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A re-examination of the community of inquiry framework: Social network and content analysis

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ABSTRACT

This study provides a simultaneous examination of all components of the Community of Inquiry (CoI) framework (Garrison, Anderson & Archer, 2000; Anderson, Rourke, Garrison & Archer, 2001; and Rourke, Garrison, Anderson & Archer, 1999) and seeks to extend previous work into the nature, development, and relationships between the constructs of "presence" hypothesized in the model. To accomplish this goal we use content and social network analysis to examine the discourse produced among all participants in two semester-length online asynchronous college courses. Coding for the existence and relative intensity of forms of presence we identify patterns and relationships between instructors' and students' teaching presence and social presence and the corresponding quantity and levels of the cognitive presence that emerges. The study reveals complex relationships between these variables that have implications for the development of higher order thinking and meaningful learning in online environments. Study findings also have implications for online teaching practice and ongoing research on the CoI framework.

1. Introduction and objectives

Garrison and Arbaugh (2007) make a convincing case that the Community of Inquiry (CoI) framework has become one of, if not the leading models guiding research into online teaching and learning in higher education. Observing that the original article that laid out the framework has been cited in more than 225 other published articles, the authors note that this is the most frequently cited paper in the Elsevier journal, The Internet and Higher Education. The other foundational articles for the CoI model have had an equally impressive impact on research in this area. In all the initial journal articles by Garrison, Anderson and Archer (2000), Anderson, Rourke, Garrison, and Archer (2001), and Rourke, Anderson, Garrison, and Archer (1999) have been cited by nearly 1000 other papers in the field of online learning research. The number of citations continues to rise and a relatively vigorous research community focusing on CoI has begun to emerge (e.g. Swan et al., 2008). In this paper we examine the CoI framework and raise conceptual and methodological issues that we feel characterize previous research. It is our goal to advance research in online learning and the development of the CoI model by approaching the enterprise with new conceptual and methodological tools.

2. Theoretical framework

The CoI framework posits that knowledge construction in learning environments occurs through the development of a community of inquiry (Lipmann, 2003; Pierce, 1955) characterized in online education specifically by optimal levels of teaching, social, and cognitive presence (Garrison et al., 2000). The model assumes that, in the absence of face-to-face interaction, participants in online learning environments must strive to recreate the social and knowledge building processes that occur via moment by moment negotiation of meaning found in the classroom. These dynamics are depicted by the concepts of presence described in more detail below.

Reflecting recent understanding of collaborative pedagogy, teaching presence refers to the instructional design and organization, facilitation of productive discourse, and direct instruction developed in online courses, ideally by both instructors and students (Anderson et al., 2001). The social presence construct in the model builds upon past research (e.g. Short, Williams, & Christie, 1976) attempting to understand how participants in mediated communication project themselves as "real people", especially in the relatively lean medium of fully text-based, asynchronous communication. Also reflecting the notion of teacher immediacy (Mehrabian, 1966), the model hypothesizes modes of social presence including the textual demonstration of affect, group cohesion, and open communication necessary to establish a sense of trust and, ideally, membership in a community dedicated to joint knowledge construction. It should be noted that the

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notions of teaching presence and social presence combine with each other and the third construct, cognitive presence, to develop such a community. In the CoI model, cognitive presence is seen as developing through a series of four cyclical stages beginning with a triggering event then moving (again ideally) to exploration, integration and resolution. The concept of cognitive presence is thus built upon the Deweyian notion of practical inquiry (Dewey, 1933, 1959) and reflects both critical and creative thinking processes.

Research on the CoI framework documents the correlation between components of the model and learner satisfaction and perceived learning (e.g. Shea, Pickett, & Pelz, 2004; Swan & Shih, 2005) and to online learner sense of community (Shea, Li, & Pickett, 2006). Additional studies have added to our understanding of the coherence of the theoretical component as a research tool (Arbaugh, 2007; Arbaugh et al., 2008; Shea et al., 2006; Shea & Bidjerano in press). Lacking in this research is an attempt to test hypotheses generated by previous work documenting online knowledge construction through the interaction of all elements of the model. In a word, what has been missing in this line of inquiry is "learning" or more significantly the "deep and meaningful learning" which is the assumed goal of all higher education. Additionally previous research (Garrison, Anderson, & Archer, 2001; Garrison et al., 2000; Kanuka, Rourke, & Laflamme, 2007; Rourke & Kanuka, 2009; Stein et al., 2007; Vaughan & Garrison, 2005) suggests that students in online discussion tend not to reach higher stages of cognitive presence, i.e. integration and resolution. It is therefore critical that we attempt to address these weaknesses and gaps in the research.

