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SOCIAL PRESENCE AS A PREDICTOR OF SOCIAL CONSTRUCTION OF KNOWLEDGE IN DISCUSSION FORUMS IN ASYNCHRONOUS ONLINE HIGHER EDUCATION COURSES

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BY

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DISSERTATION

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DEDICATION

This dissertation is dedicated to my wife, Mariah, who has been a constant source of love, support, and encouragement during the challenges of graduate school and life. I am truly thankful that I have you in my life. Also, this dissertation is dedicated to my parents and sister, Kevin, Courtney, and Ashton, who have always loved me unconditionally and whose good examples have taught me to work hard for the things that I aspire to achieve. My dissertation also is dedicated my grandparents, Max and Linda Megli, Beverly Cannon, and to the memory of my late-grandfather, Joe Cannon, whose time spent in academia inspired me in my own scholarly pursuits.

Lastly, this dissertation is dedicated to my Choctaw ancestors and I appreciate the support and resources the Choctaw Nation has provided to me in my education endeavors.

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ABSTRACT

The three research papers completed and compiled to make up this dissertation explore the relationship between social presence and social construction of knowledge in asynchronous online discussion forums in higher education courses in the instructional technology field. Paper 1 is a literature review of the interaction analysis model (IAM) (Gunawardena et al., 1997) as a methodology, which is used to measure and determine the social construction of knowledge in online discussion forums. This literature review identified and highlighted the need to determine how the social environment of online learning influences the social construction of knowledge. This led to the second paper where one aspect of the social environment of online learning, social presence, was examined in relation to social construction of knowledge.

The purpose of Paper 2 was to explore whether there is a significant relationship between social presence and social construction of knowledge utilizing a correlational study. This study utilized a Spearman Correlation Coefficient to determine whether there is a relationship between the social presence score of a single discussion post and the five phases of knowledge construction specified in the IAM. The Spearman Correlation Coefficient (r =

0.431, $p > .001$) indicated a positive moderate statistically significant relationship between the social presence score and highest IAM phase of a single discussion post. This study purported the need to further examine the relationship between social presence and social construction of knowledge in Paper 3.

Paper 3 focused on determining whether social presence can be utilized as a predictor of the IAM phase of a discussion post in an online discussion forum in higher education courses. The results of the combined content analysis found that social presence can be used to significantly predict social construction of knowledge. An ordinal logistic regression was run to predict the five phases of the IAM from the social presence score of a single discussion post. Social presence was a statistically significant predictor of social construction of knowledge and the study produced a significant ($p > .001$) ordinal logistic regression model. Ordinal logistic regression highlights the need for further research into analyzing how social presence lexicon analysis and the interaction analysis model can be used to enhance the research field's understanding the social environment of online learning. This study helps to fill this research void by analyzing the ability of social presence to predict social construction of knowledge in a specific and well-defined context for online education.

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Introduction to Study

There were over 5.8 million exclusively distance education student enrollments in higher education in the United States during the 2020 academic year, which increased by 93% from 2019 with just 3 million exclusively distance education students. (National Council for State Authorization Reciprocity Agreements, 2021). This growth over the years highlights and suggests an increased need for researchers and instructors to better understand the social environment of online learning and various metrics and predictors that can increase student success and satisfaction in online higher education. Until the late 1990s, researchers comparing in-person to online education believed online education to be an inferior modality (Mentzer et al., 2007). However, researchers have identified that there is not a significant difference in student outcomes, such as test scores and grades, related to comparisons of traditional face-to-face higher education to online higher education (Arbaugh, 2000; Neuhauser, 2002). To this end, research also suggests the way students learn in online education is arguably different due to the differences in the online and traditional face-to-face instructional modalities (Bourelle et al., 2016). The social environment of online learning is the ecosystem in which participants in online learning settings interact with one another. Harasim (2017) identified the specific benefits of online learning environments as place-independent discourse, asynchronous as well as synchronous discourse, many-to-many discourse, text-based discourse, and internet-mediated discourse. Many studies have researched the social environment of online learning and have identified the advantages of online environments in shifting the learning environment to be more social, flexible, and personal which can permit for a more social constructivist approach to online learning (Choi, 2016; Gonzáles-Gómez et al., 2016; Saghafi et al., 2014; Westermann, 2014). Moreover,

those students who are able to build social relationships are likely to be more successful and have an increase in student engagement which in turn stimulates learning (Trowler, 2010). As well, participant interactions with peers in an online social environment can positively increase student success, learning, self-esteem, and persistence (Kuh et al., 2008). There are six different types of interaction that can account for learning which can be recognized in distance learning education: student-student, student-teacher, student-content, teacher-teacher, teacher-content, and content-content (Zornić & Hasanović, 2011). Online discussion forums have been identified and greatly relied upon as the main way for students to build beneficial social connection in asynchronous online environments. Recent research has shown that the social and cognitive efforts of a student go hand-in-hand with the creation of new knowledge (Gunawardena et al., 2018). Unlike the cognitive perspective, which focuses on mental processes, the social perspective focuses on the nature of learning and places the learner within the context (Gunawardena et al., 2018). Cho and Tobias (2016) identified that online learning communities that employ the social environment of online learning can help create a stronger feeling of connectedness between learners, can establish trust, and assist students in knowledge construction and knowledge growth.

Researching the social environment of online learning is impactful for aiding instructors, students, and researchers to further the literature on best practices to promote various phenomena that have been linked to student success in online education, such as social construction of knowledge and social presence. Online discussion forums in higher education rarely reach high levels of social construction of knowledge (Howell et al., 2014). To this extent, techniques to measure and increase social construction of knowledge in higher education online discussion forums are needed to assist students, instructors, and

instructional designers in reaching higher levels of knowledge construction. Social construction of knowledge is a phenomena rooted in Vygotsky's (1978) social constructivist theory which stressed the influence of culture and social contexts in learning. Vygotsky's approach to individual development differs from behaviorist and cognitivist contemporaries such as Thorndike, Piaget, and Koffka (John-Steiner & Souberman, 1978). Vygotsky proposed that tools, artifacts (such as computers), and signs support people in developing higher mental processes (John-Steiner & Souberman, 1978, p. 133). These foundations emphasize the significance of social interactions, collaboration, and the construction of new knowledge with peers. Gunawardena, Lowe, and Anderson (1997) defined social construction of knowledge to be "the knowledge construct[ion] within the group by a process of social negotiation" (p. 412).Within asynchronous online education, Dawson (2006) identified the online discussion forum as a tool that provides a useful and valuable communication and interaction area for participants in online courses; a location where knowledge can be socially constructed. Lucas, Gunawardena, and Moreira (2014) identified that there is inadequate literature related to how to develop online discussion forums aimed at generating higher levels of social construction of knowledge. Padilla and Layne (2017) identified the social construction of knowledge as focused on looking at interaction and there are various forms of interaction such as learner to learner, learner to instructor, and learner to content. With roots from social constructivist theories of learning, researchers in this area believe knowledge is socially constructed. Due to the recognized void in the research for techniques to promote social construction of knowledge in online discussion forums, there is a need for this study in looking at the relationship between social construction of knowledge and social presence.

There are various different views on what social presence is and how it should be defined. For the purpose of this analysis, social presence is defined as "the ability of learners to project their personal characteristics into the community of inquiry, thereby presenting themselves as 'real people'" (Garrison et al., 1999, p. 89). Tammelin (1998) and McIsaac and Gunawardena (1996) observed that social presence could be linked to the larger social context of online learning including phenomena such as motivation, interaction, group cohesion, verbal and non-verbal communication, and social equality. Before computer-mediated-communication became mainstream, Short et al. (1976) determined the critical factor in a communication medium is its "social presence" and defined this type of social presence as the "degree of salience of the other person in the interaction and the consequent salience of the 'interpersonal relationships'" (p. 65). Two sub-concepts associated with measuring social presence are intimacy (Argyle & Dean, 1965), which is focused on a learner's feelings of social closeness, such as physical distance in communication, and immediacy (Wiener & Mehrabian, 1968) which focuses on the mental distance of the communicators between each other. This relates to the focus on the relationships, strength of interactions, and feeling of intimateness between participants of an interaction. Garramone et al. (1986) identified that when social presence is low, then interaction is low between participants. Lowenthal (2010) posited that the definitions for social presence seem to be on a sliding scale that is somewhere between the relationship of the concepts of interpersonal emotional connection of those involved in the communication and the receiver's perception of whether someone is present or real. There have been several studies which have determined how social presence can impact the online environment in relation to various phenomena such as motivation to participate, group cohesion, trust, interaction, nonverbal

communication, and social equality (Kreijns et al., 2011; Richardson & Swan, 2003; Tu, 2001; Whiteside & Dikkers, 2012). Whiteside and Dikkers (2012) identified that words and phrases indicative of social presence are related to the integration of affective association, community cohesion, interaction intensity, knowledge and experience, and instructor investment.

Researchers have developed instruments to measure social presence in computer mediated communication, such as Gunawardena and Zittle's (1997) "Social Presence Scale" which utilizes a Likert scale questionnaire for determining a single respondent's social presence score. The study identified that social presence is a predictor of learner satisfaction in computer mediated communication. Additionally, The Social Presence and Privacy Questionnaire developed by Tu (2002) focuses on measuring a learner's attitude towards computer mediated communication and the learner's perceived privacy. By combining these two measurements Tu developed a social presence score, which makes the assumption that a learner's attitude towards computer mediated communication and the learner's privacy are related to whether a student is perceiving social presence in the online environment. There is also the "Social Space Scale" which was developed by Kreijns et al. (2011) which focuses on a scale that consists of five items which showed an internal consistency of 0.81 and was determined to be useful in identifying social presence. These three instruments have commonalities in that they are all survey instruments that require the contributions of current students or recent students and the participation of human subjects through self-reported data. However, the social presence lexicon developed by Gunawardena et al. (2016a) measures social presence through content analysis of the text in a discussion post which does not require active participation of human subjects in a survey or the use of an additional tool.

The Interaction Analysis Model (IAM) was developed by Gunawardena et al. (1997) and is one of the methods used to measure and examine the social construction of knowledge in computer mediated communication.

Figure 1

Five Phases of the Interaction Analysis Model

PHASE I: SHARING/COMPARING OF INFORMATION. Stage one operations include:	
A. A statement of observation or opinion	[PhI/A]
B. A statement of agreement from one or more other participants	[PhI/B]
C. Corroborating examples provided by one or more participants	[PhI/C]
D. Asking and answering questions to clarify details of statements	[PhI/D]
E. Definition, description, or identification of a problem	[PhI/E]
PHASE II: THE DISCOVERY AND EXPLORATION OF DISSONANCE OR INCONSISTENCY AMONG IDEAS, CONCEPTS OR STATEMENTS. (This is the operation at the group level of what Festinger [20] calls cognitive dissonance, defined as an inconsistency between a new observation and the learner's existing framework of knowledge and thinking skills.) Operations which occur at this stage include:	
A. Identifying and stating areas of disagreement	[PhII/A]
B. Asking and answering questions to clarify the source and extent of disagreement	[PhII/B]
C. Restating the participant's position, and possibly advancing arguments or considerations in its support by references to the participant's experience, literature, formal data collected, or proposal of relevant metaphor or analogy to illustrate point of view	[PhII/C]
PHASE III: NEGOTIATION OF MEANING/COCONSTRUCTION OF KNOWLEDGE	
A. Negotiation or clarification of the meaning of terms	[PhIII/A]
B. Negotiation of the relative weight to be assigned to types of argument	[PhIII/B]
C. Identification of areas of agreement or overlap among conflicting concepts	[PhIII/C]
D. Proposal and negotiation of new statements embodying compromise, co-construction	[PhIII/D]
E. Proposal of integrating or accommodating metaphors or analogies	[PhIII/E]
PHASE IV: TESTING AND MODIFICATION OF PROPOSED SYNTHESIS OR COCONSTRUCTION	
A. Testing the proposed synthesis against "received fact" as shared by the participants and/or their culture	[PhIV/A]
B. Testing against existing cognitive schema	[PhIV/B]
C. Testing against personal experience	[PhIV/C]
D. Testing against formal data collected	[PhIV/D]
E. Testing against contradictory testimony in the literature	[PhIV/E]
PHASE V: AGREEMENT STATEMENT(S)/APPLICATIONS OF NEWLY CONSTRUCTED MEANING	
A. Summarization of agreement(s)	[PhV/A]
B. Applications of new knowledge	[PhV/B]
C. Metacognitive statements by the participants illustrating their understanding that their knowledge or ways of thinking (cognitive schema) have changed as a result of the conference interaction	[PhV/C]

Note. The IAM was developed by Gunawardena et al. (1997).

Figure 1 shows the five phases of knowledge construction that are identified in the IAM. These five phases of knowledge construction are Phase I sharing and comparing, Phase

II dissonance, Phase III negotiation and co-construction, Phase IV testing tentative constructions, and Phase V application of newly co-constructed knowledge. An assumption used in this study and the use of the IAM instrument is that this model cannot be used to measure the social presence in the social environment of online learning; just the social construction of knowledge portion. In turn, there is a need to employ an additional method in conjunction with the IAM, such as social presence lexicon analysis, in order to measure the social environment of online learning and the social context. This combined content analysis study utilizes social presence lexicon analysis and the IAM to determine whether social presence is a significant predictor of social construction of knowledge. An additional method used for analyzing knowledge construction in online discussions, which will not be used in this study, is Garrison et al. (2001)'s Cognitive Presence model, but this model focuses on the individual's cognitive development and is rooted in cognitivism and not constructivism. The Cognitive Presence model has assumptions based in cognitivism which are not appropriate for the context of this research rooted in social constructivism.

Problem Statement and Need

Online discussion forums in higher education rarely reach high levels of social construction of knowledge (Howell et al., 2014). To this extent, techniques to measure and increase social construction of knowledge in higher education online discussion forums are needed to assist students in reaching higher levels. With the development of the IAM by Gunawardena et al. (1997), the developers identified that the model alone could not measure the social environment of online learning. Leaving this void in the research hinders practitioners from guiding students and properly developing social environments that can lead to higher levels of social construction of knowledge for online students in higher

education. One phenomena, social presence, can be taught and increased in an online discussion forum and exists as part of the framework in the social environment of online learning. Social presence research has indicated that the phenomena can be used to increase knowledge, improve instruction, and help to build a sense of community (Biocca et al., 2003; Rourke et al., 2001; Tu & McIsaac, 2002; Whiteside, 2015; Whiteside et al., 2017). As well, when social presence is decreased in the online environment this is related to student dissatisfaction and higher course drop rates (Cui et al., 2013). To this point, research has not been undertaken to determine whether there is a predictive relationship between social presence and the social construction of knowledge. The purpose of this study is to determine whether social presence can be used to predict the level of social construction of knowledge in an online discussion forum in higher education. Since social presence can be taught and coached, and if it so turns out that there is a significant relationship between social presence and higher levels of social construction of knowledge, then the importance of helping produce social presence in computer mediated communication will be further lifted to the forefront in research and literature in the field of distance education research. Lastly, there has been strong growth in online education over the past few years which has increased the importance for better understanding how students build social presence and construct knowledge in asynchronous online environments (National Council for State Authorization Reciprocity Agreements, 2021).

Three Paper Dissertation Format and Organization of Papers

In order to address the identified research need, this dissertation follows the hybrid (three-paper) dissertation format. This format varies from the traditional format in specific ways, so the introduction begins by describing the different requirements and how the

researcher will meet them. The researcher includes descriptions of each of the three papers, the venues and audiences for the publications, and the research agenda. The departmental requirement for the hybrid dissertation format includes the following materials:

- Introduction
- Paper 1 – Conceptual Research Study
- Paper 2 – Empirical Research Study 1
- Paper 3 – Empirical Research Study 2
- Conclusion

The papers included in the dissertation to fulfill the dissertation requirements are:

- Paper 1: Megli, A., Etsitty-Dorame, M. (2021) *Interaction Analysis Model as a Method for Analyzing Social Construction of Knowledge: Systematic Literature Review.* [Unpublished manuscript]. Organization, Information, and Learning Sciences, University of New Mexico.
- Paper 2: Megli, A. (2022). *Exploring the Relationship Between Social Presence and the Social Construction of Knowledge*. [Unpublished manuscript]. Organization, Information, and Learning Sciences, University of New Mexico.
- Paper 3: Megli, A. (to be submitted to *The Internet and Higher Education* journal) Social Presence as a Predictor of Social Construction of Knowledge in Discussion Forums in Asynchronous Online Higher Education Courses.

Table 1

Research Questions and Methods Matrix

Paper Number	Research Questions	Design	Data	Instruments	Analysis Method
1	What are the advantages and		Academic Search Complete, Education Research	Database Search	Literature Review

	limitations of the IAM as a method in the different contexts in which social construction of knowledge was analyzed? How can the IAM as a method be revised based on the results of past studies?	Systematic Literature Review	Complete, ERIC, Psych INFO, ProQuest Dissertation & Thesis), and the interlibrary loan service. A total of 53 journal articles, 18 dissertations, and 8 conference proceedings were retained out of 356 search results. Out of 79 retained works, 45 were relevant to the purpose of the literature review, because they used IAM to analyze data. The literature review covered research published in English during the period of 1997 through 2022.		
2	Is there a relationship between a higher education discussion board post's social presence score and the five Interaction Analysis Model phases?	Correlational Research Design	122 postings from an online discussion board on the topic of culture in two graduate level courses in the learning sciences.	Interaction Analysis Model Social Presence Lexicon Analysis	Spearman Correlation Coefficient
3	Can social presence predict the IAM phase of a discussion post in an online discussion forum in higher education courses?	Combined Content Analysis	Discussion board postings from de-identified asynchronous online courses at both the undergraduate and graduate level.	Interaction Analysis Model Social Presence Lexicon Analysis	Ordinal Logistic Regression

Table 1 shows the research questions and methods that are used in each of the three papers. These three papers have been selected with the intention of creating a progression from conceptual to empirical such that the conceptual paper established the foundation and literature review for the empirical concepts and methods to be used in the two empirical papers. Megli and Etsitty-Dorame (2021) is a literature review of the IAM as a methodology,

which is used to measure and determine the social construction of knowledge in online discussion forums. This literature review identified and highlighted the need to utilize combined content analysis of social presence lexicon analysis and interaction analysis to analyze the social environment of online learning. The IAM does not assess the social environment of online learning. The empirical research, specifically Megli (2022), investigated whether there is a relationship between social presence and the social construction of knowledge in the social environment of online learning. The research study identified that there is a moderate positive significant relationship between social presence and the social construction of knowledge, which purported the need to further study the relationship in Paper 3. Paper 3 investigates whether measurements of social presence in online discussion forums, using a lexicon, can be used to significantly predict the social construction of knowledge being developed in the discussion forum in furtherance of the research study completed for Megli (2022).

The purpose of Megli and Etsitty-Dorame (2021) was to perform a systematic literature review and to examine the breadth and depth of research that has used the IAM as a method for studying the social construction of knowledge. The article explored advantages and limitations of the IAM method for analyzing the social construction of knowledge and provided recommendations for revision of the model. This paper was submitted to the Online Learning Journal (OLJ) for publication in 2022.

The IAM is based on socio-constructivist theory and is designed to analyze social construction of knowledge during collaborative discussions in virtual learning environments (Saritas, 2006; Howell et al., 2017). The developers of the IAM purposely excluded measuring the social environment of online discussions as part of the development of the

model. This led to the identification of a recommendation for future research related to the IAM of utilizing many methods (such as social presence lexicon analysis) to analyze online discussions in order to measure the social environment of online learning in relationship to the social construction of knowledge (Lucas & Moreira, 2015).

