and choose to post their responses in the same sitting. This finding does go against the suggestion made by Hewitt (2003) that students tended to reply to newer messages rather than older ones, but this may be due to additional variables, such as how large of a window between the discussion's opening and the initial post's due date, or when the majority of students access the discussion board to review the initial posts of their peers.

The other five initial post variables were not found to significantly contribute to a model predicting the generation of a response. This could be due to various reasons for each variable. An initial post's word count could influence peer responses in a number of ways. Research into the influence of this variable is mixed: some studies suggest that longer messages are more likely to attract response (Joyce & Kraut, 2006; Zingaro & Oztok, 2012), while others found shorter messages were more likely to attract response (Hewitt et al., 2007; Ho & Swan, 2007). Ho and Swan (2007) argue that long posts may contain too many ideas for a simple response, but it may also be true that shorter posts may not contain enough ideas to entice a peer to reply at all. Viewing word count as a defining characteristic of an initial post may lose some of the more nuanced details of a

post: instead of just looking at a block of words to determine if it looks too long or short, students may in fact be focusing more on the content of the post itself in determining what to reply to. In this study, especially, discussion prompts required students to choose from a number of different questions, which may have led to longer or shorter posts in order to cover exactly what the prompt demanded. Requiring all students to post to the same question may have provided more clear data on this variable.

Reading ease was another variable that did not significantly predict whether an initial post would generate a reply. Again, the literature in this area was mixed, with some studies (Hewitt & Peters, 2007) suggesting higher reading ease scores might attract more response, while others suggest that that any influence on the generation of responses was marginal at best (Zingaro & Oztok, 2012). This may be due to differing student preference in choosing what to reply to: some students may gravitate toward posts that are easier to read as they can parse out ideas to focus on in their own replies, while other students may be attracted to more complex writing as they believe it aligns more with academic discourse and thus, may be the "right" answer.

The use of first-person and second-person language was also found to have no significant influence on the generation of a reply. Little research has previously been done in this area to compare these results to. Tu and McIsaac (2002) suggest that formality of writing, which may be achieved by avoiding the use of personal pronouns, might contribute to a feeling of distance between students and may not encourage student replies. Carroll (2007) notes that students may use personal pronouns less as they move away from using their personal experiences in their reasoning, and move toward more academic writing. This could cause different reactions in different students as they seek a

post to respond to: some students may be drawn to posts that promote more personal disclosure or interpersonal exchanges, while others may instead lean toward the posts of peers that they believe are more academically advanced.

Finally, the level of cognitive presence of an initial post was not found to have a significant influence on an initial post's receiving a reply. In this area, too, not much previous research exists upon which a comparison of these results may be made. Students are required to post replies to peers, regardless of how highly developed the ideas presented in that post are, so the level of cognitive presence detected in an initial post may have no bearing in the decision to reply. Additionally, differences in peer preference may play a role: posts with lower cognitive presence, such as those in the exploration phase, may entice peer responses as students try to complete the thought initiated in the initial post. Posts with higher presence may make it easier for peers to match the presence level by providing additional examples or asking additional questions.

Emotional Engagement: Discussion of Findings from Research Question Two

Research question two investigated the influence of student initial post features on the emotional engagement of their peers, which was demonstrated by the social presence detected in the responses to that initial post. Research question two was *Which of the six initial discussion post predictor variables (i.e., time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level) are most influential in predicting social presence in response posts?* The data analysis procedure used to answer this question was multiple linear regression, in which the six initial post characteristics served as independent variables that were investigated to determine whether they contributed to a model that could predict the

amount of social presence detected in responses. Analyses were run to develop prediction models that could predict the total social presence displayed in a response, as well as the totals for each of the social presence categories of interpersonal communication, open communication, and cohesive communication. Further analyses were run for each of the indicators of these three categories to determine how initial post features might contribute to prediction models to each individual social presence indicator.

Social Presence Total

The first multiple regression analysis sought to find an equation that could predict the overall social presence density of response posts based on initial post characteristics. Garrison (2009) defines social presence as "the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (p. 352).This concept includes the categories interpersonal communication, open communication, and cohesive communication that served as the dependent variables in further multiple regression analyses conducted for this research question.