In this paper we therefore investigated hypotheses generated by recent theory-driven research with regards to the development of knowledge construction within the CoI framework (Shea and Biderjano, 2009; Garrison, Cleveland-Innes, & Fung, submitted for publication). Previous research, based on factor analysis and structural equation modeling, suggests that multivariate measures of cognitive presence presumed to reflect significant learning, especially at the higher stages of integration, application and resolution, develops as a result of instructor teaching presence and is mediated by social presence. In a study of more than 2000 online learners, Shea and Bidjerano (2009) found that more than 70% of variance in students' reported cognitive presence could be predicted based on perceived teaching and social presence (p. 548). Garrison and Cleveland-Innes replicated these findings in a study of 205 of online learners (in press). In both studies social presence developed as a function of instructor teaching presence and was found to mediate the development of cognitive presence. Additionally, through the use of CHAID analysis Shea and Bidjerano (2009) concluded that students who reported high levels of cognitive presence could be distinguished most significantly from those who reported low levels by their answers to an item reflecting social presence. Given these findings social presence appears to play an important role in the advancement of cognitive presence, a measure of significant learning within the CoI framework.

In the current paper, we present preliminary results to further investigate these relationships. Central to this line of inquiry are efforts to overcome methodological weaknesses in previous research. For example in the studies by Shea & Bidjerano (2009) and Garrison & Cleveland-Innes (in press) as well as others (Arbaugh et al., 2008), teaching and social presence were measured through survey items. While student reports serve an important function in this line of research we feel it is important to measure constructs within the CoI framework more directly as well. Quantitative content analysis is useful in this regard as it allows for more direct measurement. Also missing from past research is a direct measure of instructor social presence and its relationship to the development of students' reports of social presence. In the current study therefore we use quantitative content analysis to question whether student social presence develops as a result of instructor teaching presence or instructor social presence. We do this by examining two online courses that vary with regard to instructor teaching and social presence and compare the levels and patterns of student social presence in each. Further we document patterns of teaching and cognitive presence.

Research questions:

1) Using quantitative content analysis what are the patterns of teaching, social, and cognitive presence that emerge through joint coding of course discussion transcripts? What kinds and levels of presence do instructors and students exhibit?
2) What are the relationships between teaching, social, and cognitive presence revealed through content analysis of two courses? Do students' indicators of social presence track instructor social presence?
3) How does low instructor teaching presence correlate with students' social and cognitive presence relative to higher instructor presence? Do students demonstrate higher levels of cognitive presence when instructors are more active as measured through instructor teaching presence?
4) How do social network analysis metrics compare to quantitative content analysis in measuring teaching presence?

3. Methods

We argue that previous research on the CoI model has been limited in several respects. First most empirical research has focused on a single component of the framework, either teaching, social, or cognitive presence (e.g. Anderson et al, 2001; Rourke et al., 1999; Shea, Pickett, & Pelz, 2003, Shea et al., 2006; Swan & Shih, 2005), though exceptions exist (e.g. Akyol & Garrison, 2008; Shea & Bidjerano, 2009). While surveys on student perceptions have examined teaching, social, and cognitive presence these constructs have not been measured together directly in a comparative study of more than one online course. We believe it is time to directly examine and validate all components and the model as a whole, a strategy we employ here through quantitative content analysis of two complete online courses.

Second, research on the CoI has been limited largely to survey methods or content analysis, the latter focusing solely on the discussion transcripts within a single course (see Arbaugh & Hwang, 2006; Shea et al., 2006 for examples of the former, Anderson et al., 2001; Rourke et al., 1999; Swan & Shih, 2005 for examples of the latter). We believe that this research can be advanced in a number of ways. First we employ mixed methods and present a study using both social network analysis and quantitative content analysis to illuminate differences in discourse patterns. A third strategy for progress is to examine more than one course in which levels of teaching and social presence vary. In the present study we therefore analyzed two courses that use the same instructional design template, but have different approaches to the facilitation of discourse and direct instruction and in which the instructors' levels of presence were different.