The purpose of Megli (2022) was to explore the relationship between social presence and the social construction of knowledge in the online learning environment. The researcher utilized a lexicon for social presence lexicon analysis. The researcher qualitatively coded discussion forum posts using the IAM and utilized an algorithm in RStudio to determine a social presence score for each discussion post. Then, a Spearman Correlation Coefficient was used to determine whether there is a relationship between the social presence score of a single discussion post and the five phases of the IAM. The Spearman Correlation Coefficient was used because the two variables data are skewed and not normally distributed due to most posts being Phase I, II, and III. As well, both of the variables are not continuous variables. The Spearman Correlation Coefficient ($r = 0.431$, $p > .001$) indicated a positive moderate statistically significant relationship between the social presence score and maximum IAM phase of a single discussion post. This study recognized a relationship between social presence and social construction of knowledge. Due to the relationship only having moderate strength and a small sample size, there was a further need to explore this relationship which led to the need for the research study for Paper 3. The study utilized a larger data set in order to increase the trustworthiness and reliability of the findings in determining whether there is a relationship between social presence and social construction of knowledge. Megli (2022) will be submitted to the Quarterly Review of Distance Education for publication.

Paper 3 extended the previous study in relation to social presence and social construction of knowledge in the social environment of online learning. The dataset consists of online discussion forums in undergraduate and graduate level higher education courses from the Learning Science discipline and these discussion forums are from online courses at the University of New Mexico. This study uses the outcomes of social presence scores on this data-set of discussion forum posts to develop a predictive model for the social construction of knowledge associated with the five levels of the IAM. The study used the social presence score as the independent variable and the five levels of social construction of knowledge in the IAM as the dependent variable. This study produced a significant ($p > .001$) ordinal logistic regression which suggested that social presence can be used to significantly predict the IAM phase of a discussion post in an online discussion forum in higher education courses.

Intended Audience and Publication Venues

The intended audience for this dissertation are scholars who regularly research and work in the realm of distance education in higher education. A secondary audience for the work is the broader audience with a focus on distance and online education research and pedagogy. There are numerous identified journals that would be appropriate venues for publication of Paper 3 while keeping the intended audience in mind. The journals that are being considered for Paper 3 are provided in Appendix A, which includes the impact factor, mission of the journal, and description. The descriptions and missions of the journals were obtained from the specific journal's website. The impact factors were obtained from the Journal Citation Reports website. The researcher believes the most promising journal for

Paper 3 is *The Internet and Higher Education* journal due to the high impact factor and focus on the utilization of online education in the specific higher education context.

Research Agenda

The researcher's research agenda is focused on analyzing discussion forums in online higher education and moving forward research around interaction in asynchronous online environments. Even more broadly the researcher is interested in generally researching various topics in online higher education. To ensure consistency in the data sets, through analyzing the social environment of online education the researcher has realized the importance of ensuring contextual similarity between data-sets for this research study. Whiteside (2015) also pointed out something that was an intrinsic concern of the researcher, that the various studies that have researched social presence do not tend to focus on the context for which the study takes place and attempt to make a broader statement about social presence than is appropriate for the context and findings of the study. In being able to identify metrics for the incorporation of a specific discussion forum for the data set, then this will help to increase reliability and validity of the findings of this study due to the smaller and more specific context of the investigation.

Purpose of the Study

The purpose of the three research papers developed to make up this dissertation is to explore the relationship between social presence and social construction of knowledge in discussion forums of online higher education courses through the utilization of the IAM and social presence lexicon analysis to contribute to a stronger understanding of the social environment of online learning. The purpose of Megli and Etsitty-Dorame (2021) specifically was to develop a literature review of the IAM as a methodology, which is used to measure

and determine the social construction of knowledge in online discussion forums. This literature review identified and highlighted the need to utilize combined content analysis of social presence lexicon analysis and interaction analysis to analyze the social environment of online learning.

The purpose of Megli (2022) was to explore whether there is a significant relationship between social presence and social construction of knowledge utilizing a correlational study. Megli (2022) used a spearman correlation coefficient to determine whether there is a relationship between the social presence score of a single discussion post and the five phases of the IAM. This indicated a positive moderate statistically significant relationship between the social presence score and maximum IAM phase of a single discussion post. The Megli (2022) purported the need to further study the relationship in Paper 3.

The purpose of Paper 3 was to focus on determining whether social presence can be utilized as a predictor of the IAM phase of a discussion post in an online discussion forum in higher education courses. This combined content analysis study determined social presence can be used to predict the level of social construction of knowledge in online discussion forums in higher education. This study focused on answering the research question by utilizing social presence lexicon analysis and the IAM in relation to online discussion forums of online courses in higher education. Through the completion of the empirical study focusing on determining whether there is a relationship between social presence and social construction of knowledge, there was a stark need for further research on the relationship of these two phenomena because the outcome of the research purported that there was a moderate positive significant relationship between social presence and social construction of knowledge. Since social presence can be taught or coached, and if the outcome was to be a

significant relationship between social presence and higher levels of social construction of knowledge, then the importance of helping produce social presence in computer mediated communication will be further lifted to the forefront and will further highlight the need for research in this area. The results of this study may be beneficial for informing faculty and instructional designers developing asynchronous online social environments in online courses. The results may also help with the future of general online course design and the utilization of both social presence and social construction of knowledge in online learning environments.

Research Question

The overall purpose of this study is to determine whether social presence can predict social construction of knowledge in online higher education courses. The research question this study seeks to address is presented in Paper 3: Can social presence predict the IAM phase of a discussion post in an online discussion forum in higher education courses? Table 1 identifies the research questions addressed in Paper 1 and Paper 2.

Positionality

Regarding positionality, the researcher acknowledges his lens of an educated American Indian/White man utilizing the framework of constructivism when approaching the research study. The researcher was not a participant in these online spaces, but has observed and participated in similar online discussion forum spaces in recent times as a student and an online instructor. The researcher is intrigued by the use of language to both increase social construction of knowledge and other positive aspects of student success. The researcher acknowledges that positionality can influence this project and the researcher's ability to obtain data to some extent with the role and employment with UNM Online focusing on

supporting the Accelerated Online Programs at UNM. These aspects of the researcher's identity inform how the researcher may qualitatively code the online discussion forums.

Definition of Terms

- **social construction of knowledge:** a phenomenon rooted in Vygotsky's (1978) social constructivist theory which stressed the influence of culture and social contexts in learning. Gunawardena et al. (1997) defined social construction of knowledge to be "the knowledge construct[ion] within the group by a process of social negotiation" (p. 412).
- **interaction analysis model:** used to help researchers to analyze co-construction of knowledge in collaborative learning environments by identifying 5 phases observed during the process of social construction of knowledge: Phase I sharing and comparing, Phase II dissonance, Phase III negotiation and co-construction, Phase IV testing tentative constructions, and Phase V application of newly co-constructed knowledge (Gunawardena et al., 1997).
- **social presence:** Garrison et al. (1999) defined social presence as "the ability of learners to project their personal characteristics into the community of inquiry, thereby presenting themselves as 'real people'" (p. 89).
- **social presence model:** involves the integration of the five elements of affective association, community cohesion, interaction intensity, knowledge and experience, and instructor investment (Whiteside & Dikkers, 2012).
- **social environment of online learning:** the environment for which participants in online learning situations interact with one another.

- **asynchronous online course:** a fully online course which has no scheduled in-person or virtual meetings and all interaction between participants in the course exists through computer-mediated communication.
- **interaction analysis:** the "interaction of human beings with each other and with objects in their environment. It investigates human activities, such as talk, nonverbal interaction, and the use of artifacts and technologies" (Jordan & Henderson, 1995, p. 39).
- **lexicon analysis:** the use of a lexicon, or list of purposefully chosen words, to calculate the semantic orientation of word or phrases that occur in a text (Taboada et al., 2011).
- **learning analytics:** the application of quantitative techniques used to analyze big data to identify factors that contribute to learning (Long & Siemens, 2011, p. 34).
- **social learning analytics:** Buckingham Shum & Ferguson (2012) defined social learning analytics as a "distinctive subset of learning analytics that draws on the substantial body of work demonstrating that new skills and ideas are not solely individual achievements, but are developed, carried forward, and passed on through interaction and collaboration" (p. 5).
- **combined content analysis:** A framework developed by Hamad et al. (2016), which incorporates a mixed-methods design for textual analysis. For this study, the two types of content analysis used are social presence lexicon analysis and interaction analysis.

Paper 1: Conceptual Study

Interaction Analysis Model as a Method for Analyzing Social Construction of Knowledge: Systematic Literature Review

Austin C. Megli and Monica Etsitty-Dorame

Abstract

The purpose of this systematic literature review is to examine the breadth and depth of research that has used the Interaction Analysis Model (IAM) for studying the social construction of knowledge. It will explore advantages and limitations of the IAM method for analyzing the social construction of knowledge and will provide recommendations for revision of the model. The model describes five phases of knowledge construction which are Phase I sharing and comparing, Phase II dissonance, Phase III negotiation and co-construction, Phase IV testing tentative constructions, and Phase V application of newly co-constructed knowledge. Previous studies support the IAM as the most frequently used and reliable tool in analyzing online collaborative discussions as it provides a holistic view of discussion flow and knowledge construction. Regardless of the IAM being identified as a prominent framework, previous studies have found issues, research gaps, and limitations in the analysis tool. This study identifies the importance of understanding external variables and conditions to further investigate the limitations of the studies that have employed the IAM to analyze collaborative online discussions for knowledge construction. This study's findings suggest future research should make a point to also address social dynamics to help broaden the insights available regarding the knowledge construction process. Analyzing the social dynamics and social environment of online learning through the lens of utilizing IAM can add a more complete understanding of how students construct knowledge in online learning

environments. Furthermore, additional research focused on analyzing the IAM is necessary to conceptualize a more interpretive framework that may improve researchers' ability to quantify cognitive activity in collaborative interactions to advance our understanding of how individuals construct new knowledge in online environments.

Keywords: interaction analysis model, literature review, social construction of knowledge, distance learning

Introduction

Online discussion forums are a widely used activity in online courses and the most important aspect of the educational process happening in the virtual learning environment as it is the primary form of communication and negotiation of meaning among a group of learners (Howell et al., 2014). Online discussion forums provide potential for new forms of collaborative work, study, and community that reduce barriers of time and distance (Kanuka & Anderson, 1998). However, the types of interactions and means by which individuals construct new knowledge in online environments were not well understood (Kanuka & Anderson, 1998). Furthermore, previous studies have found that knowledge construction within online discussions rarely reach high levels of knowledge construction (Howell et al., 2014).

The flexible structure of online discussion also supports the notion that the growth of online education has created new opportunities and challenges (Akarasriworn & Ku, 2013; Luebeck & Bice, 2005). In many higher education online courses, students are expected to share experiences, negotiate meaning, and construct knowledge within online discussion forums (Moore & Marra, 2005). Therefore, it is important to understand which aspects of online discussions encourage learning and increase knowledge construction (Howell et al., 2014). The IAM developed by Gunawardena et al. (1997) can measure whether a collaborative group has constructed new knowledge through interaction. At this point, Gunawardena et al.'s (1997) article has over 2,400 citations on Google Scholar. The IAM also provides an avenue for studying the process of acquiring that knowledge—the means by which new knowledge is achieved (Luebeck & Bice, 2005).

The Interaction Analysis Model (IAM) is based on socio-constructivist theory and is designed to analyze knowledge construction during collaborative discussions (Howell et al., 2017; Saritas, 2006) in virtual learning environments (see Figure 1). This social constructivist theory sprang out of the constructivism movement because "there was a growing interest in the social nature of learning and the social context in which learning happens" (Gunawardena et al., 2018, p. 20). Gunawardena et al. (1997) developed the IAM while examining a transcript of an online debate. This debate was created from a voluntary professional development experience consisting predominantly of practicing professionals in the field of online learning before the World Conference on Distance Learning in 1995. The developers of IAM decided to leave out analyzing the "social" dimension of the interaction because they did not believe the debate context was an appropriate context for social interaction.

The model provides guidance for examining negotiation of meaning and co-construction of knowledge in collaborative learning environments by specifying 5 phases observed during the process of knowledge construction: Phase I sharing and comparing, Phase II dissonance, Phase III negotiation and co-construction, Phase IV testing tentative constructions, and Phase V application of newly co-constructed knowledge. The IAM is one of the more reliable (Marra et al., 2004) and one of the most frequently used tools for examining knowledge construction (Beaudrie, 2000: Schellens & Valcke, 2006). It is the foundation for numerous research studies exploring influences on higher level knowledge construction in online discussion forums (De Wever et al., 2010; Guo et al., 2022; Hew & Cheung, 2011).

Interaction analysis is a method used for investigating the interactions between human beings and the differing objects within the environment they are interacting within

(Jordan & Henderson, 1995). Jordan and Henderson's (1995) theory focuses on video-based interaction which is posited differently from the computer mediated communication analysis on asynchronous online discussion forums utilized by IAM. Interaction analysis is understood differently than content analysis as content analysis focuses on analyzing the content from individuals rather than the interactions focused on the group. This interaction between people instead of focusing on the progression of the group is what makes IAM stand out as a method. Another similar model for interaction analysis is Garrison, Anderson, and Archer's (2001) Cognitive Presence Model. This model utilizes four phases of triggering event, exploration, integration, and resolution. This model is differentiated from the five levels of IAM and both models track the progression of the group's exploration of ideas towards the integration and application of ideas and both show that the opportunity for group integration and synthesis of ideas is something that can be studied and hoped for in asynchronous online discussion forums. Newman, Webb, and Cochrane's (1995) Critical Thinking model is similar in that it analyzes online discussion forum text but is differentiated because it focuses on content analysis and understanding the critical thinking of individuals rather than the progression of the group.

Purpose

The purpose of this literature review is to examine research studies that have used the IAM as a method for analyzing knowledge construction to determine the versatility of the model for use in a variety of diverse contexts. This literature review will also explore the advantages and limitations of the IAM as a method for studying social construction of knowledge, and will provide recommendations for revision of the model based on the results of the studies. The guiding research questions of this literature review are:

1. What are the advantages and limitations of the IAM as a method in the different contexts in which social construction of knowledge was analyzed?
2. How can the IAM as a method be revised based on the results of past studies?

Method

A systematic literature review was conducted for this study. A systematic literature review is used to provide an exhaustive review of research that is relevant to the research questions. In following a social science systematic literature review, this study established, evaluated, and synthesized relevant research studies to answer this study's research questions (Petticrew & Roberts, 2006). Table 2 presents the research design of this literature review.

Table 2

Research Design of Megli and Etsitty-Dorame (2021)

Paper Number	Research Questions	Design	Participants	Instruments	Analysis Method
1	What are the advantages and limitations of the IAM as a method in the different contexts in which social construction of knowledge was analyzed? How can the IAM as a method be revised based on the results of past studies?	Systematic Literature Review	Academic Search Complete, Education Research Complete, ERIC, Psych INFO, ProQuest Dissertation & Thesis, and the interlibrary loan service. A total of 53 journal articles, 18 dissertations, and 8 conference proceedings were retained out of 356 search results. Out of 79 retained works, 45 were relevant to the purpose of the literature review, because they used IAM to analyze data. The literature review covered research published in English during the period of 1997 through 2022.	Database Search	Literature Review

A research 1 southwestern university's library databases (Academic Search Complete, Education Research Complete, ERIC, Psych INFO, ProQuest Dissertation & Thesis), and the interlibrary loan service, were the primary search engines for the literature

review. The keywords searched included *interaction analysis model*, *social construction of knowledge* and *interaction*, and *social construction of knowledge* and *interaction analysis*. The only criterion for the search was to retain works that discussed or utilized the IAM in the study. There were no limitations set on the type of works used, so data includes academic journals, books, dissertations and conference proceedings. A total of 53 journal articles, 18 dissertations, and 8 conference proceedings were retained out of 356 search results. Out of 79 retained works, 45 were relevant to the purpose of the literature review, because they used IAM to analyze data. The literature review covered research published in English during the period of 1997 through 2022.

Findings

IAM Contexts

IAM has been used in numerous versatile contexts. The model has been used in research studies based in North America, Asia, Europe, South America, Africa, and Australia. It has been used by numerous faculty and student researchers across the globe in K-12, undergraduate, graduate, massive online open courses (MOOC) and professional courses in disciplines ranging from nursing, chemistry, instructional design, K-12 education, faculty education, leadership, religion, engineering, law, mathematics, educational technology, veterinary studies, learning sciences, management, psychology, gaming, history, philosophy, literature, music, computer science, physics, business administration, and communications.

Advantages of the IAM for Assessing Social Construction of Knowledge

Studies that have used the IAM have discussed certain advantages of the model to analyze knowledge construction. One common thread is that the IAM is a widely used

method for analyzing knowledge construction (Commander et al., 2016) and is considered to be "one of the more reliable and user-friendly models" (Chai & Tan, 2009, p. 1306). Previous studies support the IAM as the most useful tool in analyzing online collaborative discussions as the facilitation of online discussions for knowledge construction offers authentic learning experiences (Commander et al., 2016). As well, the IAM "offers a holistic view of discussion flow and knowledge construction" (Davis & Marone, 2016, p. 3), and "presents clear and validated stages for the construction of knowledge" (Lucas & Moreira, 2015, p. 1501). Hall (2014) indicated that the validity of the IAM had been established, developed, and used in over 40 different published studies. As well, the IAM has been used to show how knowledge co-construction advanced during post-video discourse regarding YouTube videos (Dubovi & Tabak, 2020).

The IAM has "a higher level inter-rater reliability calculation" (Huntley & Thatcher, 2008, p. 13) ensuring a more solid and non-biased study with resulting data that is easier to interpret (Lim & Hall, 2015). Also, Cragg et al.'s (2008) study found that the "use of a framework like social constructivism allows the distance educator to assess the efficacy of online discourse…and enhance the understanding of the participants" (p. 119).

The IAM's strength, when analyzing data, includes, "the efficacy of the model for identifying overall patterns of knowledge construction, a 'straightforward schema' for analysis" (Davis & Marone, 2016, p. 3). In addition, the model [was] "found useful as a preliminary means to analyze and understand the kinds of communicative strategies taking place within a community of learners" when analyzing computer-mediated communications between postgraduate teachers discussing technology implementation in the classroom

(Hendriks & Maor, 2004, p. 10). Davis and Marone (2016) also postulate that the IAM is appropriate for assessing knowledge construction in formal academic settings.

Advantages regarding the phases of IAM includes the model's ability to "explicitly conceptualize the sequential relationship between different knowledge construction phases providing testable hypotheses of predicted knowledge construction patterns" allowing the phases to be explicitly evaluated (Wise & Chiu, 2011, p. 446). In addition, Osman and Herring (2007) found in their study of cross-cultural learners "that differences in the frequency of each phase manifested by students in comparison to facilitators showed a trend over time toward mutual accommodation, and thus provided partial support for the negotiative spirit of the model." (p. 135) Consequently, "the strategy of counting participant contributions in general and those at each phase of construction allowed comparison of qualitative and quantitative differences in discussions occurring in these delivery methods," in Cragg et al.'s (2008, p. 121) study of Masters nursing students discussing advanced nursing theory in an online versus face-to-face format. In turn, this means that the IAM can be used as a method for both quantitative and qualitative analysis.

Further, "the use of this [IAM] framework is intended to facilitate the comparison of findings with previous studies that consider knowledge construction in formal academic settings" (Davis & Marone, 2016, p. 3). The IAM is used quite similarly across formal academic settings, so the outcomes from those studies can be compared to one another to further the field's understanding of how students co-construct knowledge. In Huntley's 2008 study, which assessed how time can impact discussions that take place in a virtual forum, the IAM model was preferred over Newman's et al.'s (1995) Critical Thinking model because

the IAM provided fewer codes (Phases 1 through 5), easier coding applications, and interpretation of data and a better view of discussion flow and knowledge construction.