No combination of the six independent variables could significantly predict the amount of social presence demonstrated in the correspondent response posts. Social presence as a whole dictates how learners feel as part of the CoI and may influence their openness to learning, and demonstrates ways participants project themselves socially and emotionally in an online course. As the three categories of social presence and their individual indicators vary widely in the specific manner of demonstrating presence, it is possible that the overarching concept of social presence as a whole was too large to be influenced significantly by specific actions taken in initial posts. Little research exists

that investigates how certain aspects of discussion posts made by one student may influence the social presence demonstrated by peers, so comparisons with the present results are difficult. It may be surprising that none of the independent variables were found to significantly predict social presence as a whole, but specific characteristics of initial posts were found to significantly predict the more defined categories and specific indicators that make up the social presence total. This may mean that the overall concept of social presence is too broad to be directly related to specific traits in initial discussion posts.

Interpersonal Communication

Of the six independent variables analyzed, only one initial post characteristic significantly contributed to the model predicting the amount of interpersonal communication present in a response post. That characteristic was the first-person language used in the initial post. Interpersonal communication includes actions that may help initiate a community by promoting emotional connection between participants and may indicate students attempting to build trust within the community. This includes expressing emotion, sharing details of students' life outside of class, and using humor to relate to peers. Peers may respond to the use of first-person pronouns in initial posts as an invitation to share more of themselves, in terms of emotion, self-disclosure, and humor. The use of personal pronouns can denote the quality of relationships built between people, as they are used to refer to people within and outside of the interaction (Tausczik & Pennebaker, 2010). By using first-person language in initial posts, students may be sharing more of themselves with their peers; peers may respond to this sharing by reciprocating the same in their responses.

Deeper investigation into each of the three indicators of interpersonal communication found that first-person language also contributed significantly to a model predicting the indicator Interpersonal: Self-disclosure. Initial posts may include personal histories, examples, or opinions that peers will respond to in kind in their response posts; this would obviously necessitate the use of first-person language in the discussion of these personal messages. Additionally, Mayer et al. (2004) note that "using the self as a reference point increases the learner's interest," which may draw peers in to want to share their own experiences. Finally, the idea that a student is opening themselves up in an initial post by presenting themselves using first-person language may encourage their peers to reciprocate by disclosing their own experiences as a way to relate or build relationships.

The other five initial post variables were not found to significantly contribute to a model predicting interpersonal communication in response posts. This could be due to various reasons for each variable. An initial post's time from due date is temporal and does not focus on the content of the message. Interpersonal communication may stem more from how students present themselves in that initial message, rather than *when* they do the presenting. The word count of an initial post, too, may not be clearly related to how students are presenting themselves in their initial posts, and as such may not influence how peers respond. Further, a post's length could have varying effects: shorter posts may not give peers much to grab on to as they respond, with fewer opportunities to relate to one another on an interpersonal level. Longer posts may provide too much information, making it harder for the peer to find a way to relate interpersonally. It is surprising that reading ease of an initial post had no influence on the interpersonal

communication in a response; Zingaro and Oztok (2012) suggest that a post that is easier to read might promote connection more easily as meaning is made clear and students can effortlessly understand one another. However, it's possible that different students respond to different levels of reading ease in different ways: some students may be attracted to the simpler message that they can more easily relate to, while others may find a more complex message more provoking. In terms of second-person language, this could be seen as distancing on the part of the initial poster: rather than relating ideas or experiences to the self, the student may use "you" as a stand-in. This may lead peers to feel less connected to the initial post, and lead to less interpersonal communication in their responses. Finally, in terms of the variable initial post cognitive presence, it's possible that the level of cognitive presence focuses more on the content of the post in terms of understanding and solving an issue and does not relate to the ways in which students speak to one another.

Open Communication

No combination of the six independent variables could significantly predict the amount of open communication demonstrated in the correspondent response posts. Open communication demonstrates ways that students contribute to discourse between members of the community, in terms of interaction and communication, and may include asking questions of one another, asking for input, and negotiating meaning of the writing of their peers.