The data for this research includes all of the content of two fully online courses offered by a State college in the northeast that specializes in distance and adult education for non-traditional learners. The two courses, in Business Management, were designed by content experts and multimedia instructional designers and taught by instructors who were not the course designers. The two courses consisted of five modules of instruction and contained a variety of learning activities including discussions, and individual and group assignments. As mentioned above however the design of the courses was based on a template and the two were identical in this regard.

Following suggestions by Rourke and Anderson (2004) to use and modify existing protocols, to code for social presence we used the indicators originally devised by Rourke et al. (1999) with revisions by Swan and Shih (2005). We made some minor modifications to the social presence indicators. Similarly, for teaching presence we used the codes devised by Anderson et al. (2001) and made significant revisions in the area of direct instruction, which previous research has indicated failed to consistently cohere as an interpretable factor (Shea et al., 2006). Cognitive presence codes were taken from Garrison et al. (2001) and

were modified by removing "divergent" and "convergent" from the exploration and integration category descriptions and by deleting the brainstorming indicator from exploration because it could not be differentiated from information exchange. The coding schemes developed through this research are included in Appendix B.

Content analysis was conducted on a total of 10 discussions in all five modules in each course. There were a total of 490 posts in Course A and 454 posts in Course B. Two independent researchers coded a test sample of online discussion to establish a baseline inter-rater reliability. The unit of analysis upon which agreement was determined was the message (post). Coding was done in phases and the two researchers sought to identify one form of presence at a time until all of the posts had been coded. After each module had been coded for one of the forms of presence the researchers met to check inter-rater reliability. Codes were compared for agreement, disagreement, and errors. Every coding of each of the three forms of presence was checked and adequate inter-rater reliability was established for all 944 posts. This required that 5664 independent judgements about student and instructor discourse be made and checked for agreement.

Previous research using content analysis suggests that considerable care is needed to reach valid results and that achieving high levels of agreement between coders is critical to this goal. Earlier research has been somewhat remiss in this regard with authors frequently supplying inadequate information, or no indicators of inter-rater reliability measures (see e.g. Anderson et al. (2001) for a review of 19 such studies). Previous work has also depended on very small samples of jointly coded and compared content assuming that subsequent coding proceeded without significant disagreement. As outline above, we took several steps to achieve additional rigor. First we calculated two measures of inter-rater reliability, and second we did not depend on sampling, but rather coders compared results of coding for all discussions in all of the modules of both courses to ensure adequate levels of validity and reliability.

Inter-rater reliability was initially computed using Cohen's Kappa. After calculating initial inter-rater reliability, the coders met to negotiate disagreements. Previous research suggests that symmetrical imbalances in the marginal distributions of the coding table is problematic and can lead to high levels of observed agreement yet a very low kappa (Feinstein & Cicchetti, 1990). Because of this, Holsti's Coefficient of Reliability, which measures percent agreement was also used to calculate inter-rater reliability.

4. Results

4.1. Methodological results

Inter-rater reliability measures are displayed in Tables 1–3. As can be seen the process of negotiation results in higher levels of agreement. This is due in part to the discovery of simple coding errors as well as to achieving greater consensus on the meanings ascribed by each coder.

Inter-rater reliability changed considerably when affective indicators were removed and only cohesive indicators and open communication were evaluated. Course A had an average pre-negotiated inter-rater reliability ranging from a $k = 0.75$ to 0.79 and CR ranging from 0.90 to 0.92. The IRR for Course B ranged from a $k = 0.68$ to 0.83 and CR of 0.88 to 0.93. When affective indicators were removed, the IRR for both courses increased considerably.

Table 1
Social presence initial and negotiated inter-rater reliability measures: Cohen's Kappa.

Initial and negotiated inter-rater reliability using Cohen's Kappa				
	Course A (KS)		Course B (JY)	
	Initial *k*	Negotiated *k*	Initial *k*	Negotiated *k*
Module 1	0.78	0.95	0.76	0.97
Module 2	0.79	0.95	0.79	0.99
Module 3	0.75	0.95	0.68	0.91
Module 4	0.75	0.99	0.72	0.96
Module 5	0.79	1.00	0.83	1.00

Table 2
Social presence initial and negotiated inter-rater reliability measures: Holsti's Coefficient of Reliability.