Essentially, the IAM is "both theoretically and empirically grounded and attempts to capture 'the complete process of negotiation' involved in knowledge construction" (Wise & Chiu, 2011, p. 446). The IAM as a methodology measures the process of social construction of knowledge in online courses. While several studies have shown the advantages of using the IAM, some studies have also noted some limitations of the IAM.

Limitations of the IAM for Assessing Social Construction of Knowledge

Despite the IAM being identified as a prominent framework to conceptualize learner-learner interactions, previous studies have identified a common theme of inconsistencies. In the review of literature, a study which focused on studying the professional development of P-12 teachers in Singapore, mentions that the IAM phases in other studies show results that learners rarely "achieve higher phases of co-construction of knowledge" (Chai & Tan, 2009, p. 1314). Lucas et al. (2014) also acknowledge that complex thinking is rarely achieved and emphasize that "space for developing arguments or negotiating them becomes limited" especially "when participants only have to agree or disagree with a given statement" (p. 576). The IAM was not created to be used with either poorly constructed discussion prompts or students who may be new to creating knowledge regarding a new topic but it has been adopted to analyze discussion forums where this may be present

Other inconsistencies that researchers found in the IAM is that it does not account for time constraints set by instructors in discussions forums of working groups (Akarasriworn & Ku, 2013). Due to time constraints students may achieve higher levels of knowledge construction off-line which is not assessed in the IAM. That is something the IAM cannot do

because the IAM is text based. In addition, Ke et al. (2011) indicate that the student's knowledge is not always identifiable within a discussion post unless there is an ability to assess interactions outside formal learning environments, which excludes interactions in massive open online courses (MOOCs), recently popularized mechanism of informal online learning, which, by their very "open" nature are inclusive of a wider array of learners (Stich & Reeves, 2017). Interactions outside of the formal learning environment are left out of the IAM analysis, as the analysis solely focuses on text-based interaction present in the discussion forum.

Another limitation of the IAM is the inability to assess "'unspoken" interactions between participants and their environment, nor the chronological and systemic evolution of such interactions; as well it did not provide an accurate picture of the discussion flow nor the progress and development of students' knowledge (Lucas & Moreira, 2015). Sometimes online discussion forums do not flow steadily, one after another, and the IAM makes the assumption that each response builds upon a past post and does not account for external interactions that may have taken place. Within a threaded discussion, there is the assumption that a student has read what was posted and they are building off of what prior students have posted, although this may not always be true. The findings from previous studies confirm some contextual limitations of the tool developed to assess knowledge construction, which often depends on other variables or study limitations. This limitation is accounted for and should be considered when using IAM.

Wise and Chiu (2011), in their study which focused on how prescribed roles can influence a group's construction of knowledge, stated "while Gunawardena et al.'s (1997) model conceptualizes knowledge construction as a process which occurs though learners'

interactions (via their posts), previous work has not capitalized on its capacity to examine this process by analyzing patterns of KC [knowledge construction] groups constructing knowledge through a specific sequence of phases" (p. 447). In addition, Wise and Chiu add that the IAM "does not differentiate quality: a creative detailed proposed task solution may contribute more to a discussion than a simple opinion but both are coded as knowledge construction Phase 1" (p. 467). In turn, this adds to the argument that the specific phases of the IAM could be further reviewed and differentiated and that there may be ways to further breakdown and analyze the five phases.

Another limitation in the IAM is that the "qualitative analysis of content is often limited to specifying the quality of individual participation, which provides an understanding of the micro level of interaction" (Heo et al., 2010, p. 1385) and the measure of subtle negotiation cannot be captured and "does not reflect the true quality and meaning of students' learning knowledge construction through computer-mediated communication" (Hendriks & Maor, 2004, p. 27). In Osman and Herring's (2007) study of deep learning in cross-cultural contexts, students did not predominantly reach Phases IV and V as was predicted, essentially "reflect[ing] negatively on the usefulness of the Gunawardena et al. (1997) model, which has been criticized for being difficult to operationalize and implement (e.g., Kanuka and Anderson, 1998)" (p. 135). In response, although student's do not reach higher levels of knowledge construction in some discussions, this has not been identified as a limitation of the tool, but as an issue with numerous online discussions themselves or the participants.

Lastly, another limitation of the IAM is the historical lack of analysis of social dynamics. In the first study of IAM, Gunawardena et al. (1997), the developers of IAM, purposefully left out social dynamics. For example, Lucas and Moreira (2010), a study

focusing on online asynchronous discussions in a first-year Master's Degree course in Multimedia in Education, noticed that despite focusing on interaction as the vehicle of knowledge construction, the IAM does not have the capability of demonstrating social dynamics that go beyond the differing categories proposed for the specific phases for IAM. Although this limitation has been historically accounted for; recent studies have shown how social dynamics can be accounted for in future studies utilizing the IAM.

Discussion

The discussion will focus on recommendations for revision of the IAM, adaptions of the IAM, and specific conditions for supporting knowledge construction.

Recommendations for Revision of the IAM

It is important to note that the IAM framework mainly examines the evidence of collective knowledge development in an open-ended online debate forum (Ke et al., 2011). It was later used for group discussions and coding mostly open-ended and argument-natured comments, focused on collective development and meaningful thinking rather than contextualized individual cognition and content acquisition (Gee & Green, 1998; Ke et al., 2011; Marra et al. 2004). Marra et al. (2004) found the IAM to be a reliable from work for coding open-ended debates specifically. Ke et al. (2011) proposed that more research needed to be put into the variables that cannot be measured with the IAM, such as interactions outside of the online discussion forum. This would imply the need to address identified variables in studies utilizing the IAM that could potentially limit the analysis tool. For example, the minimum participation quantity affects how often students must participate to meet the learning objectives (Moore & Marra, 2005) and their discussions may not reach the highest level of knowledge construction correlating with testing and modification of the

proposed synthesis or co-construction (Kokic & Rukavina, 2017). This causes a major issue for the use of IAM as the lack of communication by the participants to clarify and discuss inconsistencies results in a nonfluid and nonsequential discussion which leads to nonexistent exchange of information between participants, and existing paradigms appear to remain unchanged (Kanuka & Anderson, 1998). This in-of-itself limits the IAM assessing all types of construction of knowledge.

Regardless of the rigor of the coding schema, the coding process is a subjective process with many nuances (Cragg et al., 2008). Previous studies have mentioned that the IAM tool does not give individual scores that distinguished among subcategories (Howell et al., 2014). Conflicts can arise when a message evidences multiple phases and operations but staying true to the IAM coding gives deference to the highest phase identified in a message; such an approach still leaves rooms for nuanced subjective interpretation (Cragg et al., 2008).

Gunawardena et al. (2016a) also showed the advantage of using many methods to analyze online discussions. Using multiple methods can provide insight into the social dynamics that accompany the process of the social construction of knowledge. Other researchers (e.g., Aviv et al., 2003; Kumar & Buraphadeja, 2010) have also used a mixed method approach in examining the relationship between knowledge construction and social networks. In turn, they have gained insight into social dynamics of online discussion forums, which is still the standard communication tool and used by online faculty in facilitating online discussions of course content, promoting social construction of knowledge among students, helping groups to achieve higher levels of knowledge construction. Further research in social dynamics in relation to knowledge construction is vital for greater understanding of social knowledge construction in online learning environments. Social dynamics are not

often focused in studies that have employed IAM. In the first study of IAM, Gunawardena et al. (1997), the developers of IAM, purposefully left out social dynamics. In returning to this idea, Gunawardena et al. (2016a), in a study which focused on relaying the benefits of using learning analytics and social network analysis when studying the social construction of knowledge asserted that "social network diagrams make the social dynamics of online learning tangible which extends the IAM analysis beyond its typical capacity of focusing on cognitive processes." In turn, the developers of IAM and other researchers have found that LA and SNA augment IAM by enlarging understanding of the socio-emotional dynamic that goes along with the knowledge construction process (Gunawardena et al., 2016a).

Adaptations to the IAM

A common consensus derived from previous studies suggests that the IAM provides sufficient explanatory power to accurately quantify cognitive activity among online learners by conducting content analysis on discussion posts to assess the construction of knowledge in an online environment. The IAM could be considered insufficient due to the debate context it was originally developed to assess, which causes the model to be severely limited in its applicability (Luebeck & Bice, 2005). Some previous studies identified new patterns that have emerged from transcript analysis (Kanuka & Anderson, 1998). In some cases, new codes were created to fit the study (Chai & Tan, 2009), or creating a new category, Phase 0, to account for conceptual background content (Osman & Herring, 2007). The adaptations of the IAM were completed until all the discussion posts were placed into appropriate categories and further analysis did not provide new information (Kanuka & Anderson, 1998). The need for a new category was recognized after several attempts of "refining the operationalization of the categories, particularly for Phase I, sharing and comparing

information, and Phase III, negotiation of meaning/co-construction of knowledge, due to the difficulty in differentiating" between the phases (Osman & Herring, 2007, p. 130). Other difficulties in differentiating occurred for "phases II, exploration of dissonance or inconsistency among ideas, concepts, or statements, and phase III, because indicators for those phases imply the existence of disagreement and a need to resolve a conflict" (Luebeck & Bice, 2005, p. 36).

The IAM may need to be adapted depending on the culture of the participants in the online discussion forum. For example, Chen and Starosta's (2000) study showed using debate format created issues for some participants, as this context is a product of low-context culture that requires a specific expression of one's argument by using logical reasoning. Students from Asia or Latin America found the argumentative format of debate to be uncomfortable in an academic context (Gunawardena et al., 2018, p. 121). This uncomfortable feeling can further affect students because the asynchronous debate is happening in a medium that does not allow for nonverbal interaction. In turn, further adaptations of the IAM may need to be created to make for a better way to analyze social construction in cultural environments that do not comfortably lend themselves to the progression of the IAM analysis.

Findings from previous studies have indicated that the volume in Phase I coding, sharing and comparing information, was significantly higher than in any other of the categories of constructing knowledge (Hendriks & Maor, 2004). This is a common finding when utilizing the IAM. One explanation is the "development of the IAM assumed—in fact contrived—a contentious context with the goal of resolving opposing viewpoints" (Luebeck & Bice, 2005, p. 36). Low scores in higher phase levels could be a result of the hesitancy to

assign higher values to messages due to the "lack of [IAM] indicators referring to dissonance, disagreement, and the need to negotiate opposing views" (Luebeck & Bice, 2005, p. 36). One recommendation to improve the IAM is to include more detailed and explicit boundaries between phases since few discussion forums reach higher phases of social construction of knowledge (Kanuka & Anderson, 1998, p. 72). It may prove "beneficial to identify the paths of discussions that progress to the higher phases of knowledge co-construction (e.g. the co-construction of meaning, the testing of new knowledge, and summaries and applications of new knowledge)" (Davis & Marone, 2016, p. 32). An analysis model that moves "away from learning through rational argument ("I will convince you") to a more fluid process of learning through interaction ("Let's pursue this together") would be more suitable to the student experience" (Luebeck & Bice, 2005, p. 36).

Conditions Supporting Knowledge Construction

Implications for designing online discussions that reach higher levels of social construction of knowledge could be better off by utilizing the following environments for the social construction of knowledge. Researchers from previous studies identified external conditions that encourage discussion to enhance the learning experience in online environments. It is important to consider understanding which external conditions would create the most successful online discussion (Howell et al., 2014). The first condition is the online environment, researchers recommend an open discussion environment to prevent participants from being perceived as confrontational, which could lead to feeling afraid or hesitant to question or challenge other's ideas (Hew & Cheung, 2011). "An open environment helps protect the participant's personal self-image from being threatened

because of the contributor's comments or opinions, which could terminate further contribution" (Hew & Cheung, 2011).

The second condition, the task design for online discussion forums can promote knowledge construction (Howell et al., 2014). Facilitators must try to ensure that participation protocols align with the task and intended objectives of the discussion board task which may contribute to more meaningful discussions and assist with reaching higher phases (Moore & Marra, 2005). Online environments rely on online discussion forum participation as the primary form of interaction, so it is recommended to utilize the appropriate levels of expected interaction among students and instructors to produce high levels of critical thinking (Belcher et al., 2015). "A certain amount of online interaction is a necessary factor [for consideration,] but the quality of online interaction is critical for successful outcomes" (Jakubec & Campbell, 2003, p. 1391).

The last external condition to consider is understanding the social context of online discussions. An analysis of this condition was purposefully left out in the original iteration of the IAM. The quality of online interactions can be improved by social presence. The objective of creating "social presence" among participants is to reduce the feeling of isolation (Moore & Marra, 2005). One recommendation is to assign roles in asynchronous group discussions and should be introduced at the state of the discussions to enhance the knowledge construction processes (De Wever et al., 2010). Assigning roles may help participants to reach higher levels of knowledge construction. "Social activities during knowledge construction with group members may lead to obtaining higher achievements" (Jakubec & Campbell, 2003, p. 1391). Previous studies suggest that structure of the online discussion forums is not enough to influence higher-level of thinking (Luebeck & Bice, 2005) so

developing social presence can be done by encouraging participants to give comments or opinions, show appreciation, contribute, and summarize more frequently may promote higher level knowledge construction in online discussions (Hew & Cheung, 2011). “Designers should create prompts that naturally encourage participants to collaborate in creating solutions and ideas or require them to choose an argument and defend their opinion” (Howell et al., 2014, p. 15). The desired outcome of understanding external conditions is higher-level thinking, negotiation of meaning, and eventual conceptual change (Luebeck & Bice, 2005).

Conclusion

Advantages and limitations of the IAM are evident in the different contexts in which construction of knowledge building is analyzed. The IAM is clearly a favorable framework amongst researchers who conducted studies analyzing collaborative online discussion forums for co-construction of knowledge. The consensus is that the IAM is a reliable, user-friendly, and theoretically and empirically grounded model. Contrarily, limitations of the IAM are apparent and accounted for in numerous studies. A common thread amongst researchers is that learners rarely do not achieve higher phases (Phases IV and V) of co-construction of knowledge when utilizing IAM (Chai & Tan, 2009, p. 1314). This is not a fault of the IAM, but is likely a product of the data that is being coded and the knowledge level of the participants in the forum, as many are novice students in relation to the topic. The IAM was originally developed in analyzing a discussion forum consisting of experts on a topic. In turn, there is a misconnect in the expectation for students to obtain the same higher levels of knowledge construction as experts in the field may be able to regarding a discussion forum on the same prompt. The inability to assess “unspoken interactions amongst the participants and their environment [which in turn] does not provide an accurate picture of the discussion

flow nor the progress and development of students' knowledge" (Lucas & Moreira, 2015, p. 1501) is also a part of the identified limitations of the developer's framework of IAM.

Previous studies that have utilized the IAM identified some issues, research gaps, and limitations. Previous studies have identified conflicts when coding messages as evidence of multiple phases and operations. The IAM provides sufficient explanatory power to accurately quantify cognitive activity among online learners when researchers stay true to the IAM coding. Some variables have been identified that could potentially limit the analysis tool. An example of this is the level of participation is a major limitation of the IAM as communication depends on participation level. The lack of communication is a major issue for the use of IAM as it leads to nonexistent exchange of information and existing paradigms appear to remain unchanged. There needs to be sufficient data and communication in order to effectively study the group's progression. There are also some external conditions that encourage discussion to enhance the learning experience in online environments. More understanding of external variables and conditions is required to further investigate the limitations of the studies that have employed the IAM to analyze collaborative online discussions for knowledge construction.

Social dynamics are infrequently addressed in the studies that have used IAM. Analyzing the social portion was purposefully left out of the initial iteration of the IAM. For this reason, future research should make a point to also address social dynamics through utilizing interdisciplinary methods such as LA and SNA. Employing the results of IAM to conduct SNA and LA can add value to the overall analysis. In fact, Gunawardena et al. (2016a) found that LA and SNA enrich IAM by expanding understanding of the socio-emotional dynamic that accompanies the knowledge construction process (Sanchez, 2019).

In addition, the development of an SCK lexicon can be used as the foundation for future studies that will use the IAM and social learning analytics (Sanchez, 2019). LA, SNA, and IAM can be used to assess multiple variables in relation to social dynamics to better account for a broader understanding of knowledge construction. Utilizing LA and SNA may offer new insights, expand future research opportunities, and offer a deeper understanding of the variables that can affect the social construction of knowledge.

Future Research

The IAM can be improved by:

- Utilizing many methods in combination (such as learning analytics and social presence lexicon analysis) to analyze online discussions which will further inform research studies that utilize the IAM.
- Comparing the IAM with other models that guide the social construction of knowledge**.**
- Identifying whether the online discussion forum's posting order affects the IAM analysis.
- Creating a lexicon or dictionary classifiers and concrete examples that fit within a specific phase in order to increase inter rater reliability.
- Further parsing out the phases of the IAM and potentially creating new phases or altering current phases, such as combining Phases IV and V.
- Determine a method to analyze the social environment of online learning in collaboration with IAM.
- Accounting for the cultural context of specific participants when analyzing the data, especially data related to participants from Latin America or Asia.

- Analyzing the environment outside of the formal learning context that the IAM does not analyze.

Some questions to consider from previous studies that will guide future research on the IAM, include “was the model or its application biased toward the first phase rating? Does the coding accurately reflect the interaction that took place in this forum?” (Kanuka & Anderson, 1998, p. 71). It is clear that a blank framework for content analysis may not be plausible, as emergent coding may provide interesting perspectives when examining how collaborative discussion contributes to the construction of knowledge. However, additional research is necessary to further analyze the IAM in an effort to conceptualize a more interpretive framework to resolve differentiating conflicts between the five phases of knowledge construction: Phase I sharing and comparing, Phase II dissonance, Phase III negotiation and co-construction, Phase IV testing tentative constructions, and Phase V application of newly co-constructed knowledge.

Paper 2: Empirical Research Study 1

Exploring the Relationship Between Social Presence and the Social Construction of Knowledge

Austin C. Megli

Abstract

The purpose of this study was to explore the relationship between social presence and the social construction of knowledge in the online learning environment. Social presence is the degree to which users in mediated communication perceive one another as "real" (Garrison et al., 1999) When Gunawardena et al. (1997) developed the IAM, which is based on socio-constructivist theory and is designed to analyze knowledge construction during collaborative discussions in virtual learning environments, they purposefully noted that the IAM was not developed to analyze the social environment of online learning. The model provides guidance for examining negotiation of meaning and co-construction of knowledge in collaborative learning environments by specifying five phases they observed during the process of knowledge construction: Phase I is sharing and comparing, Phase II is dissonance, Phase III is negotiation and co-construction, Phase IV is testing tentative constructions, and Phase V is the application of newly co-constructed knowledge. The social presence lexicon developed by Gunawardena et al. (2016a) was used in this study to assess the social presence score of a single discussion post. Spearman Correlation Coefficient was used to determine whether there is a relationship between the social presence score of a single discussion post and the five phases of the IAM. The Spearman Correlation Coefficient was used because the two variables information is skewed and not normally distributed due to most posts being Phase I, II, and III. In this data set, 82% of the discussion posts were either Phase I, II, or III.

Investigating social presence through utilizing learning analytics methods can shed light on whether social presence is related to knowledge construction. The result is that there is a positive moderate relationship between social presence and the maximum IAM phase of a discussion post.

Keywords: social presence, interaction analysis model, social construction of knowledge

Introduction and Literature Review

This study established, evaluated, and synthesized relevant research studies to answer this study's research questions. The Research One Southwestern University's library databases, Academic Search Complete, Education Research Complete, ERIC, Psych INFO, ProQuest Dissertation & Thesis, and the interlibrary loan service, were the primary search engines for the literature review. The keywords searched included *interaction analysis model*, *social construction of knowledge*, *interaction*, *social construction of knowledge*, *interaction analysis*, *social presence*, and *social presence analysis*. The only criterion for the search was to retain works that discussed or utilized the IAM or social presence in the study. There were no limitations set on the type of works, so data includes academic journals, books, dissertations and conference proceedings.