Deeper investigation into each of the three indicators of open communication found that reading ease contributed significantly to a model predicting Open Communication: Referring explicitly to others' messages. A higher score in reading ease

contributed to a model predicting the density of referring to the content of messages. A higher score in reading ease means that the message was easier to read, which might inspire more negotiations as peers interact with what the initial post meant. Zingaro and Oztok (2012) suggest that messages that are easier to read may better facilitate communication. By referring explicitly to parts of the initial post, a peer might be trying to point to specific areas they'd like to investigate further. Being able to clearly understand the idea set forth in the initial post makes it easier for a peer to be confident as they build on it in their response.

There are many possible explanations for why the initial post characteristics investigated were not found to significantly predict open communication. A post's time from due date focuses on when the post was made, not its content. Posts made earlier in the week or later in the week might still contain the same ideas, which may or may not encourage peers to respond in ways that contribute to discourse. For example, if a peer asks a question of the initial poster, this question will need to be asked regardless of when the post was made. A post's word count could influence responses in multiple ways: shorter posts may require peers to respond with questions for clarification, while longer posts may provide many points that the peer needs to negotiate meaning on. The use of personal pronouns may have had little influence here, as the positioning of the initial poster within their message mattered less than the content of the message itself in terms of garnering responses contributing to discourse.

Cohesive Communication

Of the six independent variables analyzed, only one initial post characteristic significantly contributed to the model predicting the amount of cohesive communication

present in a response post. That characteristic was the word count of the initial post. Cohesive communication is that which contributes to students identifying and acting as part of the learning community, and includes using inclusive pronouns when discussing the group, addressing peers by name, or using phatics or salutations to help develop familiarity within the group (Garrison, 2011). Word count in initial posts contributed to a model predicting the density of cohesive communication in responses, in that a lower word count predicted a higher level of cohesive communication. Zingaro and Oztok (2012) hypothesize that longer messages include more ideas that peers could respond to than shorter messages; it is possible that fewer words in the initial post provided peer less to respond to, and so responses used more "friendly" wording rather than more content-focused wording.

Deeper investigation into each of the three indicators of cohesive communication found that word count contributed significantly to a model predicting Cohesive Communication: Phatics, salutations. This category includes communication that serves a purely social function such as greetings or closures. This model predicts that initial posts with lower word counts will generate responses that have higher use of phatics and salutations. This could be grounded in the idea that a shorter initial post provides fewer opportunities for the response to speak to, and the responding peer may try to bulk up their post by including a greeting or sign off.

As to the five independent variables that did not significantly contribute to the model predicting cohesive communication, there are many possible explanations. An initial post that is made well before the due date may attract the response of other students working ahead of schedule, who may be more likely to try to build cohesive

relationships within the group; however, students who post later in the week may also generate responses that contain cohesive communication as peers try to draw those late posters in and make them feel a part of the community. It is also possible that the concept of cohesive communication is tied more specifically to communication actions that have less to do with the content of the post, and more to do with the community itself. Reading ease, first- and second person language and cognitive presence may have no bearing on whether a peer chooses to use greetings or peer names, as these actions are not tied to the content itself but rather to building that community.

Cognitive Engagement: Discussion of Findings from Research Question Three

Research question three investigated the influence of student initial post features on the cognitive engagement of their peers, which was demonstrated by the cognitive presence detected in the responses to that initial post. Research question three was *To what extent can the probability of an initial discussion post generating higher levels of cognitive presence in peer responses be predicted by that post's posting time from due date, word count, reading ease score, use of first-person pronouns, use of second-person pronouns, or cognitive presence level?* The data analysis procedure used to answer this question was binary logistic regression, in which the six initial post characteristics served as independent variables that were investigated to determine whether they contributed to a model that could predict the level of cognitive presence reached in response posts. Two predictors (first-person language and initial post cognitive presence) were found to significantly contribute to the model predicting the level of cognitive presence in response posts.

The initial post cognitive presence independent variable predicting the cognitive presence in a response post is clear. The concept of cognitive presence is built on the idea that students work as a community to build understanding. A higher level of cognitive presence in the initial post will provide a higher platform upon which a peer can build their response, thus also reaching higher levels of cognitive presence. In an initial post that reaches the integration phase, for example, will provide a solid foundation for the peer response to continue integrating ideas in the pursuit of understanding, or to take the discussion thread to the next level by building on the ideas put forth in the initial post integration by providing additional ideas to lead to resolution.