Initial and negotiated inter-rater reliability using Holsti's Coefficient of Reliability				
	Course A (KS)		Course B (JY)	
	Initial CR	Negotiated CR	Initial CR	Negotiated CR
Module 1	0.92	0.98	0.91	0.99
Module 2	0.92	0.98	0.92	0.99
Module 3	0.91	0.98	0.88	0.97
Module 4	0.90	0.99	0.90	0.99
Module 5	0.92	1.00	0.93	1.00

This difficulty reflects findings by Rourke et al. (1999) who stated that inclusion of affective indicators "may be more trouble than they are worth" (p. 12). Specifically, the humor indicator was contentious because the author's intent is often unknown or misunderstood (Rourke, Anderson, Garrison, & Archer, 2001; Swan & Shih, 2005). Paralinguistic elements (emoticons) also confounded coding because they were used for unconventional expressions of emotion as well as to "lighten the tone" of a post (Poole, 2000). The former may fall into the affective category, while the latter is a potential cohesive indicator — an attempt to reduce misunderstanding. Expressions of values (Swan & Shih, 2005) posed similar problems due to their highly subjective nature. Some statements coded as values were found to be rephrased textbook information. Despite coding self-disclosure conservatively, with outside information directly related to the discussion coded as teaching presence, difficulties arose because outside information may fall into the cohesive indicator of social sharing. In summary, while affective messages exist in online course transcripts, consistently identifying affect for research purposes remains problematic.

4.2. Content analysis results

Garrison and Arbaugh (2007) report that as courses progress social presence should become "somewhat transparent" as focus shifts to academic purposes (p.160). However, preliminary analyses on the occurrences of social presence indicators throughout the courses reveal inconsistent results. As both courses progressed, average social presence indicators per student increased in Course A, while indicators per student decreased in Course B as demonstrated in Fig. 1 below.

Preliminary results also found differences in the distribution of individual indicators in each course. In course A, only affective indicators decreased over time, with both open communication and cohesive indicators increasing (See Fig. 2). However Course B showed a decrease in all three indicators by course end (see Fig. 3). This stands in contrast to Swan (2002) and Swan and Shih (2005), who posit that cohesive indicators decline over the duration of the course, but parallels portions of Vaughan's findings (cited in Garrison and

Table 3
Social presence inter-rater reliability measures with all three indicators and with affect removed: Cohen's Kappa.

Initial and negotiated inter-rater reliability using Cohen's Kappa				
	Course A (KS)		Course B (JY)	
	All indicators	No affect	All indicators	No affect
Module 1	0.78	0.88	0.76	0.89
Module 2	0.79	0.92	0.79	0.98
Module 3	0.75	0.93	0.68	0.90
Module 4	0.75	0.86	0.72	0.91
Module 5	0.79	0.91	0.83	0.96

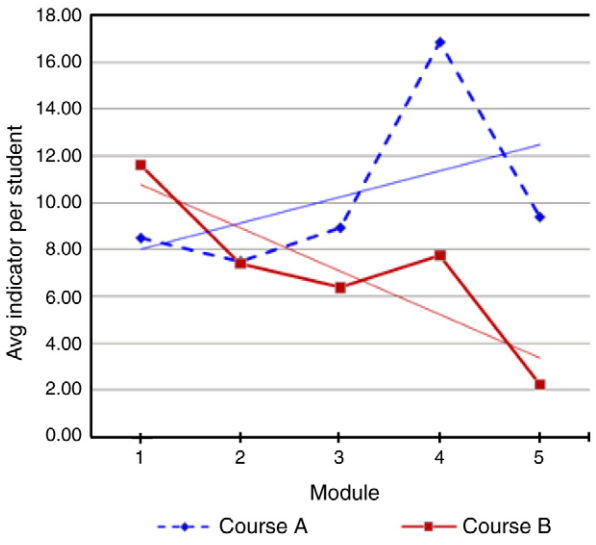

Fig. 1. Average number of student social presence indicators per module.