There are various competing definitions for social presence. Garrison et al. (1999) defined social presence as "the ability of learners to project their personal characteristics into the community of inquiry, thereby presenting themselves as 'real people'" (p. 89). Short, Williams, and Christie (1976) defined social presence as the "degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships" (p. 65). Garrison et al. (1999) defined social presence as "the ability of learners to project their personal characteristics into the community of inquiry, thereby presenting themselves as 'real people'" (p. 89). Gunawardena and Zittle (1997) determined that social presence is a significant predictor of participant satisfaction in computer mediated communication. The objective of creating "social presence" among participants is to reduce the feeling of isolation (Moore & Marra, 2005). Finding ways to increase social presence can be done by motivating participants to give their comments or opinions, to show their appreciation for others, to find

ways to contribute, and to summarize more frequently so that they may promote higher level knowledge construction in online discussions (Hew & Cheung, 2011).

This social presence lexicon utilized in this study was adopted from Gunawardena et al.'s (2016) social presence lexicon and was used to determine the degree of social presence exhibited by the specific posts in the online discussion. In Gunawardena et al. (2016a) the researchers were not able to confirm whether higher levels of social presence in a posting was associated with higher IAM phases due to the small data set they worked with. Another limitation in that research study was that the data set used did not contain the full range of IAM phases, as Phase III was the maximum phase observed. Investigating social presence through learning analytics methods can shed light on whether social presence is related to knowledge construction and can also save time when analyzing communications (Sanchez, 2019).

The IAM, developed by Gunawardena et al. (1997), characterizes five phases in the social construction of knowledge, which users cycle through when engaged in computer-mediated discussions (see Figure 1 for description of each phase). Phase I is sharing and comparing, Phase II is dissonance, Phase III is negotiation and co-construction, Phase IV is testing tentative constructions, and Phase V is the application of newly co-constructed knowledge. The IAM is based on socio-constructivist theory and is designed to analyze knowledge construction during collaborative discussions in virtual learning environments (Saritas, 2006). Gunawardena et al. (1997) developed the IAM while examining a transcript of an online debate. The model provides guidance for examining negotiation of meaning and co-construction of knowledge in collaborative learning environments by specifying five phases they observed during the process of knowledge construction: Phase I is sharing and

comparing, Phase II is dissonance, Phase III is negotiation and co-construction, Phase IV is testing tentative constructions, and Phase V is the application of newly co-constructed knowledge. The IAM has the ability to measure whether discussion has led to new knowledge. It also provides an avenue for studying the process of acquiring that knowledge—the means by which new knowledge is achieved (Luebeck & Bice, 2005). Gunawardena et al. (2016a) also showed the advantage of using many methods to analyze online discussions. Using multiple methods can provide insight into the social dynamics that accompany the process of the social construction of knowledge.

This paper is organized into four sections. Section one contains the introduction and literature review of the study. Section two includes the research questions to be answered by the research, which is further described by the specific hypothesis and methods. Section three consists of the results of the research. The final section discusses the conclusion and implications of this research.

Research Question

Is there a relationship between a higher education discussion board post's social presence score and the five Interaction Analysis Model phases?

Research Design

In this section I cover the research design of the study. This study utilizes a correlational research design. A correlational research design is appropriate for this research study because the purpose of the study is to try and determine whether social presence is related to social construction of knowledge. Table 3 identifies the research design of this study and identifies the research questions, design, data, instruments, and analysis methods.

Table 3

Research Design of Megli (2022)

Research Questions	Design	Data	Instruments	Analysis Method
Is there a relationship between a discussion board post's social presence score and the five IAM phases?	Correlational Research Design	122 postings from an online discussion board on the topic of culture in two graduate level courses in the learning sciences.	Interaction Analysis Model Social Presence Lexicon Analysis	Spearman Correlation Coefficient

The variables used in this analysis are the maximum IAM phase score and the social presence score of a single discussion post within the entire discussion board on the topic of culture. The maximum IAM phase score is a categorical variable and can either be I, II, III, IV, or V. The social presence score is a continuous variable. This study is needed because it helps to fill this research void by analyzing the relationship between social presence and the social construction of knowledge in a specific and well-defined context for online education.

Sample

The sample used for this study consisted of 122 postings from an online discussion board on the topic of culture in two graduate level courses in the learning sciences. The data was de-identified before being provided to the researcher.

Data Analysis

SPSS 28, Microsoft Excel, and R-studio were used to analyze the data for this study. First, the researcher focused on analyzing the data in order to obtain the counts of each IAM phase along with the signaling words for each of the five phases. The two sets of discussion posts were qualitatively analyzed and coded by four doctoral level researchers in Microsoft Excel (see Appendix B). In groups of two, the researchers were assigned one of the two

transcripts. The researchers first individually coded the transcripts assigned to them and then worked in pairs to compare their individual analysis of the same transcript to check and ensure interrater reliability. When areas of disagreement were found, the researchers revisited the specific post and came to a consensus based on the best fit of the five IAM phases along with the words that were appropriate for the Social Presence Lexicon. The Social Presence Lexicon was then compiled to include words identified from the transcripts along with data previously compiled in Gunawardena et al. (2016a) Social Presence Lexicon. In addition, the data was cleaned to remove punctuation, therefore all of the words in the lexicon are without punctuation. Punctuation was removed because it is not always appropriately used in online discussions. Through this process, a total of 170 words were identified for the Social Presence Lexicon (list of words shown in Appendix C).

The Social Presence Lexicon was adopted by the researcher and was informed by Gunawardena et al. (2016a**)** and Whiteside and Dikkers (2012) previous research regarding the type of words that are indicative of online social presence. Gunawardena et al. developed the lexicon by choosing words which were chosen from the IAM coded transcripts and through analyzing previous research on social presence that identified language indicative of adding to social presence in the social environment of online learning. In order to assess social presence, words that contribute to the creation of social presence were used. Words appropriate for the categorization were identified by conducting a content analysis of the transcript. The transcripts were imported into Microsoft Excel, with each post placed in its own cell. Next, the words from the lexicon were input into R-studio. An algorithm in R-studio was then run on all of the rows of each transcript (algorithm shown in Appendix D).

The output of this analysis is the social presence score for each row corresponding to a single post.

In order to identify whether there is a relationship between social presence and the IAM phase of a single discussion post the data was inputted into SPSS 28 to calculate the Spearman Correlation Coefficient for the relationship. De-identified text data (discussion posts) from previous online courses where grades have already been assigned does not constitute "human subjects" research. An Institutional Review Board (IRB) review was not required for this study.

Findings

In this section I will discuss the descriptive statistics for the variables in the study. I will also include the appropriate tables and figures to support the text that presents and discusses the descriptive statistics. Lastly, I will present the hypothesis test with the Spearman Correlation Coefficient analysis and the results.

Descriptive Statistics

This study consisted of a sample of 122 discussion board posts from two separate discussion boards. Both online discussion forums exemplified interactions between students over 1-week of the semester in a 16-week fully asynchronous course. The first discussion board had 48 posts and the second discussion board had 74 posts. Both discussion boards exemplified the full range of IAM phases with 40.2% of the posts being Phase I, 23.8% Phase II, 18% Phase III, 6.6% Phase IV, and 11.5% Phase V, 82% of the discussion posts exemplified either Phase I, Phase II, or Phase III. The social presence score of the posts ranged from 4 to 77. The mean social presence score for the posts was 32 with a median score of 31.

Hypothesis Test

In this section I will present and discuss the one hypothesis test that is being analyzed with this data set.

Relationship Between Social Presence Score and Maximum IAM Phase

The null hypothesis is that there is no relationship between the social presence score and maximum IAM phase of a single discussion post. The Spearman Correlation Coefficient ($r = 0.431$, $p > .001$) indicates a positive moderate statistically significant relationship between the social presence score and maximum IAM phase of a single discussion post. Thus, I will reject the null hypothesis that there is no relationship between social presence score and maximum IAM phase of a single discussion post.

Discussion

In returning to the research question of 1) is there a relationship between social presence score and the maximum IAM phase of a discussion post, there is a positive moderate statistically significant relationship between the social presence score and maximum IAM phase. This means that there is an indication of a relationship between the two phenomena of social presence and social construction of knowledge. This relationship is moderate and further testing this relationship on a larger data set in the future may prove useful to determine whether the relationship continues to hold true in other contexts of online education.

Conclusion

In conclusion, my research question explored whether there is a relationship between social presence score and the maximum IAM phase of a single discussion post in the online learning environment. In utilizing the Pearson Correlation Coefficient analysis I was able to

determine that there is a positive moderate statistically significant relationship between social presence and the social construction of knowledge. This research study analyzed this relationship in a data set that exemplified all five phases of the IAM. Using Social Presence Lexicon Analysis can identify discussions which reach higher levels of construction of knowledge. This research relays the importance of teaching students to utilize personable language in online discussion forums. The Social Presence coding process is difficult and time consuming. In turn, utilizing an automated process will help teach future researchers who use Social Presence Lexicon Analysis how to code properly while also saving them time in the process. This will also allow Social Presence Lexicon Analysis to be used in more widespread ways, as the amount of time consumed while analyzing a discussion is reduced in comparison to manual coding. Researchers should be able to analyze more transcripts at quicker speeds which will allow researchers to assess larger data sets. A limitation of this lexicon is that it was solely developed from analyzing discussions in the graduate higher education context and has not been tested in informal learning environments or on undergraduate online discussion forums. Another limitation of the social presence lexicon is that it does not currently track misspelled words; if a word is misspelled then the algorithm will not identify the word and attribute it to the social presence score of a post, which may lead to an underreporting of social presence scores for certain posts. Lastly, the lexicon is only applicable for English transcripts at this time, so a lexicon will need to be developed for use with different languages.

This lexicon can be used to mine large amounts of data, specifically in online discussion forums and transcripts. This tool can also be used to further increase interrater reliability during the IAM coding process due to the moderate positive relationship; posts

that have a higher social presence score are more likely to be a higher phase of IAM. In utilizing the social presence lexicon, it is possible to analyze large data sets that would normally take a large amount of time to analyze without computer assistance. Future research should focus on creating a lexicon for the IAM coding process in order to save even more time when analyzing discussions. The IAM process takes time itself, so a lexicon should be developed to predict IAM. Future research should also take into account colloquial language utilized in informal communications. Higher education transcripts likely use more formal language than that which is used in informal conversations. As well, further research into the social dynamics of the online environment in relation to knowledge construction is vital for a broadening the understanding of how knowledge construction can best be constructed in the online learning environment.

Paper 3: Empirical Research Study 2

Determining Whether Social Presence is a Predictor of Social Construction of Knowledge

Austin C. Megli

Abstract

In online courses students must utilize computer mediated communication tools in order to interact with other students and their instructors in the online environment. This study seeks to determine whether social presence can significantly predict the interaction analysis model (IAM) phase of a discussion post in an online discussion forum in higher education courses. Social construction of knowledge is defined by Gunawardena et al. (1997) as "the construction of knowledge within the group by a process of social negotiation." Social presence is the ability of learners to portray and project their own personal characteristics into a community of inquiry in computed mediated communication, presenting themselves as "real people" (Garrison et al., 1999). This study utilized combined content analysis; both social presence lexicon analysis and interaction analysis based on the IAM in order to analyze online discussion forums to determine a social presence score and the phase of social construction of knowledge of individual discussion posts. These two variables were then input into SPSS 28 to run an ordinal logistic regression to determine whether there was a significant predictive relationship. The results revealed a significant ($p > .001$) regression equation for the model, which is social presence is a positive significant predictor ($B = .140$, standard error = .006, $p < .001$) of the probability of a discussion post being a higher IAM phase as opposed to a lower IAM phase. Identifying this predictive relationship relays that

increasing social presence in online courses can likely positively increase social construction of knowledge in asynchronous online discussion forums.

Keywords: combined content analysis, social presence, social construction of knowledge, interaction analysis

Introduction

Online education is seeing rapid growth across the globe in the post-COVID world ever since students were forced into emergency remote situations and were exposed to online education at a large scale (Moore et al., 2021). There were over 5.8 million exclusively distance education student enrollments in higher education in the United States during the 2020 academic year, which increased by 93% from 2019 with there being around 3 million exclusively distance education students (National Council for State Authorization Reciprocity Agreements, 2021). In online courses, students must utilize computer mediated communication tools in order to interact with other students and their instructors in the online environment. One of these tools, typically situated within the learning management system, is the asynchronous online discussion forum, which has a major role in asynchronous online courses by supporting both social and educational activities (Gunawardena et al., 2016a). To improve the facilitation of collaborative online learning and social knowledge construction, it is necessary to ensure and improve social interaction and collaboration among online learners (Guo et al., 2022). To do this, researchers and instructors must develop ways to analyze both social construction of knowledge and social presence in the social environment of online learning. Social construction of knowledge is defined by Gunawardena et al. (1997) as "the construction of knowledge within the group by a process of social negotiation." Garrison et al. (1999) defined social presence as "the ability of learners to project their personal characteristics into the community of inquiry, thereby presenting themselves as 'real people'" (p. 89). Megli (2022) established a relationship between social presence and social construction of knowledge. This study will further examine social presence and social construction of knowledge through combined content analysis and whether social presence

can be used as a predictor of social construction of knowledge in online higher education discussion forums.

Context

Online discussion forums have been a staple of the social environment of online learning for decades. Online discussion forums are situated in learning management systems, are used as a means for most commonly text-based interaction, and can be used for many purposes such as helping students to review material prior to an assignment or exam, engaging students in discussion of course material before coming to class, and reflecting on material that they have read or worked with outside of class. Online discussion forums are regularly used to promote regular and substantive interaction in online courses, which is a federal compliance requirement for distance education which was further clarified in the Distance Education and Innovation Regulations published in 2021, which ensures that students have a means to regularly interact with one another in a distance education course (Institutional Eligibility Under the Higher Education Act of 1965, 2021). The online discussion forum is a valuable means to allow both teachers and students to express their thoughts, impart individual experiences, and build bonds with their colleagues without having to account for barriers related to time or location (Gao et al., 2013; Johnson, 2008). Within this context of the online discussion forum environment, both learning and social interaction takes place. It can be challenging to build relationships in the online context in comparison to the in-person learning environment due to the missing social cues which are apparent in face-to-face communication (Cobb, 2009; Kear et al., 2014). To this end, this context necessitates mechanisms to analyze social interaction and learning in order to identify techniques that more positively increase outcomes for students in online learning

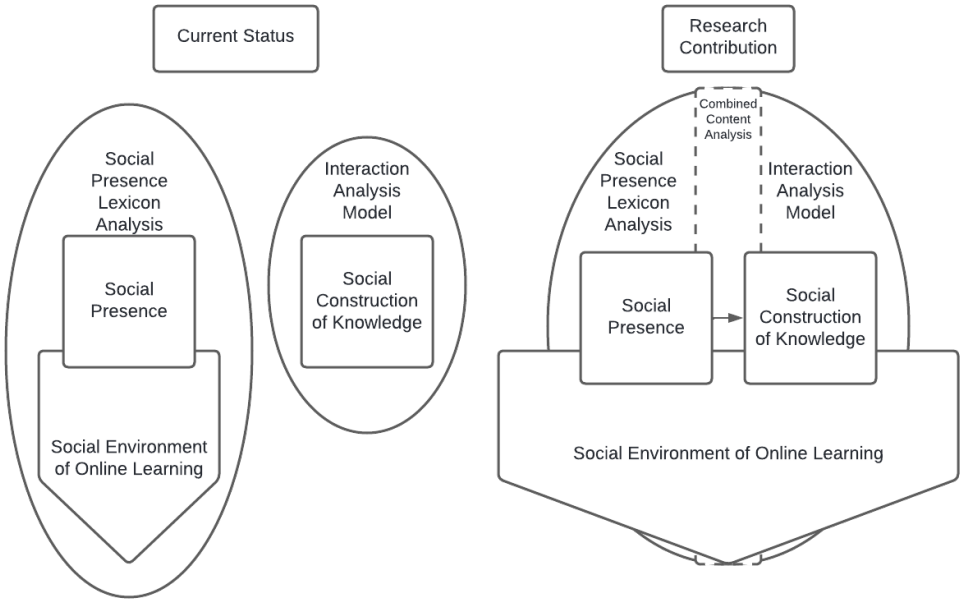
environments. In both in-person and online social environments, when students connect with other students in new social situations they are able to create social presence and an increased degree of interpersonal contact (Aragon, 2003; Gunawardena & Zittle, 1997).

Theoretical and Conceptual Framework

The conceptual framework for this study is presented in Figure 2.

Figure 2

Conceptual Framework



The illustrated conceptual framework for this study was developed to exemplify the author's perception of the various concepts in this study. Starting on the left side, the "current status" indicates the author's framing of current research and the relationships between social presence, the social environment of online learning, and social construction of knowledge. Social presence lexicon analysis can be used to analyze social presence and the social environment of online learning, but not social construction of knowledge. The interaction analysis model (IAM) can be used to analyze social construction of knowledge. On the right

side is the how the author believes the “research contribution” of this study will bridge the relationships between these variables. By utilizing combined content analysis, which will be defined in the methods section of this study, social presence lexicon analysis and the IAM can be used in combination to better understand the social environment of online learning. The social environment of online education surrounds the more specific relationship between social presence and the social construction of knowledge. The social environment of online education is the foundation for which social presence and the social construction of knowledge sit upon and are topics within the social environment of online learning. There is a line between social presence and the social construction of knowledge indicative of the positive moderate significant relationship between the two phenomena as identified in Megli (2022). The three theoretical frameworks for the conceptual framework are further discussed below.

The Social Environment of Online Learning

The social environment of online learning is a virtual “place” where students can interact and build relationships with each other. Within this online environment social connections can be harder to develop due to lack of immediacy in asynchronous online learning environments. Techniques have been identified to support online community building in online learning environments such as facilitator and participant introductions, cyber cafes, communities, desktop or mobile conferencing, and netiquette (Gunawardena et al., 2018). Students who build relationships show increased student engagement which in turn stimulates learning (Trowler, 2010). As well, interactions in the social environment with peers can positively increase student success, learning, self-esteem, and persistence (Kuh et al., 2008). Online discussion forums have been identified and developed as a means for

students to build beneficial social connections in asynchronous online environments. Students need to feel intimacy and immediacy of communications to succeed in the social environment of online learning (Argyle & Dean, 1965; Wiener & Mehrabian, 1968). “Social learning environment (SLE) is used to support not only learning activities from the institutional e-learning system, but also problem solving, collaboration, and communication with instructor and their peers” (Raspopovic et al., 2017). Within this social environment of online learning, through the utilization of online discussion forums, students are able to collaborate to construct knowledge and build social presence with one-another. When researching and studying the online environment, many researchers have identified the importance of using multiple methods to better understand the process and progression of social knowledge construction in online discussions (Gunawardena et al., 2016a; Lucas et al., 2014; Wise & Chiu, 2011). To summarize, there are many aspects of the social environment such as locations for collaboration and interaction, relationship building, engagement, and learning opportunities. Social presence is one of the key features of the social environment of online learning.