The use of first-person language in an initial post significantly contributing to a model predicting higher cognitive presence in a response is a little more surprising. Carroll (2007) hypothesizes that a decline in the use of first-person language may be due to students moving away from using personal experiences as evidence in their writing; it is possible that the use of first-person language may provide a more relatable base in the initial post that may help the peer to better understand the concept and allow them to take the concept from the personal to universal in their response. Researchers have found that the use of personal pronouns in writing is related to lower academic performance (Pennebaker, 2011; Robinson et al., 2013); it's possible that a use of first person in the initial post lays groundwork for peers to jump to higher levels by building on the lower level presented in the initial post. Mayer et al. (2004) note that "using the self as a reference point increases the learner's interest," which may also attract the peer as they take the concepts presented in the initial post and develop them further in their own response.

The other four independent variables did not significantly contribute to the prediction model, and this may be due to various reasons. In terms of an initial post's time from due date, it's possible that a post made earlier in the week is created by a student who is more connected to and engaged with the course; one might expect these posts to contain more thoughtful ideas that might promote higher levels of cognitive presence in responses. This does not seem to be the case, which could be due to confounding factors such as the student population within discussion groups: if the students posting earlier in the week are the better students, poorer students will be the ones responding to them, which may lead to lower levels of cognitive presence demonstrated in their posts. Word count was another initial post characteristic that did not significantly contribute to the model predicting response post cognitive presence. Within one message, word count has been found to be a predictor of higher levels of cognitive presence (Joksimovic et al., 2014), but no previous research has focused on the word count of one student's work influencing the cognitive presence of a peer's response. Word count has also been found to be a predictor of overall academic success, possibly due to a higher level of conscientiousness on the part of the initial poster as hypothesized by Abe (2020); this could mean that a higher word count could indicate more effort put into the initial post by one student, which could influence how that initial post is interpreted by peers. Some students may have taken a longer post to mean that the initial poster said all there was to say on the subject, already achieving higher levels of cognitive presence themselves that the peers could not grow in their responses; other students may have taken a longer post to lay more solid groundwork for them to add to, achieving higher levels. Reading ease could also have led to varying results in the

responses of peers: some students may have felt that an easy-to-read post provided a clear foundation upon which to build their ideas, leading to higher levels of cognitive presence, while other students may have taken an initial post's difficulty level to indicate the completeness (or lack thereof) of the idea presented, which may have influenced what the peer could contribute at higher levels of cognitive presence. Finally, second-person language may have had varying results in peer responses as peers had varying reactions to the level of familiarity presented in the initial post. Some students may have been attracted to this, again finding the post appealing to build upon, while others may have felt the post was too low-level cognitively to add to in a meaningful way.

Conclusions

This study aimed to investigate the influence that characteristics of student initial discussion posts may have on the engagement of their peers as demonstrated in peer response posts. The results indicated that some initial post characteristics can influence peer behavioral, social, and cognitive engagement.

There were five main findings in this study. The first finding details initial post characteristics' influence on peer behavioral engagement, specifically that initial posts that were posted well in advance of the due date were slightly more likely to generate replies than initial posts posted later in the assignment period. The second through fourth findings describe student to peer influence on social engagement. The second finding indicates that the use of first-person language in an initial post influenced Interpersonal Communication in the responses of peers, specifically in the area of self-disclosure. The third finding shows that the reading ease of an initial post influenced Open Communication in the responses of peers, but only significantly in referring explicitly to

others' messages. The fourth finding indicates that the word count of an initial post influenced Cohesive Communication in the responses of peers, specifically in the area of phatics and salutations. Finally, the fifth finding relates to student influence on peer cognitive engagement, specifically that first-person language and cognitive presence in initial posts influenced the level of cognitive presence achieved in the responses of peers.

Taken together, these findings show that the work of students can influence the engagement of their peers in online discussions. This supports the concept that learning does not take place in a single-student vacuum, and that the actions of one student may influence the way their peers interact and engage with the course content and one another. Previous research in the areas of engagement and Community of Inquiry have focused primarily on how students demonstrate their own engagement or learning in their work; this study sought to determine how the work of students influence these areas in their peers. Student responses require the work of a peer to lay the foundation upon which the responder builds their post, so it makes sense that characteristics of initial posts would have some influence on how the responses are crafted. These responses are a major point of interaction between students, allowing students to "talk" to one another about course content and ideas as they build their own understanding. Seeing how students influence one another's posts, and thus their thinking and learning related to the discussion prompt, provides a window into the ways in which students develop and contribute to a community of learners.

In this study, I hoped to investigate the intersection of student engagement and the Community of Inquiry framework, with an eye toward helping instructors and designers evaluate the success of the learning activity. Specifically, the three research questions that

guided this study focused on how students influenced their peers' engagement, demonstrated as a multidimensional contract that includes the three areas of behavioral, emotional, and cognitive engagement (Fredricks et al, 2004), and peer participation in a learning community in terms of the CoI framework presented by Garrison et al. (1999). At least one characteristic of a student's initial discussion posting significantly contributed to models predicting each of the three dimensions of engagement.

For the behavioral dimension of engagement, how a student initial post might influence peer engagement was investigated in terms of providing a response. An initial post's time from due date significantly correlated with the generation of a response from a peer. From this, it may be surmised that one student's conscientiousness in regards to meeting course deadlines ahead of schedule can affect a peer's choice in a post to respond to. In this case, the decision of one student to complete course work early affects the decision of a peer in how they will interact with the discussion, pushing the peer to develop their understanding on a certain topic as they craft their response. The initial poster's action thus directs their peers' learning to a degree.

For the emotional dimension of engagement, how a student initial post influenced peer engagement was investigated in terms of peer social presence demonstrated. Initial post time from due date, first-person language, reading ease, and word count each influenced at least one aspect of peer social presence in responses. Like research question one, the results of research question two indicate that the decisions made by a student in their initial post influence their peers, specifically in terms of how those peers participate as members of the learning community, communicate with one another, and build relationships (Garrison, 2009). By making decisions related to when to post, how much to

post, and what to include in their post, students are affecting the decisions made by peers to demonstrate social presence, and how they present themselves as a part of the learning community. In this way, one student may influence how a peer not only learns but develops as a contributing member of a community of learners.

For the cognitive dimension of engagement, how a student initial post might influence peer engagement was investigated in terms of the cognitive presence level reached in their interaction on the discussion board. Initial post first-person language and cognitive presence each influenced the level of cognitive presence detected in peer responses. These results indicate that not only do the decisions made by a student in their initial post in terms of writing (first-person language) influence how their peers cognitively engage with the course material, but also the initial poster's own cognitive engagement influences that of their peers. In this way, the higher order thinking of one student influences the higher order thinking of their peers by providing a foundation upon which the peer can build his or her own deeper understanding and thinking on a topic. Here, the learning demonstrated by one student is directly related to the possible learning achieved by another.

In summary, the findings from this study contribute to the overall understanding that students can and do influence the engagement of their peers. While the focus of this study was student engagement and how it is demonstrated, that engagement is also directly related to how students learn. Not only is engagement tied to active involvement in a course that can lead to student achievement of learning outcomes and cognitive development (Ma et al., 2015), but it also influences how a student chooses to interact with course material. Being engaged with a certain discussion thread begun by a peer

directs a student's trajectory of thought by forcing a response to a specific idea presented by another. This means that the student is not just thinking for themselves in terms of the course content, but is reacting to the ideas or understanding put forth by another person, which requires additional consideration to relate to, agree with, or diverge from. In this way, the work of one student can influence not only the engagement of peers, but their potential for learning as well.

Limitations

There are several limitations of this study. The first is that the specific design of the discussions in the course that data was drawn from may have had a larger influence on the responses generated than anticipated, or that could be generalized to a larger or different population. Specifically, the course employed small-group discussions instead of whole-class discussions. This meant that students were only able to view the initial posts made by some of their peers in order to choose whom to reply to. In a whole-class discussion, the number of options for students to reply to at different times of the week would have been larger, and may have influenced the outcome of research question one.

Another limitation related to the design of the discussion in the class from which data was drawn is the discussion prompts that students were able to choose from. Students were given the opportunity to reply to two out of five to nine prompts, but groups had to answer at least four prompts overall. As such, students in the same group did not always answer the same questions, and this may have led to some responses automatically requiring more social or cognitive presence than others. For example, a prompt that asked for a student's opinion on a topic may have resulted in more first-person language, or a prompt asking students to relate a concept to their own experience

may have resulted in more self-disclosure or use of humor. Further, different prompts prompted different levels of cognitive presence, which may have skewed how cognitive presence influenced all initial posts or response posts related to that prompt. Working with data pulled from posts related to just one prompt across the whole population may have provided more accurate comparisons.