Social Presence

Garrison et al. (1999) defined social presence as “the ability of learners to project their personal characteristics into the community of inquiry, thereby presenting themselves as ‘real people’” (p. 89). With this in mind, when participants interacting with each other are perceived as real persons who engage with other students and they are able to create a personal connection, students are more likely to learn and enjoy what they are learning (Rourke et al., 2001). Over the years, online instructors have found that social presence is important in online education because it sets the climate for learning to take place (Caspi &

Blau, 2008). Within the context of online education, social presence is a vital part of the social environment of online learning because it adds the human elements of face-to-face communication into online interaction (Marmon, 2018). Social presence can be conveyed through various mediums in the social environment of online education and positing research within the specific medium, such as text-based communication in online discussion forums is useful for contextualizing research on social presence (Lambert & Fisher, 2013). Social presence can be exemplified through text-based communication and voice-based communication within the online discussion forum setting (Chen & Bogachenko, 2022). Past studies regarding social presence have identified that social presence can be used to increase knowledge, improve instruction, and help to build a sense of community (Biocca et al., 2003; Rourke et al., 2001; Tu & McIsaac, 2002; Whiteside, 2015; Whiteside et al., 2017). Alternatively, a decrease in social presence in an online environment has been shown to increase a student's dissatisfaction with the course and increase student drop rates in courses (Cui et al., 2013). Other factors associated with a lack of social presence in online communication are negative impacts on student perceived learning and satisfaction, online communities, and interaction (Garrison et al., 1999; Gunawardena & Zittle, 1997; Richardson & Swan, 2003; Tu & McIsaac, 2002). In comparison to traditional face-to-face education, students in online courses are more likely than their counterparts to feel isolated and alienated, experience lower social presence, and as a result of this have higher attrition (Wei et al., 2012). Also, the context in which the learners are participating can affect the level of social presence students display in online environments. For example, in a study of Ghanaian female students they identified they preferred anonymity to safely portray their personal views when participating in online discussion forums in online courses whereas they

would not have been as comfortable to socially participate in traditional face-to-face discussions (Gunawardena et al., 2016b). Depending on the cultural context of a participant, the participant may desire a different degree or level of social presence in online discussion forums. As well, in countries and locations where female students may be prevented or discouraged from pursuing education the anonymity aspect of online education can provide a safe place for these students to learn and socially construct knowledge that is not available to them in their in person contexts, which may discourage this student population from building social presence in online courses. Researchers have yet to determine whether higher levels of social presence can be used to predict higher levels of social construction of knowledge.

Researchers have developed instruments to measure social presence through survey techniques, such as Gunawardena and Zittle's (1997) "Social Presence Scale" which uses a Likert scale to determine an individual's social presence score. Tu (2002) developed the "Social Presence and Privacy Questionnaire" which measures a learner's attitude towards the computer mediated communication and a learner's feeling of privacy. Kreijns et al. (2011) developed a "Social Space Scale" which has been determined to be useful in measuring social presence, specifically the social space. These instruments require a survey to be administered to participants who are actively participating in a live course in order to determine their current self-reported measure of social presence. Instead of utilizing survey instruments, this study will utilize text-based data from past online discussion forums. This study utilized a social presence lexicon, which analyzes social presence at the text-level of an online discussion forum and can look at historic online discussion forums to elicit whether social presence existed in individual discussion posts. A lexicon can be used to measure a

construct through automated analysis of bodies of text to determine whether the words that exist in the lexicon also exist in the body of text.

The social presence lexicon that was used in this study was generated using Gunawardena et al.'s (2016a) social presence lexicon, which is available in Appendix C, and is used to determine the degree of social presence exhibited by the specific posts in the online discussion. Gunawardena et al.'s (2016a**)** lexicon used words that contributed to the creation of social presence (Sanchez, 2019). The resultant score from the lexicon analysis indicated how much social presence was being created in each post. For example, if a discussion post stated "both of your ideas make sense to me," then the social presence score would be five because there is a total count of five words that indicate social presence in the discussion post from the social presence lexicon (see Appendix C).

Liu (2012) determined that one of the approaches to developing a lexicon is by using a dictionary and thesaurus to generate a comprehensive lexicon based on seed words that represent the data set along with manually coding words into categories and assigning their orientation by hand. The lexicon does not differentiate between positive and negative words, as the social presence lexicon is used to determine the level of social presence in a single discussion post and not whether there is a positive or negative sentiment of a post. When a word is matched to the lexicon the social presence score of a post increases by one. Gunawardena et al. (2016a) utilized a content analysis to add additional words to the lexicon which were specific to the data being analyzed. The list of the words utilized in this lexicon are located in Appendix C. In Gunawardena et al. (2016a) the researchers were not able to confirm whether higher levels of social presence in a posting was associated with higher IAM phases, which caused the researcher to delve into this unanswered question in Megli

(2022). Another limitation in that research study was that the data set used did not contain the full range of IAM phases, as Phase III was the maximum phase observed. In turn, a larger analysis is needed which includes online discussion forums exemplifying the full range of IAM phases to determine whether there is a relationship between social presence and social construction of knowledge. Investigating social presence through learning analytics methods can shed light on whether social presence is related to social construction of knowledge and can also save time when analyzing communications (Sanchez, 2019). Various instructor facilitated actions can aid in increasing social presence in online learning environments such as utilizing participant introductions, online spaces where students can discuss freely or in communities, web conferencing, and the implementation of netiquette in online discussions (Gunawardena et al., 2018). Lastly, the format of the discussion prompt and tasking from the instructor can have an impact on social presence in online discussion forums (Lowenthal & Dunlap, 2020).

Social Construction of Knowledge

Social construction of knowledge is defined by Gunawardena, Lowe, and Anderson, (1997) as "the construction of knowledge within the group by a process of social negotiation." Within asynchronous online education, Dawson (2006) identified the online discussion forum as a tool that provides a useful and valuable communication and interaction area for participants in online courses; a location where knowledge can be socially constructed. Padilla and Layne (2017) identified several factors that contribute to social construction of knowledge such as inquiry provoked by facilitator, team projects, team mentoring, and individual mentoring. The IAM is the method of choice for measuring social construction of knowledge in this study. The IAM is based on social constructivist theories of

learning and researchers in this area believe knowledge is socially constructed (Vygotsky, 1978). Gunawardena et al. (1997) developed the IAM as a method to measure social construction of knowledge and it is made up of five phases: Phase I sharing and comparing, Phase II dissonance, Phase III negotiation and co-construction, Phase IV testing tentative constructions, and Phase V application of newly co-constructed knowledge. This model identifies the various levels of social construction of knowledge that students may exhibit in online discussion forums. The IAM is a commonly used method for analyzing social construction of knowledge and is also considered to be "one of the more reliable and user-friendly models" (Chai & Tan, 2009, p. 1306; Commander et al., 2016). The model has been utilized by many researchers over the past 20 years to study social construction of knowledge in online discussions (Akarasriworn & Ku, 2013; Aviv et al., 2003; Davis & Marone, 2016; De Wever et al., 2010; Dubovi & Tabak, 2020; Gomez, 2018; Gunawardena et al., 2016a; Guo et al., 2022; Heo et al., 2010; Hew & Cheung, 2011; Howell et al., 2014; Kumar & Buraphadeja, 2010; Lucas et al., 2014; Sanchez, 2019), and by 2014, Hall had identified that that it had been used in over 40 published research studies. To date, Gunawardena et al.'s (1997) article has over 2,500 citations on Google Scholar.

External conditions that support social construction of knowledge in online discussion forum environments are the online environment, task and prompt design of the online discussion forum, and the social context of online discussions (Hew & Cheung, 2011; Howell et al., 2014; Jakubec & Campbell, 2003). Specifically the format of the social context, or social environment, of online learning can either assist with or detract with the achievement of higher levels of social construction of knowledge. An open online discussion forum environment that does not lead to confrontation or feelings of hesitancy can assist with

students obtaining higher levels of social construction of knowledge (Hew & Cheung, 2011). Online discussion forums that are task or prompt oriented can assist students with having more meaningful discussions that can lead to higher levels of social construction of knowledge (Moore & Marra, 2005). Instructors who design online discussion forum prompts should account for the social environment and develop situations where participants are naturally able to contribute solutions and ideas to lead to higher levels of social construction of knowledge. Researchers have studied various technologies to promote knowledge construction in online discussion forums such as text based, video based, and voice based discussions and have found text-based forums to yield higher levels of social construction of knowledge (Guo et al., 2022). Determining whether different phenomena are associated with increasing social construction of knowledge in text-based online discussion forums will assist students with higher-level thinking and developing more higher levels of knowledge. Higher levels of social presence may be associated with higher levels of social construction of knowledge.

Depending on the cultural background of the participants, moving through the levels of social construction of knowledge may not be linear nor may all participants be comfortable with all phases of social construction of knowledge, such as the negotiation phase. Gunawardena et al. (2018) discussed that many students who come from Latin America and Asia may find the argumentative format of a debate type online discussion forum to be discomforting, which may prevent students from moving through the levels of social construction of knowledge due to this format being uncomfortable in low context cultures that “require a direct expression of one’s argument by logical reasoning” (p. 121). The cultural background of participants may be related to how participants express their

presence online, and understanding cultural context for which the participants are participating is needed.

Purpose

The purpose of this study is to determine whether social presence can be used to predict the IAM phase of a discussion post in an online discussion forum in higher education courses. This study extends research into the relationship between social presence and social construction of knowledge in the social environment of online learning. Since social presence can be taught or coached, and if it so turns out that social presence an significantly predict IAM phases, then the importance of social presence in computer mediated communication will be further lifted to the forefront in research in the field of distance education.

Research Question

This study focuses on analyzing online discussion forums in higher education from asynchronous fully online courses. After completing an empirical study which determined that there is a significant moderate positive relationship between social presence and social construction of knowledge there is a research need to further explore this relationship in a study with a larger data set to increase the reliability of the findings in the specific context of online discussion forums in higher education. Therefore, the goal of this study is to determine whether social presence is a predictor of social construction of knowledge in online discussion forums in higher education. The research question for this study is: Can social presence predict the IAM phase of a discussion post in an online discussion forum in higher education courses?

Method

This section will cover the methodology of the study and will focus on the research design, data collection and screening, IAM, and social presence lexicon analysis.

Research Design

To analyze the content, structure, and context of the online discussion forums this study used combined content analysis, a framework developed by Hamad et al. (2016), which incorporates a mixed-methods design for textual analysis. Table 4 presents the research design for this study showing the research questions, research design, data, instruments, and analysis used in this combined content analysis study.

Table 4

Research Design of Paper 3

Research Questions	Design	Data	Instruments	Analysis Method
Can Social Presence predict the IAM phase of a discussion post in an online discussion forum in higher education courses?	Combined Content Analysis	Discussion board postings from de-identified asynchronous online courses at both the undergraduate and graduate level.	Interaction Analysis Model Social Presence Lexicon Analysis	Ordinal Logistic Regression

In combined content analysis methodology, the first step is preparation, step two is organization, and step three is interpretation and presentation. Step one focuses on identifying research questions and the focus of the study. Preparation also focuses on the organization of the research design, which here is a mixed methods research design utilizing the IAM based on qualitative content analysis, and social presence lexicon analysis based on text analysis and quantitative data. Step two is related to the organization of the study,

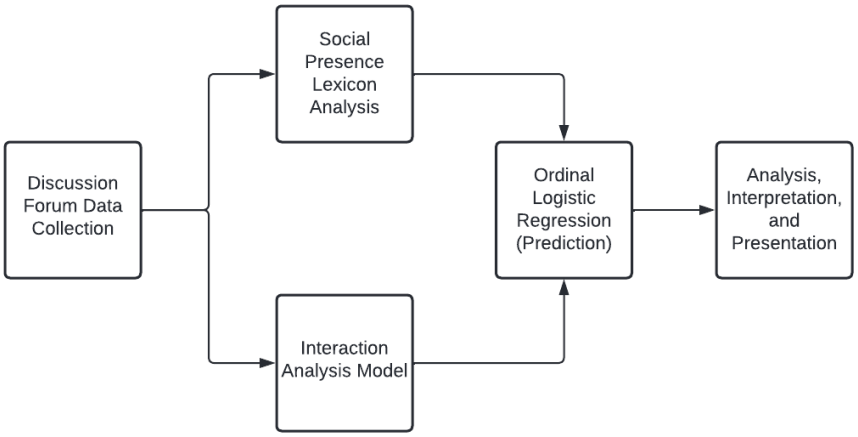
sampling, and coding. The sample used in this study consists of online discussion forums from asynchronous online courses, both graduate and undergraduate, from the Organization, Information, and Learning Sciences program at the University of New Mexico. Within the Organization, Information, and Learning Sciences program, the specific courses all focused on instructional design and technology, eLearning, and design for online learning. The researcher emailed and spoke to instructors within the Organization, Information, and Learning Sciences program at the University of New Mexico and requested instructors to voluntarily provide de-identified online discussion forum data from online discussion forums in asynchronous online courses that were based on prompts that asks students to co-construct knowledge and collaborate in the online discussion forum. The researcher received permission to analyze the de-identified data from all instructors who provided de-identified data for this study. Instructors also provided the prompts to the online discussion forums so the researcher could verify whether students were being asked to co-construct knowledge and collaborate. Example of how the online discussion forum prompts used in this study asked students to co-construct knowledge and collaborate was to "build on the moderator's post and discuss whether you agree with his/her definitions and why you agree, and if you disagree, how you will change the definitions building on what other class members have contributed," and another online discussion forum prompt asked students to "analyze and reflect on competencies for online learning and respond to at least two classmates after making an initial post."

Coding was completed in two steps, first utilizing the IAM and second using social presence lexicon analysis. The coding using the IAM was completed manually in Excel. The researcher and assistant examined the entire transcript of each individual post and then

assigned the IAM phase score, as exemplified in Appendix B, to each individual discussion post. Each discussion post, which is considered a unit of analysis, was qualitatively coded and received an IAM phase score. The coding using social presence lexicon analysis, which was based on the Gunawardena et al.'s (2016a) social presence lexicon, utilized an algorithm (Appendix D) in RStudio which counts the number of words identified in the social presence lexicon which contributed to the social presence score of a single discussion post. The output of this analysis is the social presence score. The data was cleaned to remove punctuation; all words had punctuation removed because it is not always appropriately used in online discussions and the social presence lexicon does not analyze punctuation. The social presence score and IAM phase measure the same unit of analysis: a single post made by a participant in the online discussion forum. The IAM phase score of I, II, III, IV, or V, and social presence score was then entered into SPSS in order to run the ordinal logistic regression on the data. Step three focused on interpretation and presentation, and the study utilized ordinal logistic regression analysis to determine whether social presence can be used as a predictor for social construction of knowledge. Figure 3 shows the study's combined content analysis design.

Figure 3

Combined Content Analysis Research Design



Data Collection and Screening

The data collected in this study was de-identified online discussion forum transcripts in higher education online discussion forums in 8-week and 16-week asynchronous online courses at the University of New Mexico. All data used in this study was de-identified prior to the researcher obtaining access to the data. The researcher received permission from all instructors whose courses de-identified data was used in this study. De-identified texts data (discussion posts) from previous online courses where grades have already been assigned, does not constitute "human subjects" research. An Institutional Review Board (IRB) review was not required for this study.

In relation to the sample, this study utilized convenience sampling of online discussion forums that have already been de-identified prior to the researcher receiving the data. This sample should be considered representative sample of the population of asynchronous online courses within the Organization, Information, and Learning Sciences program related to eLearning, design for online learning, and instructional design and technology due to the amount of online discussion forums utilized. The data set included 24

unique online discussion forums from 9 separate courses with a total of 1,209 unique discussion board posts. This is also likely a representative sample of the larger population due to the utilization of solely asynchronous online course discussion forums in a single subject area at a single institution. The researcher, both verbally and via email, requested online discussion forums from courses in the Organization, Information, and Learning Sciences program at the University of New Mexico. The discussion activities are initiated by the instructor of the course who decides a prompt for the students in the course. Information that was gathered for each transcript included whether the transcript was from an undergraduate or graduate course, and the length of the course. The context of the online discussion forum can take a role in determining the results of the study; as the participants in the online discussion forum can be differently situated in their education pursuit as they may be undergraduate students or graduate students, and may be enrolled in accelerated course formats, such as 8-week courses, due to personal situations or personal preference. After reviewing the de-identified online discussion forum data to ensure the prompts asked students to co-collaborate and construct knowledge, the transcripts were then entered into Microsoft Excel for qualitative coding and quantitative analysis. The IAM was used for the qualitative coding and social presence lexicon analysis was used for the quantitative analysis. After coding and analyzing, each individual post was given a social presence score (0 to 84) and an IAM phase score (I to V).

Interaction Analysis Model

Utilizing the IAM as a method, researchers can qualitatively analyze knowledge-building processes within a collaborative group (Gunawardena et al., 2018). The IAM, developed by Gunawardena et al. (1997), characterizes five phases in the social construction

of knowledge process which users cycle through when engaged in computer-mediated discussions (see Figure 1 for description of each phase). Phase I is sharing and comparing, Phase II is dissonance, Phase III is negotiation and co-construction, Phase IV is testing tentative constructions, and Phase V is the application of newly co-constructed knowledge. The process of knowledge co-construction happens in Phases I, II, and III while the process of knowledge legitimization in a community happens in Phases IV and V. The IAM is based on socio-constructivist theory and is designed to analyze social construction of knowledge during collaborative discussions in virtual learning environments (Saritas, 2006). Gunawardena et al. (1997) developed the IAM while examining a transcript of an online debate. The IAM is one of the most reliable (Marra et al., 2004) and one of the most frequently used tools for examining knowledge construction (Beaudrie, 2000; Schellens & Valcke, 2006). The model provides guidance for examining negotiation of meaning and social construction of knowledge in collaborative learning environments. It has been widely used for identifying social construction of knowledge in online environments (Buraphadeja & Dawson, 2008; Lucas et al., 2014). The IAM has the ability to measure whether discussion has led to new knowledge. It also provides an avenue for studying the process of acquiring that knowledge—the means by which new knowledge is achieved (Luebeck & Bice, 2005). Gunawardena et al. (2016a) determined there is an advantage to using multiple methods to analyze online discussions, not simply, qualitative interaction analysis. These methods can include quantitative analysis techniques such as social network analytics and learning analytics. Social learning analytic methods can be used for investigating social presence and social construction of knowledge and using multiple methods can provide insight into the social dynamics that accompany the process of the social construction of knowledge.

Researchers who have used IAM in their own data analysis have addressed the validity of IAM by stating that it: "offers a holistic view of discussion flow and knowledge construction" (Davis & Marone, 2016, p. 3), and "presents clear and validated stages for the construction of knowledge" (Lucas & Moreira, 2015, p. 1501). Hall (2014) indicated the validity of the IAM has been established, developed, and used as a methodology in over 40 different published studies. These previous studies have confirmed the validity of IAM as a tool for analyzing social construction of knowledge in online discussion forums.

The transcripts were qualitatively coded through the IAM and the researcher was assisted by one assistant who qualitatively coded the transcripts for interrater reliability. The IAM coding spreadsheet, which is available in Appendix B, was used for each transcript to identify the operations and phase of the IAM. Each discussion post for a single online discussion forum was transcribed into a single row in the IAM coding spreadsheet. Each discussion post was determined to be one unit of analysis and was identified as one specific phase in the IAM, either Phase I, II, III, IV, or V. A single post is able to consist of words and phrases identifying more than one IAM phase (Commander et al., 2016) but only one single phase is identified overall for a single discussion post in this study; whichever phase is most appropriate and identified during the qualitative coding process. Irrelevant or off-topic unit(s) of analysis(es) are excluded from the analysis in for the IAM phase score. For example, an online discussion forum prompt asked students to discuss how cultural factors influence teaching and learning and part of a student's discussion post focused on students discussing a future assignment in the course which was off-topic from the prompt at hand. In turn, this off-topic conversation was excluded from the analysis in determining the single post's IAM phase score. Next, the researcher and assistant discussed and came to a consensus

on the IAM phase score of the single discussion post for those which they disagreed upon and came to a consensus on the IAM phase score for all 1,209 discussion posts. After giving reach discussion post an IAM phase score the researcher then began the social presence lexicon analysis process.

Social Presence Lexicon Analysis

A lexicon can be developed by using a dictionary and thesaurus to generate a comprehensive set of words based on seed words that represent the data set along with manually coding words into categories and manually assigning those words to the lexicon. The social presence lexicon that was utilized in this study is Gunawardena et al.'s (2016a) social presence lexicon, which is available in Appendix C. The lexicon was built and influenced by Whiteside and Dikkers (2012) who identified five elements to the Social Presence Model, which were used to identify which words would show an increase of social presence exhibited by the specific posts in the online discussion. The Social Presence Model involves the integration of the five elements of affective association, community cohesion, interaction intensity, knowledge and experience, and instructor investment (Whiteside & Dikkers, 2012). Gunawardena et al. (2016a) chose words and phrases from the transcripts identified in the study according to the IAM coding in the study. They specifically chose words that contributed to social presence in a discussion post. No additional words were added to the social presence lexicon from the current transcripts in order to maintain the validity of the social presence lexicon developed by Gunawardena et al.

The social presence lexicon analysis is conducted utilizing an algorithm in RStudio which counts the number of words identified in the social presence lexicon which contributed to the social presence score of a single discussion post. This algorithm is available in

Appendix D. The algorithm was ran on all 1,209 discussion posts. The social presence lexicon analysis determined the social presence score of an individual discussion post by counting the number of times words in the social presence lexicon were found in the single discussion post. For example, if the social presence lexicon analysis counted 5 words from the social presence lexicon, then a social presence score of 5 would be identified for the discussion post. Each online discussion forum post received one social presence score which was associated with the count of social presence words from the social presence lexicon that are present in each single discussion post. After the social presence lexicon analysis was completed, the data was then input into SPSS 28 to run an ordinal logistic regression on the IAM phase score and the social presence score.

Results

This section will cover the results of the study including the sample and descriptive statistics, results from the IAM, results from the social presence lexicon analysis, and the results from the ordinal logistic regression.

Sample and Descriptive Statistics

This study consisted of a sample of 1,209 discussion board posts from 24 separate discussion boards from 9 separate courses within the Organization, Information, and Learning Sciences program at the University of New Mexico. The courses covered topics related to eLearning, instructional design and technology, and design for online learning. All discussions used asked students to collaborate and respond to other student's posts. Students were asked to answer various questions related to readings, solve problems together, collaborate to develop a more complex understanding of a topic, and to respond to other related topics. Discussion posting lengths identified in the prompts ranged from one to two

weeks, but it was unclear from the de-identified data for whether students were restricted to posting within those ranges identified in the prompts. Each online discussion forum included a different frequency of posts ranging from 21 posts to 85 posts, which is exemplified in Figure 4. The number of posts can vary based on the prompt of the forum, the directions given by the instructor, and the number of students who participated in the online discussion forum in a single course. For example, the discussion forum with 21 posts asked students to answer the question of what it means to be culturally inclusive in instructional design while the discussion forum with 85 posts asked students to discuss their opinion on various sources of cultural programming.

Figure 4

Number of Discussion Posts for Each Discussion Board

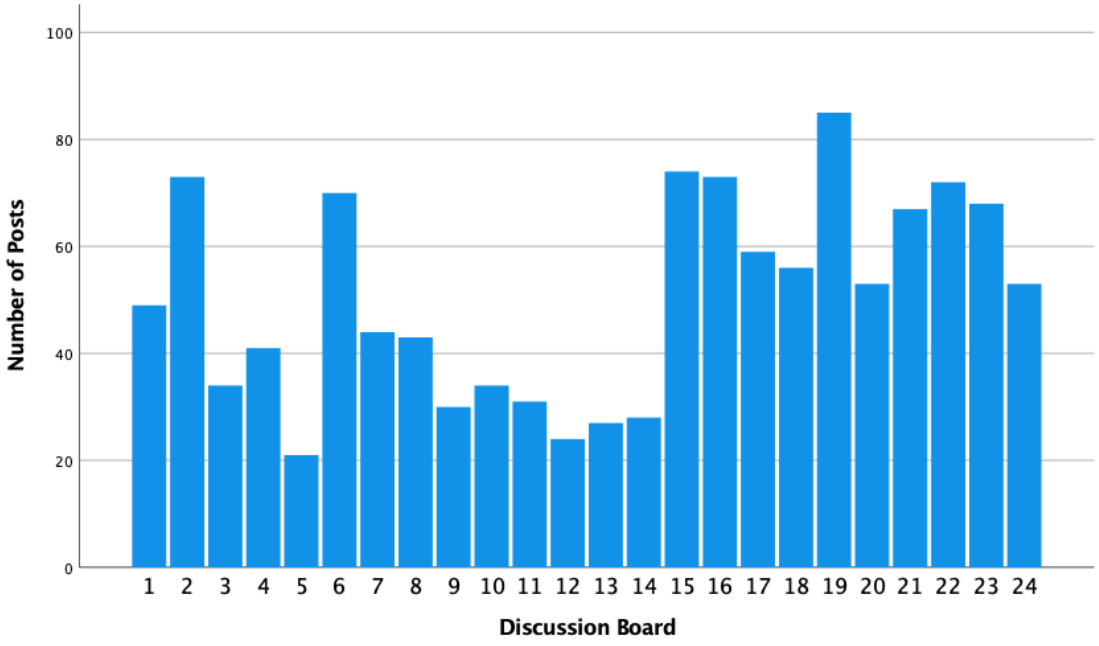


Figure 4 shows all 24 unique discussion boards and how many individual posts were present in each discussion board. For example, discussion board 5.00 in Figure 4 had 21 discussion posts. All online discussion forums were asynchronous interactions between

students on online discussion forums during either an 8-week or 16-week fully asynchronous course. 48.1% of the discussion forums were from 8-week courses while the rest were from 16-week courses. The study included both undergraduate and graduate level online discussion forums, with 51.8% of the discussion posts from undergraduate online discussion forums.

Results of Social Construction of Knowledge Using the IAM

Most discussion boards exemplified the full range of IAM phases with 424 of the posts being Phase I, 198 Phase II, 377 Phase III, 106 Phase IV, and 104 Phase V. 22 of the 24 online discussion forums had at least one single discussion post which reached Phase V. An example of a segment of a discussion post which caused the entire post to be coded as Phase I was "I agree with this statement on online learning techniques…," because the statement exemplifies a statement of agreement with another participant. Table 5 provides examples for each of the IAM phases.

Table 5

Examples of Discussion Post Phrases Indicating Each IAM Phase

IAM Phase	Total Number of Posts in Phase	Example of Phrase from Discussion Post Indicative of Phase
I	424	"I agree with this statement on online learning techniques..."
II	198	"I'm curious what you thought were similarities and differences between American and South American culture?"
III	377	"Although I believe we disagree on… I can see that we both agree with…"
IV	106	"The theories identified in the literature do not seem to mirror my own personal experiences in relation to…"
V	104	"To summarize the viewpoints stated in this discussion, I think that…"

Note. This table provides examples of phrases that were included in discussion posts from the data set. The posts were coded using the framework provided in Figure 1.

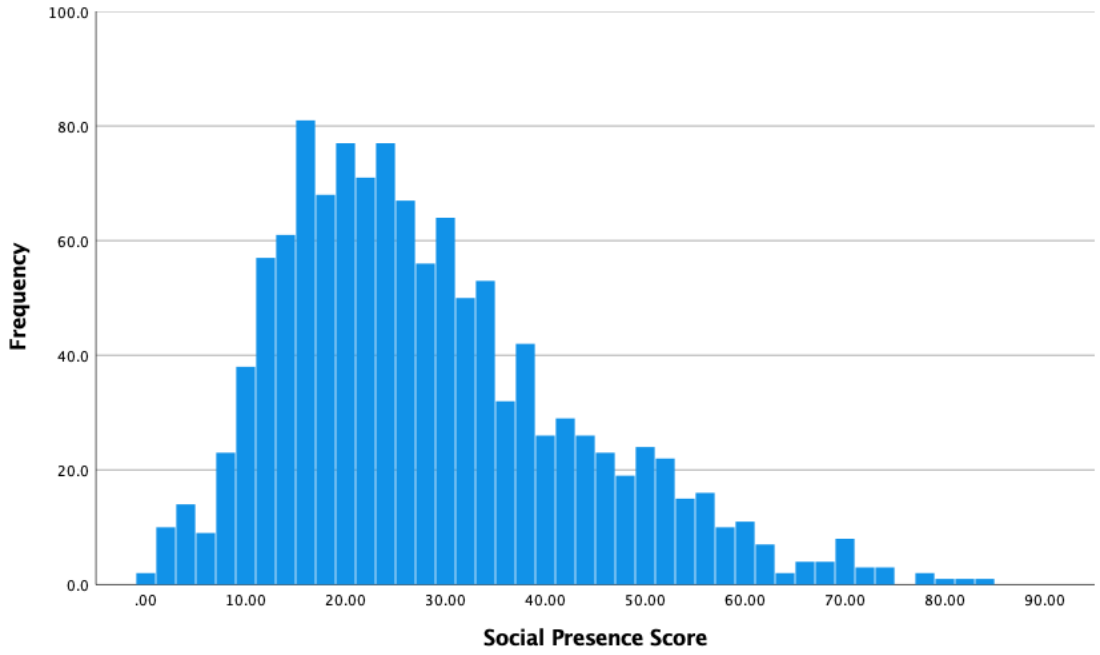
Of the total discussion posts, 82.6% exemplified either Phase I, Phase II, or Phase III and 66.2% exemplified Phase I or Phase III. This lower number of Phase IV and Phase V posts is consistent with past studies on the IAM (Gunawardena et al., 2016a).

Results from Social Presence Lexicon Analysis

Figure 5 presents the frequency of social presence scores for individual discussion posts.

Figure 5

Total Frequency of Social Presence Scores for Each Individual Post

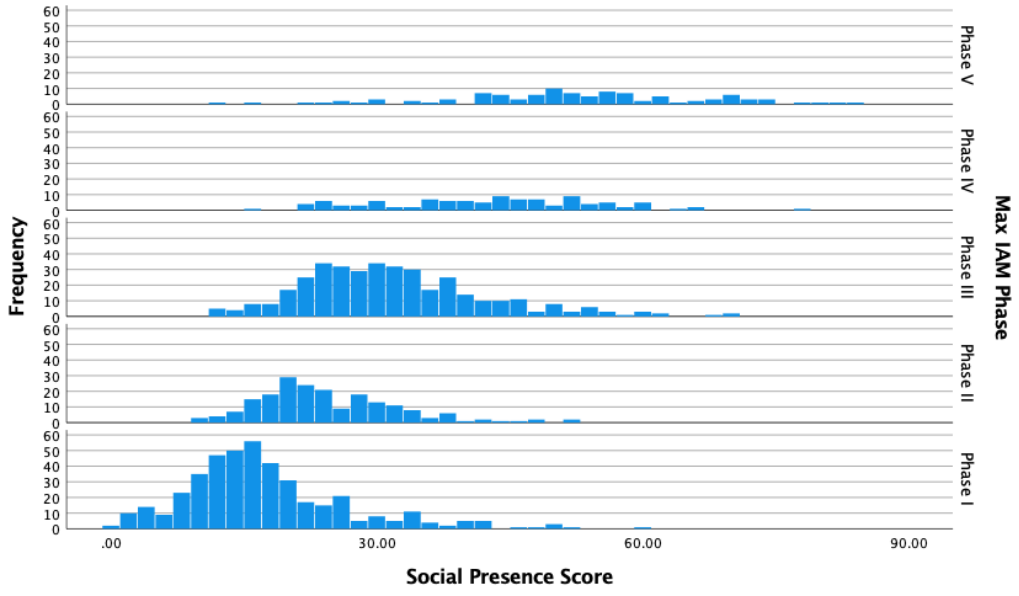


The social presence lexicon analysis determined the social presence score of an individual discussion post by counting the number of times words in the social presence lexicon were found in the single discussion post. There were over 40 individual discussion posts with a social presence score of 16, but only one individual discussion post with a social presence score of 81. A high social presence score indicates a post included a large number

of words found in the social presence lexicon that are known to contribute to increasing social presence in online discussions, while a low social presence score means that fewer words were identified through the social presence lexicon analysis. For example, one of the posts stated “I agree with this statement on online learning techniques, good luck golfing,” and this post had a social presence score of three because three of the words “this, with, and I,” were matched to the social presence lexicon which is available in Appendix C. Figure 5 shows that the majority discussion posts had social presence scores somewhere between nine and 60, with most being lower scores. The social presence score of the posts ranged from zero to 84. The frequency of social presence scores in each IAM phase is presented in Appendix E. The mean social presence score for the posts was 28, with a median score of 25, and 64.1% of social presence scores were either less than or equal to 30. Figure 6 presents the frequency of social presence scores broken out by each IAM phase.

Figure 6

Frequency of Social Presence Scores for Each IAM Phase



Note. Refer to Figure 5 for the total number of posts for each IAM phase.

Most of the discussion posts are either Phase I or Phase III. Figure 6 shows that IAM Phase I has the most posts. However, most of those posts in IAM Phase I exemplify lower social presence scores in relation to the discussion posts from the higher IAM phases. There are far less discussion posts at IAM Phase IV and Phase V, but those posts at those phases have higher social presence scores, as exemplified in Figure 6. Figure 7 presents a box-and-whisker plot of the social presence score associated with each IAM phase.

Figure 7

Relationship Between Social Presence and IAM Phase

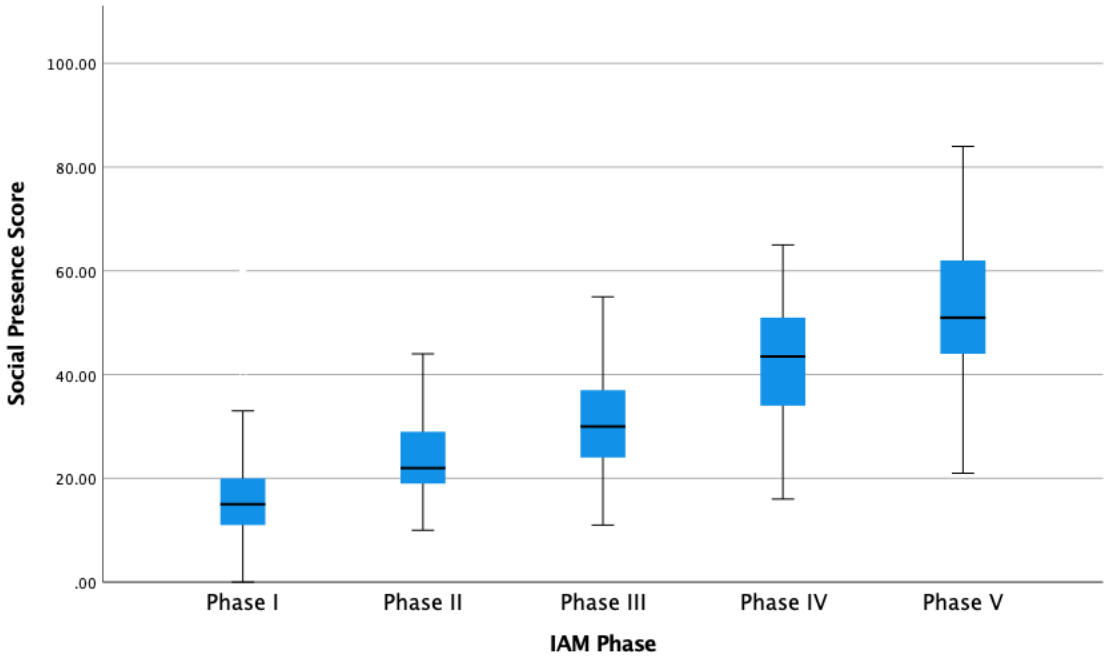


Figure 7 suggests that there is a clear positive increase of the median social presence score as the IAM phase increases along with the lower quartile and upper quartile following this trend as well. The box and whisker plot also suggests the social presence scores are relatively symmetrically distributed for each IAM phase.

Results from the Association of Social Presence with Social Construction of Knowledge using Ordinal Logistic Regression

Ordinal logistic regression is a statistical analysis method that can be used to model the relationship between an ordinal response variable, such as IAM phase, and an explanatory variable, such as social presence. Ordinal variables are categorical variables that are ordered or ranked like the IAM phase. An ordinal logistic regression analysis was used to investigate whether social presence (an explanatory variable) can predict IAM phases (ranked categorical variable). The predictor variables were tested to verify that there were not any violations of the assumption of no multicollinearity. Table 6 presents the model fitting information for the ordinal logistic regression from SPSS 28.

Table 6

Ordinal Logistic Regression Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	Df	Significance
Intercept Only	3509.95			
Final	2628.723	881.228	1	<.001

Note. This table is the output of the Model Fitting Information in SPSS 28.

For this ordinal logistic regression analysis, the final model containing the predictor variable of social presence indicates a significant improvement in fit relative to the intercept only model. [$\chi 2(4) = 881.228$, $p < .001$]. The intercept only model is solely based on the marginal probabilities of the outcome categories. The significant chi-square statistic ($p < .001$) indicates the final model gives a significant improvement over the baseline intercept only model. This suggests the final model gives better predictions than the original model solely based on marginal probabilities for the outcome categories.

Table 7 presents the parameter estimates output for the ordinal logistic regression.

Table 7

Ordinal Logistic Regression Parameter Estimates

				95% Wald Confidence Interval		Hypothesis Test				95% Wald Confidence Interval for Exp(B)	
Parameter	IAM Phase	B	Std. Error	Lower	Upper	Wald Chi^2	df	Sig.	Exp(B)	Lower	Upper
Threshold	I~II	2.703	.1484	2.412	2.993	331.97	1	<.001	14.928	11.161	19.966
	II~III	3.788	.1646	3.465	4.111	529.9	1	<.001	44.168	31.991	60.978
	III~IV	6.415	.2368	5.951	6.879	733.78	1	<.001	611.13	384.19	972.12
	IV~V	7.780	.2777	7.236	8.324	784.66	1	<.001	2392.2	1388	4123.02
Social Presence Score		.140	.0057	.129	.151	595.62	1	<.001	1.150	1.138	1.163

Note. This table is the output of the Parameter Estimates in SPSS 28.

Table 7 shows an increase in social presence score was associated with an increase in the odds of a discussion post being a higher IAM phase, with an odds ratio of 1.150 (95% CI, 1.138 to 1.163), Wald $\chi2(1) = 595.62$, $p < .001$. Social presence is a positive significant predictor (B = .140, standard error = .006, $p < .001$) of the probability of a discussion post being a higher IAM phase as opposed to a lower IAM phase. For every one unit increase of social presence, there was a predicted increase of .140 of a discussion post being in a higher IAM phase, as opposed to a lower IAM phase. This indicates that a discussion post with a higher social presence score likely predicts a higher IAM phase.

The pseudo R square values in an ordinal logistic regression are treated as measures comparative to the commonly R-square value. The Nagelkerke pseudo R square is .548 and the McFadden pseudo R square is .251 for this ordinal logistic regression. In turn, the model containing the social presence predictor exhibits a 25.1% improvement in fit relative to the intercept-only model. As well, the Nagelkerke pseudo R square of 54.8% indicates that social presence explains a moderate proportion of the variation between predicted IAM phases.

Table 8 presents the test of parallel lines output.

Table 8

Ordinal Logistic Regression Test of Parallel Lines

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	2628.723			
General	2625.026	3.696	3	.296

Note. This table is the output of the Test of Parallel Lines in SPSS 28.

The test of parallel lines indicates the relationship between the independent variable, social presence is the same across all possible comparisons involving the dependent variable, IAM Phase. Statistical significance is taken as an indicator that the assumption is not satisfied. If the assumption was not satisfied, and the significance value were to indicate significance, then that would mean the general model would be more useful in predicting IAM phase than the model including social presence. Here, the results from the ordinal logistic regression analysis test of parallel lines presents a non-significant result ($p = .296$), thus the results mean that the assumption is satisfied. This means that the general model does not give a significantly better fit to the data than the ordinal logistic regression model which includes social presence.