The third limitation deals with the reliability of the data included in the analysis. One researcher coded the data in two separate coding periods in order to test coding reliability. For some variables, the reliability between coding periods was not as robust as it could have been. While reliability was still deemed to be sufficient for data coding overall, these discrepancies in coding may have led to slightly skewed data. One method to overcome this issue would be to use two independent coders, and to normalize coding between two coders before embarking on the coding project.

Recommendations

Based on the findings of this study, several recommendations may be made, both in the area of practice and in the area of future research.

Recommendations for Practice

Based on the findings of this study, recommendations for instructors and designers may be made as they design discussion posts aiming to encourage behavioral, emotional, and cognitive engagement among students. Instructors or designers may consider making a point to ask students to post well before due date, perhaps by awarding points or extra credit for the earlier initial posts made. This may help to bulk up the discussion board earlier in the assignment time period, making more initial posts available for peers to choose from to reply. Another suggestion would be to fully separate

discussion due dates, having initial posts due in one week and responses due in the next; by spacing out the deadlines in such a way, students would have the opportunity to see more initial posts before deciding whom to reply to.

Instructors or designers may also consider discussing the concepts of social and cognitive presence with their students prior to assigning online discussions. By making students aware of how these concepts may contribute to engagement and success in the course and showing students how such presences may be demonstrated in discussions, instructors or designers could provide students with a better understanding of how they interact with one another and the importance of that interaction on their own knowledge building and learning. Further, instructors or designers could tip the scales for social presence in some ways by including instructions in discussion prompts, for example, by

- asking for personal opinions, which may lead to more self-disclosure or use of humor;
- prompting students to ask questions of one another, which might lead to more organic interaction; or by
- asking students to include specific reference to points made by their peers, which might help students to position themselves more clearly within the learning community.

Instructors or designers could also aim to develop prompts that demand a higher level of cognitive presence in student initial posts, as well as specific directions for student responses that would further the cognitive presence attained within the discussion thread.

Finally, instructors or designers could include example discussion posts that demonstrate to students what is appropriate within course discussions. For example, by demonstrating the use of salutations and expressions of appreciation or agreement with peers, instructors could model behavior that students should themselves follow as they interact with their peers.

Recommendations for Research

Beyond recommendations for practical applications in terms of the results of this study, some recommendations for future research in this area may be made. Future studies might find more conclusive results by working with a course with different design considerations, such as one that uses whole-class discussions or includes fewer discussion prompts per week. Further, studies could employ data from multiple completely different courses to draw data that could be generalized across a larger swath of undergraduate or graduate student populations.

Future studies might also find success in designing an experimental study, rather than a correlational study. By including an intervention to be tested with one portion of the sample, such as including a module on social and cognitive presence prior to the first discussion or encouraging questions or more personal details in initial posts, then comparing the results of the test and control groups, it may be possible to see differences in results in terms of specific variables.

Finally, future studies might consider taking a qualitative approach rather than quantitative. Rather than focusing on coding and counts, a qualitative investigation might provide more depth and detail in terms of seeing how students are demonstrating presence.

Summary

No student is an island when it comes to learning, although it may feel that way to some students in online classes. Students must actively interact with the content, their instructor, and their peers to build their own understanding and knowledge. How students engage with the course and their peers impacts their learning as part of a community of learners; investigating the variables that may influence that engagement provides a starting point to better understand how to encourage or build deeper engagement in discussions and the course overall.

This study focused on how students influenced the behavioral, emotional, and cognitive engagement of their peers as demonstrated in online discussion posts. Each research question found at least one characteristic of student initial posts that significantly contributed to models predicting a dimension of engagement of their peers. This knowledge can help instructors and designers to better understand how students influence one another, and how to best structure discussions to encourage traits that set in motion such engagement.

This chapter began with a summary of the current study, followed by a discussion of the results of each research question in detail. Conclusions of this study were then discussed, followed by limitations of the study and recommendations for practical application and future research in the area of online course engagement.

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