Table 9 presents the predicted probability of a discussion post being each IAM phase when a social presence score is calculated from the ordinal logistic regression.

Table 9

Predicted Probability of Each IAM Phase Based on Social Presence Score

Social Presence	Phase I	Phase II	Phase III	Phase IV	Phase V
1	0.94	0.04	0.02	0.00	0.00
2	0.93	0.05	0.02	0.00	0.00
3	0.92	0.05	0.03	0.00	0.00

Social Presence	Phase I	Phase II	Phase III	Phase IV	Phase V
4	0.91	0.06	0.03	0.00	0.00
5	0.89	0.07	0.04	0.00	0.00
6	0.88	0.08	0.04	0.00	0.00
7	0.87	0.08	0.05	0.00	0.00
8	0.85	0.09	0.05	0.00	0.00
9	0.83	0.11	0.06	0.00	0.00
10	0.81	0.12	0.07	0.00	0.00
11	0.79	0.13	0.08	0.00	0.00
12	0.76	0.14	0.09	0.01	0.00
13	0.74	0.16	0.10	0.01	0.00
14	0.71	0.17	0.11	0.01	0.00
15	0.68	0.18	0.13	0.01	0.00
16	0.65	0.20	0.14	0.01	0.00
17	0.61	0.21	0.16	0.01	0.00
18	0.58	0.22	0.18	0.01	0.00
19	0.54	0.23	0.20	0.01	0.01
20	0.51	0.24	0.22	0.02	0.01
21	0.48	0.25	0.25	0.02	0.01
22	0.44	0.26	0.27	0.02	0.01
23	0.41	0.26	0.30	0.03	0.01
24	0.37	0.26	0.32	0.03	0.01
25	0.34	0.26	0.35	0.03	0.01
26	0.31	0.26	0.38	0.04	0.01
27	0.28	0.26	0.41	0.04	0.02
28	0.25	0.25	0.43	0.05	0.02
29	0.23	0.24	0.46	0.06	0.02

Social Presence	Phase I	Phase II	Phase III	Phase IV	Phase V
30	0.20	0.23	0.48	0.06	0.02
31	0.18	0.22	0.50	0.07	0.03
32	0.16	0.20	0.52	0.08	0.03
33	0.14	0.19	0.54	0.09	0.04
34	0.13	0.17	0.55	0.10	0.04
35	0.11	0.16	0.57	0.11	0.05
36	0.10	0.15	0.57	0.13	0.05
37	0.09	0.13	0.58	0.14	0.06
38	0.08	0.12	0.58	0.16	0.07
39	0.07	0.11	0.57	0.17	0.08
40	0.06	0.10	0.56	0.19	0.09
41	0.05	0.09	0.55	0.21	0.10
42	0.05	0.08	0.54	0.22	0.12
43	0.04	0.07	0.52	0.24	0.13
44	0.03	0.06	0.50	0.26	0.15
45	0.03	0.05	0.48	0.27	0.17
46	0.03	0.05	0.45	0.29	0.19
47	0.02	0.04	0.43	0.30	0.21
48	0.02	0.04	0.40	0.31	0.23
49	0.02	0.03	0.37	0.32	0.26
50	0.02	0.03	0.34	0.32	0.29
51	0.01	0.03	0.32	0.33	0.32
52	0.01	0.02	0.29	0.33	0.35
53	0.01	0.02	0.27	0.33	0.38
54	0.01	0.02	0.24	0.32	0.41
55	0.01	0.01	0.22	0.31	0.45

Social Presence	Phase I	Phase II	Phase III	Phase IV	Phase V
56	0.01	0.01	0.20	0.30	0.48
57	0.01	0.01	0.18	0.29	0.52
58	0.01	0.01	0.16	0.28	0.55
59	0.00	0.01	0.14	0.26	0.59
60	0.00	0.01	0.12	0.24	0.62
61	0.00	0.01	0.11	0.23	0.65
62	0.00	0.01	0.10	0.21	0.68
63	0.00	0.00	0.09	0.19	0.71
64	0.00	0.00	0.08	0.18	0.74
65	0.00	0.00	0.07	0.16	0.77
66	0.00	0.00	0.06	0.15	0.79
67	0.00	0.00	0.05	0.13	0.81
68	0.00	0.00	0.04	0.12	0.83
69	0.00	0.00	0.04	0.11	0.85
70	0.00	0.00	0.03	0.09	0.87
71	0.00	0.00	0.03	0.08	0.88
72	0.00	0.00	0.03	0.07	0.90
73	0.00	0.00	0.02	0.07	0.91
74	0.00	0.00	0.02	0.06	0.92
75	0.00	0.00	0.02	0.05	0.93
76	0.00	0.00	0.02	0.04	0.94
77	0.00	0.00	0.01	0.04	0.95
78	0.00	0.00	0.01	0.03	0.95
79	0.00	0.00	0.01	0.03	0.96
80	0.00	0.00	0.01	0.03	0.96
81	0.00	0.00	0.01	0.02	0.97

Social Presence	Phase I	Phase II	Phase III	Phase IV	Phase V
82	0.00	0.00	0.01	0.02	0.97
83	0.00	0.00	0.01	0.02	0.98
84	0.00	0.00	0.00	0.02	0.98

Note. This table demonstrates the predicted probabilities of a social presence score of a discussion post being a specific IAM phase. The numbers zero through 84 indicate the social presence score of a discussion post.

Table 9 identifies the predicted probability of a discussion post with a certain social presence score being coded as a specific IAM phase. This table can be used to identify the specific probability of a discussion post being a certain IAM phase based on the social presence score. For example, the probability of a discussion post being Phase I ranges from 94% at a social presence score of one to a 1% chance of being a social presence score of 58. Once the social presence score of a single discussion post is 59 or higher, the probability of a discussion post being Phase I is 0% based on the ordinal logistic regression. On the other end of the table, the ordinal regression model predicts that if a discussion post has a social presence score of 84, then there is a 98% chance of that discussion post being Phase V, a 2% chance of the post being Phase IV, and a 0% chance of the post being Phase I, II, or III.

Discussion

The key finding of this study is that social presence can significantly predict the IAM phase of a discussion post in an online discussion forum in higher education courses. Social presence is a positive significant predictor ($B = .140$, standard error = .006, $p < .001$) of the probability of a discussion post being a higher IAM phase as opposed to a lower IAM phase. This predictive relationship may suggest that variables associated with higher IAM phases may also be associated with higher social presence scores. For example, when social presence is low then learner engagement may be low. The post from this data set “I agree

with this statement on online learning techniques, good luck golfing," which only had a social presence score of three indicates the low engagement in this individual post. This lack of engagement and social presence can have a detrimental effect on other students as well. Cui et al.'s (2013) study showed that when social presence decreased in the online environment, then student dissatisfaction increases and students tend to drop from their courses at higher rates. The findings of this study may suggest that in courses where students are able to co-construct higher levels of social construction of knowledge, then those students may also be less likely to experience dissatisfaction and higher course drop rates in those courses. Also, factors that contribute to social construction of knowledge such as inquiry initiated by a facilitator, team projects, team and individual mentoring, task prompt designs of online discussion forums, discussion environments designed to not lead to confrontation or feelings of hesitancy, and text-based online discussion forum mediums may also contribute to increasing social presence (Hew & Cheung, 2011; Padilla & Layne, 2017; Howell at al., 2014; Guo et al., 2022). This predictive positive relationship may also suggest that variables associated with decreased levels of social presence may also be associated with decreased levels of social construction of knowledge as identified by other researchers such as negative impacts on online communities, interaction, and student perceived learning and satisfaction (Garrison et al., 1999; Gunawardena & Zittle, 1997; Richardson & Swan, 2003; Tu & McIsaac, 2002).

This predictive relationship between social presence and social construction of knowledge likely holds true intuitively because when students feel more comfortable interacting and socializing in asynchronous discussion forums it is more likely that they will feel comfortable and less vulnerable interacting with others and reaching higher levels of

social construction of knowledge. When students feel more comfortable engaging and interacting then they may feel more comfortable presenting their own knowledge and perspectives, building upon other student's discussion posts, and incorporating the thoughts and contributions of other students hence assisting the group with navigating to the higher levels of knowledge construction. Simply put, the results of this study are plausible because having higher social presence in discussion forums may generate an atmosphere where students feel safer to connect and contribute their own knowledge to the group.

The developers of the IAM identified that the model alone could not measure the social environment of online learning. For the past 25 years this void has remained present in the tool and has hindered researchers from being able to adequately research the social environment along with the development of cognitive processes in online learning when using the IAM. Social presence is distinctly associated with the social environment of online learning. Determining ways to measure social presence in concert with data sets that can be measured by the IAM can help to provide a superior lens to better understand how the social environment supports online learning.

As well, this study can help increase the opportunities for new research associated with the IAM and social presence using lexicon analysis, as there are possibly other variables that can significantly contribute to predicting IAM phases. Potential avenues could be other text-based variables associated with student communication inside or outside of the online discussion forum environment. Instructors may sometimes guide students to avoid using words indicative of social presence and to utilize more formal language, which may be associated with decreasing social presence and social construction of knowledge in discussion forums. Another potential variable that should be analyzed more closely in the

future could be the exact wording of the discussion prompts or variables related to the contexts for which the learners are interacting in the online discussion forum (Lowenthal & Dunlap, 2020).

Previous studies have found that online discussion forums in the higher education context rarely reach higher IAM phases (Howell et al., 2014, Gunawardena et al., 2016a). In this study, about 16% of the discussion posts were coded as either Phase IV or Phase V, while the other 84% of the discussion posts were either Phase I, Phase II, or Phase III. This study mirrored this trend in that only 16% of the discussion posts exemplified either Phase IV or V. This is likely a similar data set to discussion posts that have been coded utilizing the IAM in the past due to the low number of discussion posts exemplifying higher IAM phases. Even though a small portion of the discussion posts were either Phase IV or V, the ordinal logistic regression analysis was still significant ($p < .001$) at Phase IV and V showing that social presence is still a significant predictor of the higher IAM phases in this data set.

The qualitative IAM coding process takes time as it involves manual coding by researchers. On the other hand, the social presence lexicon analysis is automated and can be completed quite quickly in relation to qualitative IAM coding. Future researchers may also find it beneficial to develop a way to analyze IAM phases through an algorithm similar to the social presence lexicon analysis in order to increase the speed at which the IAM coding process can be completed (Megli et al., 2022). Researchers may be able to utilize social presence lexicon analysis determine whether the online discussion forum data set at hand may include higher IAM phase postings by quickly determining whether high social presence scores are present in the data set through utilizing the social presence lexicon analysis algorithm. Table 9 exemplified the probability of a discussion post being a certain IAM

phase based on the social presence score of the discussion post. For example, a discussion post with a social presence score of 21 has a 48% chance of being Phase I, 25% chance of being Phase II, 25% chance of being Phase III, 2% chance of being Phase IV, and a 1% chance of being Phase V. If an online discussion forum only exhibits posts with lower social presence scores, such as social presence scores of 19 or lower, then there is about a 1% chance of there being a discussion post that is either Phase IV or V based on the ordinal logistic regression. Facilitators and designers should pay careful attention to discussion prompts that will move discussion phases into higher phases of IAM.

The utilization of Table 9 could help increase the interrater reliability of future IAM coding if utilized by researchers in the IAM coding process. It could be used to more accurately qualitatively code IAM posts through using the social presence score of the post. Researchers could look towards Table 9 to help them to understand the probability of a certain post's IAM phase to help in this decision if it is unclear what post the IAM phase should be coded as. A downside for utilizing Table 9 is that this data set's highest social presence score for a single discussion post was 84, therefore it is unclear whether discussion posts with social presence scores higher than 84 may fit this predictive model. In turn, it may be beneficial to analyze discussion posts with social presence scores that are higher than 84 to ensure the predictive strength of the model at those higher social presence scores.

The social presence lexicon could be further developed by adding additional words to the lexicon. Two of the discussion posts in this data set had a social presence score of 0, which means there were no words indicative of social presence in those individual discussion posts present in the current social presence lexicon. A closer look at those discussion posts should be undertaken in the future to determine whether the social presence lexicon is

complete; that there are not words missing from the lexicon that are indicative of social presence. As well, there are gaps in the lexicon in its ability to measure misspelled words. For example, For example, one of the words in the lexicon is “themselves.” One student wrote “themselve” in their discussion post which is misspelled and was not counted by the social presence lexicon. In turn, close misspellings of words indicative of social presence may need to be added to the social presence lexicon to increase its accuracy of measuring social presence. If additional words are added to the lexicon, then analysis will need to be analyzed to determine if the social presence lexicon with the additional words added is still a reliable tool for analyzing social presence.

There are various other tools that could have been used to measure social presence in this study such as the social presence scale (Gunawardena and Zittle, 1997), social presence privacy questionnaire (Tu, 2002), and the social place scale (Kreijns et al., 2011). These three are all survey instruments that require self-reported data. This study was based on text analysis of asynchronous discussions that reflected the perspectives participants contributed to a topic under discussion. Therefore, it was important to analyze how participants used words to generate social presence in text. The social presence lexicon based on words that generated social presence was a more appropriate analysis tool than a survey. By choosing to use social presence lexicon analysis I was able to analyze a larger amount of data much more quickly, was able to avoid having to obtain data from current students, and I did not need to obtain IRB approval to move forward with this study. This lexicon may require more testing and may need to be developed even further to increase its efficacy and accuracy for measuring social presence.

Gunawardena et al. (2016a) developed the social presence lexicon which was used to automate the analysis of social presence in online discussion forums, but that study fell short of being able to determine whether social presence is associated with the social construction of knowledge because that data set did not include any IAM Phase IV or V discussion posts. This study dealt with this limitation because of the large number of discussion posts and the utilization of online discussion forums that exemplified the full range of IAM phase postings, such as Phase IV and V, which likely enhanced this study's ability to determine that social presence is a useful factor in contributing to the IAM phase of a discussion post and that social presence is a significant predictor of an IAM phase. The significance of this study is the finding that the online social environment should be studied in conjunction with social construction of knowledge, as they go hand in hand. This study supports research which has shown the link between cognitive and affective processing of learning a task (Schneider et al., 2022).

The relationship between social presence and social construction of knowledge may potentially lead to techniques that can create higher levels of knowledge co-construction. Participants in an online discussion forum who feel socially connected may engage in higher levels of knowledge construction. Crim (2006) posited that social presence may be a significant factor in increasing the effectiveness of instruction because an increase in social presence may help increase student satisfaction, in-depth discussions in computer mediated communication, and promote collaborative learning. Tu and Corry (2002) determined that social presence can significantly positively influence instructional effectiveness and increase learning in online learning environments. Luebeck and Bice (2005) suggest that structure of the online discussion forums is not enough to influence higher-level of thinking and social

construction of knowledge. Gunawardena (1995) asserted that "participants can be trained to create social presence in a text-based medium and build a sense of community," as social presence can be developed by encouraging participants to give comments or opinions, show appreciation, contribute, and summarize more frequently may promote higher level social construction of knowledge in online discussions (Hew & Cheung, 2011). If social presence can be taught or coached, and it so turns out that there is a significant relationship between social presence and higher levels of social construction of knowledge, then the importance of helping produce social presence in computer mediated communication will be further lifted to the forefront in research in the field of distance education. Techniques that can assist with increasing social presence in online discussion forums may also lead to the social construction of knowledge among a group of interacting participants.

Limitations

Limitations are parts of the study that are not under the researcher's control which may influence the study. This study does not account for whether there are additional communications that went out in relation to student-student or teacher-student interaction in relation to the online discussion forums in these courses. For example, students may have communicated outside of the online discussion forum environment and avoided communicating that information in their discussion posts. This could potentially lead to lower levels of social presence and social construction of knowledge exemplified in the individual discussion posts if students are asked to communicate outside of the online discussion forum. Another limitation is the length of time the online discussion forum is available to students. Each instructor may allow a different amount of time for students to respond in the online discussion forum. The quality of student responses and participation

may vary depending on the length of time students are given to participate in the discussion forum. In addition, the student's personal experience with online courses, online discussion forums, and online education in general was not accounted for in this study.

Due to the utilization of an algorithm to measure social presence, misspelled words may not be identified and counted by the algorithm and the lexicon itself may not be entirely accurate. When the algorithm misses including misspelled words in its analysis, then that leads to an inaccurate indication of the social presence score for a discussion post. For example, if a student misspelled the word "themselves" as "themselve," or some other variation of the word in a misspelled way, then the social presence lexicon algorithm would not be able to count this specific word due to the misspelling. The social presence lexicon and IAM can only measure the artifacts of social construction of knowledge and social presence in online discussion forums and are not able to account for artifacts outside of the online discussion forum environment. The social presence lexicon and IAM can only capture a small portion of the social environment of online learning, as the method of analysis is solely looking at the written language as a means for measuring the constructs of social presence and social construction of knowledge. In this study the researcher did not analyze the prompts except to determine whether students were asked to co-construct knowledge and collaborate in the online discussion forum space, which could lead to different expectations for student interaction and the quality of collaboration from prompt to prompt.

Delimitations

Delimitations have been identified such as the dataset, which consisted of only online discussion forums found in the asynchronous courses that are a part of the University of New Mexico's online courses. All of the courses were either graduate or undergraduate courses at

a 4-year research university. Only asynchronous online courses were used so as to give a consistent data set for portions of the social environment of learning that may vary based on the type of modality the course is offered in, so online discussion forums from synchronous online courses and low residency online courses were not used. The timeframe limited this data set to courses that were offered from Fall 2014 to Spring 2022. The participants in these courses participated in the English language and were likely participating from a western context. As well, the results of this study were limited to the online discussion forum interactions in learning sciences and organizational learning courses.

Significance

This study makes a significant contribution to the body of literature regarding the relationship between social construction of knowledge and social presence in the field of online education research. A more complete framework for understanding the social environment of online learning is not possible without studies and tools that can both assess the social construction of knowledge in the online environment and social presence. This study helps to fill this research void by analyzing the ability of social presence to predict social construction of knowledge in a specific and well-defined context for online education. All data from this study is from the asynchronous online discussion forum environment from higher education courses; whereas Gunawardena et al.'s (1997) original IAM study focused on analyzing an online debate amongst professionals in the field of distance education at a professional conference. In turn, this study has bolstered Davis and Marone's (2016) assertion that the IAM is appropriate for assessing knowledge construction in formal academic settings and can accurately measure social construction of knowledge in online courses. As well, this study shows how a researcher can measure social construction of

knowledge and social presence on the same level of analysis; through looking solely at the language used in online discussion forums and without needing to utilize human subject research. Lastly, this study has established that social presence can be used to significantly predict IAM phases.

Conclusion

In conclusion, this study answers the research question in that social presence can likely be used to significantly predict IAM phases in online discussion forums in higher education. Through the identification of this predictive relationship, when social presence increases in an online courses and in individual discussion posts, then it is likely that students are exemplifying higher levels of social construction of knowledge in those singular discussion posts that also have higher levels of social presence. Various studies have established techniques that can assist participants in online courses with increasing social presence in online courses. This predictive relationship may suggest that techniques that increase social presence may also increase student creation of social construction of knowledge. Instructors should seek to further utilize techniques that promote an increase of social presence in the classroom if the instructors want to increase social construction of knowledge in their online courses, specifically in online discussion forums. As well, social presence lexicon analysis can be used to quickly scan online discussion forums to predict whether online discussion forums with higher IAM phases are present. This can help speed up the research process to analyze online discussion forums that exemplify all IAM phases.

Future Research

This study has shown that there is a predictive relationship between social presence and social construction of knowledge through utilizing a combined content analysis

methodology. Future researchers may be able to build upon this framework by utilizing other content analysis techniques to help further develop a more complex picture and understanding of the social environment of online learning. Combined content analysis of online transcripts is a fairly new method and it was developed because we are now able to use technology to quickly analyze large sets of data. We also have the means to utilize machine transcription for synchronous communications so future researchers may be able to quickly analyze audio and video interactions in large volumes in contexts that were historically hard to access for content analysis research due to the lack of development and accessibility of technology in this realm. The advancement of technology itself has brought about the capability for using combined content analysis more frequently in future studies. Future researchers can do this through combining other interaction analysis techniques with either social presence lexicon analysis or the IAM to see if there are other predictive relationships with other variables that are present in the social environment of online learning. They could also take a closer look at the online discussion forum prompts to determine structures for the prompts most beneficial to developing social presence or social construction of knowledge.

In relation to future research in new contexts or cultures, I believe it will be important to leverage data that can be pursued with IRB approval to give a better understanding of the context and cultures of the students that are participating in the discussion forum. If future researchers are able to obtain more demographic information, then there would be more to contribute to the conversation around how culture and context play a role in social presence and social construction of knowledge. For context, it is important to try and identify where the institution is located for these formal learning environments so as not to contribute to

confusion related to aspects of certain cultural traits or preferences that contribute to a group moving through the levels of knowledge construction or exemplifying social presence in online asynchronous discussion forums. In order for the social presence lexicon to be used across cultural and geographic contexts it will be important to expand the lexicon from discussions in diverse contexts, and develop the lexicon in languages other than English. Developers of the lexicon in other languages will need to reflect on how words may differ from the English lexicon as words that increase social presence are not symmetrical across cultures and languages.

Future research may also focus on analyzing online discussion forums of different academic disciplines. This study was limited to utilizing online discussion forums from the learning sciences discipline, so further research into other disciplines may yield different or similar results. Past researchers have utilized the IAM in subject areas such as business, healthcare courses, and other subject areas. (Megli & Etsitty-Dorame, 2021). To this end, the social presence lexicon analysis has not been widely used, so future research could determine whether the lexicon is an accurate measure of social presence in subject areas outside of the learning sciences discipline. As well, these content analysis techniques could be used in other contexts such as informal learning or workplace learning.. For example, through machine transcription social presence lexicon analysis and the IAM could be used to analyze whether a work group was able to reach higher levels of social construction of knowledge and whether they exemplified social presence along the way. Through technology's ability for machine transcription it is possible to analyze different types of conversations in different contexts outside of the academic environment.

The online discussion forum posts were from graduate and undergraduate level fully asynchronous online courses at a 4-year R1 institution. In turn, future research should determine whether different results may occur in online courses in community colleges and other 2-year institutions. This relationship may be different in courses with a larger volume of synchronous online meetings, which offers students more opportunities to communicate with one another outside of the online discussion forum environment. This study also took place in the United States with courses taught primarily in English. The learners and instructors in these courses likely come from a Western learner background and participate in online discussion forums from this perspective. In turn, future research may study whether the relationship holds true for languages other than English and whether the same outcome happens in relation to situations in different cultures and universities in other countries.

The participants in the online discussion forums were entirely anonymous to the researchers, so data relative to delving into the background and culture of participants was not available for this study. Participants from different cultures may have a different perspective on utilizing social presence language in online discussion forums. A better understanding of the background and culture of the students who are participating in the specific courses can help to further contextualize this analysis to specific student groups. As well, the social presence lexicon would need to be developed into a different language other than English in order for a similar study to happen with online discussion forums written in another language.

Analyzing whether the number of participants in a discussion forum has an effect on the social construction of knowledge exemplified in the discussion forum may be of interest to future researchers. There may be a potential relationship between the number of

participants taking part in a discussion forum and the likelihood of the participants reaching higher levels of social construction of knowledge.

Lastly, future researchers can also work to determine additional words that may need to be added to the social presence lexicon. Some of the discussion posts used in this study had a social presence score of 0, so there may be additional words that should be added to the social presence lexicon. As well, the highest social presence score of a discussion post in this data set was 84. Discussion posts from online discussion forums accessible to future researchers may have higher social presence scores and could be used to increase the ability of the ordinal logistic regression's ability to predict IAM phases for discussion posts with social presence scores higher than 84. The transcripts from this study should be reviewed to determine whether there were words indicative of social presence that are not currently included in the social presence lexicon.

Conclusion of the Studies

The findings of Megli and Etsitty-Dorame (2021) in the first paper identified the stark need to identify method combinations to analyze the social environment of online education when utilizing the IAM which does not include an analysis of the social environment of online learning. The IAM was developed to measure the social construction on knowledge in computer mediated communication and purposefully left out the analysis of the social interaction of participants in the social environment of online learning. In a more recent study, In the second paper, Megli (2022) determined that there is a moderate positive significant relationship between social presence and social construction of knowledge with a small sample through the use of social presence lexicon analysis and the IAM, which led to the need to further explore this relationship in the this study to increase the trustworthiness and reliability of this finding across the broad context of online education. The third paper used combined content analysis by using social presence lexicon analysis and the IAM in combination to explore this relationship. The third study determined that social presence is a significant predictor of IAM phases in online discussion forums through utilizing ordinal logistic regression. The third study solidifies the relationship between social presence and the social construction of knowledge in online higher education courses. The implication for research from this study is the development of a text analysis framework based on Combined Content Analysis utilizing both the IAM and social presence lexicon analysis for determining how the social environment of online learning supports knowledge construction. This analysis framework focuses on solely using language available in online discussion forums and will expedite the analysis of online social construction of knowledge so designers and instructors can make adjustments as the course is being developed.

The combined content analysis design for the final study (3rd paper) helped to answer the research question on the ability of social presence to predict the level of social construction of knowledge in online higher education discussion forums. The more specific content analysis methods used were social presence lexicon analysis and the IAM. To use these methods, the qualitative coding through the IAM was used, which is associated with the social construction of knowledge, and quantitative coding was completed using an R-script to determine the social presence score. An ordinal logistic regression was used to determine the answer to the research question for whether social presence score can be used to predict the Phase of social construction of knowledge in a discussion post in a higher education online discussion forum. The outcome of this study will make a significant contribution to the body of literature with the goal of understanding and analyzing the social environment of online learning and its impact on social construction of knowledge.

Summary of Findings

This dissertation study had three major findings. First, the initial literature review identified that there was a void in the research related to whether there is a relationship between the social environment of online learning often represented by social presence and social construction of knowledge. This had only been surmised and identified as future research in the literature. The IAM was developed to analyze the social construction of knowledge and purposely left out the analysis of the social environment of online learning. The second study determined that there is a significant relationship between social presence and social construction of knowledge. This was identified by utilizing social presence lexicon analysis and the IAM. The third study determined that social presence can be used to predict the IAM phase of a discussion post. Through the utilization of the combined content analysis

method, this study was able to employ IAM in combination with the social presence lexicon analysis to provide a picture of the social environment of online learning that accounts for how knowledge is socially constructed in online discussion forums. This study moves forward the conversation around the positive relationship between social presence and social construction of knowledge in the social environment of online learning, specifically in asynchronous online discussion forums in higher education in the United States.

Implications

There are numerous broad implications from the outcomes of this study. First, this study established a statistically significant relationship between social presence and social construction of knowledge. This study also showed that social presence can be used to significantly predict the IAM phase of a discussion post from utilizing the social presence score of a single discussion post. In establishing this relationship and affirming the positive relationship between these two phenomena within the social environment of online learning, instructors can further promote the use of social presence in online courses with the goal of increasing social construction of knowledge in those online courses. It is well established that various instructor implemented techniques can increase social presence in the social environment of online learning (Gunawardena et al., 2018). Due to the significant positive predictive relationship in this study, then it is likely that utilizing those techniques would potentially help to increase the level of social construction of knowledge in online courses, specifically in online discussion forums. This study also identified various future research opportunities related to the utilization of the IAM as a method for future researchers to build upon. This study may be beneficial to informing faculty and instructional designers developing asynchronous online social environments on useful techniques to enhance student

learning and social presence. This significant contribution to the field of online education can open the door for future research studies that may seek to determine whether other phenomena may have a positive or negative effect on producing social presence or social construction of knowledge in asynchronous online courses.

Final Thoughts

This research shows the benefit of combined content analysis to determine whether various phenomena that make up the social environment of online learning are significantly related. Utilizing combined content analysis can produce a strong understanding of how various phenomena, such as social presence and social construction of knowledge, are related within the online environment. This research has contributed to filling a void in distance education research by establishing a positive relationship between social construction of knowledge and social presence. Instead of developing instructional environments devoid of social interaction, instructors should ensure they utilize and promote opportunities for students to build social presence in online asynchronous environments with the goal of allowing for students to better socially construct knowledge. This may help students to stay connected, overcome the isolation of distance learning perform better in their courses, and decrease attrition rates in individual college courses. Through these studies, researchers will be able to build upon the use of combined content analysis, social presence, and the social construction of knowledge to provide insight on increasing the quality and fidelity of learning through online instruction.

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Appendix A

Potential Publication Venues for Individual Papers

Journal Title and Website	Impact Factor	Mission	Description
The Internet and Higher Education Journal https://www.sciencedirect.com/journal/the-internet-and-higher-education	7.178	The Internet and Higher Education is a quarterly journal devoted to addressing contemporary issues and future developments related to online learning, teaching, and administration on the Internet in post-secondary settings. It is a peer-reviewed journal intended to be a vehicle for scholarly presentation and dissemination of contributions, theoretical and applied, significantly addressing innovative deployments of Internet technology in instruction and reporting on research to demonstrate the effects of the Internet and information technology (IT) on instruction in various contexts in higher education.	The scope of the journal is broad in terms of the range of issues and trends to be addressed, for example, innovations or best practices in online teaching, learning, management, and administration. Other issues may include: Internet technology design and use; instructional models in online courses; online course development and instructional design; interaction in online courses; collaborative learning; usability and evaluation of online environments and portals; online communities of practice; institutional policies, standards and assessment; accessibility standards in online instruction; internationalization and cultural aspects of online classrooms; and issues and trends in synchronous, asynchronous, and hybrid online learning.

Harvard Educational Review https://www.hepg.org/her-home/home	2.935	Our mission is to contribute to the knowledge and greater understanding of educational issues that are of central importance in our society today. We are committed to serving as a forum for different perspectives within the field of education and to participating in current debates through a variety of media.	The *Harvard Educational Review* is a scholarly journal of opinion and research in education. Its mission is to provide an interdisciplinary forum for discussion and debate about education's issues. Since its founding in 1930, the *Review* has become one of the most prestigious journals in education, with circulation to policymakers, researchers, administrators, and teachers. The focus is on practice, policy, and scholarship.
Computers & Education https://www.journals.elsevier.com/computers-and-education	8.538	*Computers & Education* aims to increase knowledge and understanding of ways in which digital technology can enhance education, through the publication of high-quality research, which extends theory and practice. The Editors welcome research papers on the pedagogical uses of digital technology, where the focus is broad enough to be of interest to a wider education community.	We do not publish small-scale evaluations of specific software/systems in specialist domains or particular courses in individual institutions (unless the findings have broader relevance that is explicitly drawn out in the paper). Papers that include discussions of the implementation of software and/or hardware should focus on the context of use, the user/system interface, usability issues and evaluations of the user experience

			and impacts on and particularly on the implications for learning and teaching. Computers as a delivery platform only is insufficient. Detailed information on implementation architecture should NOT be included in the paper, but may be provided via URLs.
Journal of Computer-Mediated Communication https://academic.oup.com/jcmc	5.410	*JCMC* is one of the oldest web-based Internet studies journals in existence, having been published quarterly continuously since June 1995. The journal was started by Margaret McLaughlin and Sheizaf Rafaeli in response to the growth of CMC scholarship in the early- to mid-1990s. The founding editors had the vision to make *JCMC* a free-to-read online journal. This, combined with high quality standards, proved to be a recipe for success: today *JCMC* is widely read and cited by CMC scholars around the world. In 2004, *JCMC* became an official journal of the International Communication Association. *JCMC* became a fully open access journal in 2020. All accepted articles, as of August 1, 2020,	The *Journal of Computer-Mediated Communication* is a web-based, peer-reviewed scholarly journal which focuses its publications on research on computer-mediated communication; such as online discussion forums.

		will be published in the journal under an open access license immediately upon publication. Article processing charges (APCs) are currently being waived.	
Journal of Learning Analytics https://learning-analytics.info/index.php/JLA	4.41	The journal seeks to connect learning analytics researchers, developers and practitioners who share the common interest of using data traces to better understand and improve learning through the creation and implementation of new tools and techniques, and the study of transformations they engender. The interdisciplinary focus of the journal recognizes that computational, pedagogical, institutional, policy and social perspectives must be brought into dialogue with each other to ensure that interventions and organizational systems serve the needs of all stakeholders. Together, these communities each bring a valuable lens to provide ongoing input, evaluation and critique of the conceptual, technical, and practical advances of the field.	The *Journal of Learning Analytics* is the first journal focused on challenges of collecting, analyzing, and reporting, on learning analytics research. Higher education coursework and students is one of the focuses of "learning" in the journal.
Distance Education Journal https://www.tandfonline.com/toc/cdie20/current	2.952	***Distance Education*** is a peer-reviewed journal of the Open and	All papers undergo double-blind peer review, and are reviewed by

		Distance Learning Association of Australia, Inc. The journal publishes research and scholarly material in the fields of open, distance and flexible education where learners are free from the constraints of the time, pace and place of study.	members of the Editorial Board with expertise in the areas(s) represented by a paper, and/or invited reviewers with special competence in the area(s) covered. The Editors reserve the right to make minor alterations to all papers that are accepted for publication.

Appendix B

Table Used to Analyze Discussion Posts Utilizing IAM

Author	One Post is a Unit of Analysis	PhI/A	Ph/B	Ph/C	Ph/D	Ph/E	PhII/A	PhII/B	PhII/C	PhIII/A	PhII I/B	PhIII/C	PhII I/D	PhIII/E	PhIV/A	PhIV/B	PhIV/C	PhIV/D	PhIV/E	PhV/A	PhV/B	PhV/C
Graciana Campos	RE: Gender and zolpidem side effects Freya, Thank you for your feedback. I actually revised my thinking after I made my initial post. I don't believe that drunk tweeting should be considered the same as tweeting while on Ambien. After more reflection, I realized I was making a value judgment on the legitimacy of insomnia treatment versus some other kind of medical treatment. If instead of the Ambien defense it was the Lipitor defense, I think we may react differently. Because Ambien has the pop culture popularity, plus the abuse potential that it does, I think we may not take these side effects as seriously as we would for another course of medical treatment. I'm concerned that this drug is on the market given what is documented on its side effect potential.												3			1						2

Appendix C

Words Utilized in Social Presence Lexicon from Gunawardena et al. (2016a)

"i"
"me"
"my"
"myself"
"we"
"our"
"ours"
"ourselves"
"you"
"your"
"yours"
"yourself"
"yourselves"
"he"
"him"
"his"
"himself"
"she"
"her"
"hers"
"herself"
"it"
"its"
"itself"
"they"
"them"
"their"
"theirs"
"themselves"
"what"
"which"
"who"
"whom"
"this"
"that"
"these"
"those"
"am"
"is"
"are"
"was"

"were"
"be"
"been"
"being"
"have"
"has"
"had"
"having"
"do"
"does"
"did"
"doing"
"would"
"should"
"could"
"ought"
"im"
"youre"
"hes"
"shes"
"theyre"
"ive"
"youve"
"yall"
"weve"
"theyve"
"id"
"youd"
"hed"
"shed"
"wed"
"theyd"
"ill"
"youll"
"hell"
"shell"
"well"
"theyll"
"isnt"
"arent"
"wasnt"
"werent"
"hasnt"
"havent"
"hadnt"

"doesnt"
"dont"
"didnt"
"wont"
"wouldnt"
"shant"
"shouldnt"
"cant"
"cannot"
"couldnt"
"mustnt"
"lets"
"thats"
"whos"
"whose"
"whats"
"heres"
"theres"
"whens"
"wheres"
"whys"
"hows"
"but"
"if"
"or"
"because"
"until"
"while"
"of"
"at"
"by"
"for"
"with"
"about"
"against"
"between"
"into"
"through"
"during"
"before"
"after"
"above"
"below"
"to"
"from"

"up"
"down"
"in"
"out"
"on"
"off"
"over"
"under"
"again"
"further"
"then"
"once"
"here"
"there"
"when"
"where"
"why"
"how"
"all"
"any"
"both"
"each"
"few"
"more"
"most"
"other"
"some"
"such"
"no"
"nor"
"not"
"only"
"own"
"same"
"so"
"than"
"too"

Appendix D

Algorithm Used in RStudio for Social Presence Lexicon Analysis

```
library(IAM)
df=read.csv("FileName.csv")
df
automated=score(df$Post)
automated$scores
write.csv(automated$scores,"FileName",row.names = F)
```

Appendix E

Frequency of Social Presence Score for Each IAM Phase

Social Presence Score	IAM Phase I	IAM Phase II	IAM Phase III	IAM Phase IV	IAM Phase V	Total
0	2	0	0	0	0	2
1	6	0	0	0	0	6
2	4	0	0	0	0	4
3	7	0	0	0	0	7
4	7	0	0	0	0	7
5	4	0	0	0	0	4
6	5	0	0	0	0	5
7	10	0	0	0	0	10
8	13	0	0	0	0	13
9	14	0	0	0	0	14
10	21	3	0	0	0	24
11	24	3	4	0	1	32
12	23	1	1	0	0	25
13	27	3	3	0	0	33
14	23	4	1	0	0	28
15	28	8	4	0	1	41
16	28	7	4	1	0	40
17	24	10	4	0	0	38
18	18	8	4	0	0	30
19	22	10	6	0	0	38
20	9	19	11	0	0	39
21	10	15	12	3	1	41
22	7	9	13	1	0	30
23	9	15	13	4	0	41
24	6	6	21	2	1	36
25	11	6	12	3	1	33
26	10	3	20	0	1	34
27	2	10	14	1	0	27
28	3	8	15	2	1	29
29	2	8	15	3	2	30
30	6	5	19	3	1	34
31	3	7	15	1	0	26
32	2	4	17	1	0	24
33	6	5	11	1	1	24
34	5	3	19	1	1	29
35	2	3	8	4	1	18
36	2	0	9	3	0	14
37	0	6	16	1	2	25
38	2	0	9	5	1	17

39	3	1	10	2	0	16
40	2	0	4	4	0	10
41	2	1	4	2	2	11
42	3	1	6	3	5	18
43	0	0	4	2	2	8
44	0	1	6	7	4	18
45	1	0	5	3	0	9
46	0	1	6	4	3	14
47	0	2	1	3	4	10
48	1	0	2	4	2	9
49	3	0	5	1	7	16
50	0	0	3	2	3	8
51	0	1	3	6	5	15
52	1	1	0	3	2	7
53	0	0	5	3	2	10
54	0	0	1	1	3	5
55	0	0	3	3	0	6
56	0	0	0	2	8	10
57	0	0	0	1	4	5
58	0	0	1	1	3	5
59	0	0	3	1	0	4
60	1	0	0	4	2	7
61	0	0	1	0	0	1
62	0	0	1	0	5	6
63	0	0	0	0	1	1
64	0	0	0	1	0	1
65	0	0	0	2	2	4
67	0	0	1	0	1	2
68	0	0	0	0	2	2
69	0	0	2	0	5	7
70	0	0	0	0	1	1
71	0	0	0	0	2	2
72	0	0	0	0	1	1
73	0	0	0	0	1	1
74	0	0	0	0	2	2
77	0	0	0	1	1	2
80	0	0	0	0	1	1
81	0	0	0	0	1	1
84	0	0	0	0	1	1
Total:	424	198	377	106	104	1209