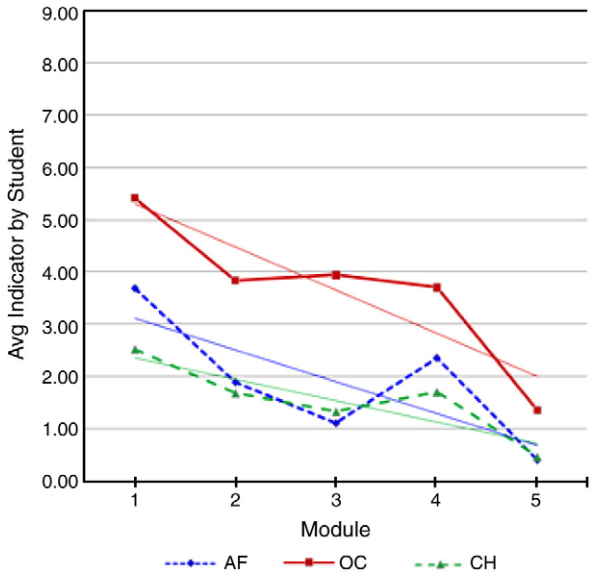

Fig. 3. Average number of social presence indicators by student course B.

Arbaugh, 2007), that affective and open communications measures decrease while cohesive measures increase over time.

The research question of interest here has to do with possible causes for fluctuations and differences in social presence levels both within courses and between courses. Two competing hypotheses for understanding these differences in light of the CoI framework are that either instructor teaching presence (instructional design, facilitation of discourse, and direct instruction) or instructor social presence (affective expression, open communication, cohesion) correlate more strongly with students expression of social presence. Recall that this relationship is significant in light of recent theory-driven research documenting correlations between social presence and the multivariate measure of significant learning, cognitive presence in research with more than 2000 online students (Shea & Bidjerano, 2009). In this paper we examine the development of social presence first, focusing on the question of whether it appears to be more closely associated with instructor teaching presence or instructor social presence.

Figs. 4 and 5 represent an examination of the second research question— the relationship between instructor teaching presence and student social presence. As can be seen a significant relationship exists between these two variables, as instructor teaching presence rises or falls, there is a correlating rise or fall in student social presence.

Note that the correlation between instructor teaching presence and student social presence in this course initially appears to be quite weak ($r = .02$). However, when the initial module is excluded from the analysis (in which students and the instructor are still tentatively determining roles relative to each other) the correlation becomes much stronger. The correlation between student social presence and instructor teaching presence in the subsequent four modules of the course is almost perfect ($r = .97$).

The same results do not hold true for the course with low levels of instructor teaching presence and are indicated in Fig. 5.

As can be seen, average student social presence indicators decline correspondingly with the decline in instructor teaching presence indicators. Here too the correlation is quite strong ($r = .78$). However when the first module of instruction is excluded from the analysis the correlation between instructor teaching presence and student social presence becomes weaker over the subsequent four modules of the course ($r = .38$).

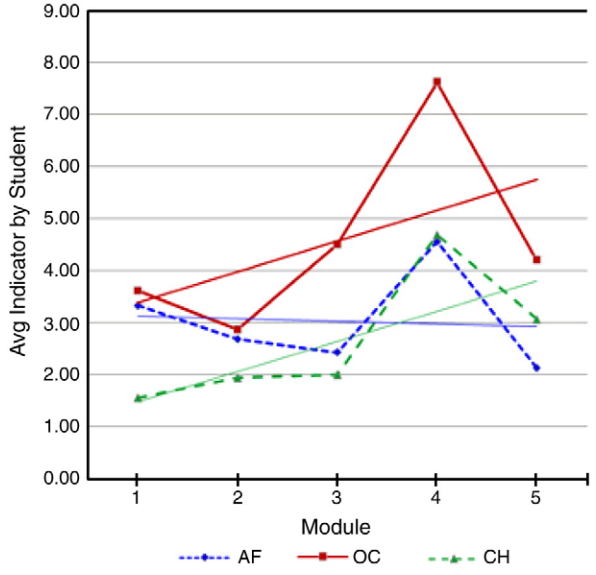

Fig. 2. Average number of social presence indicators by student course A.

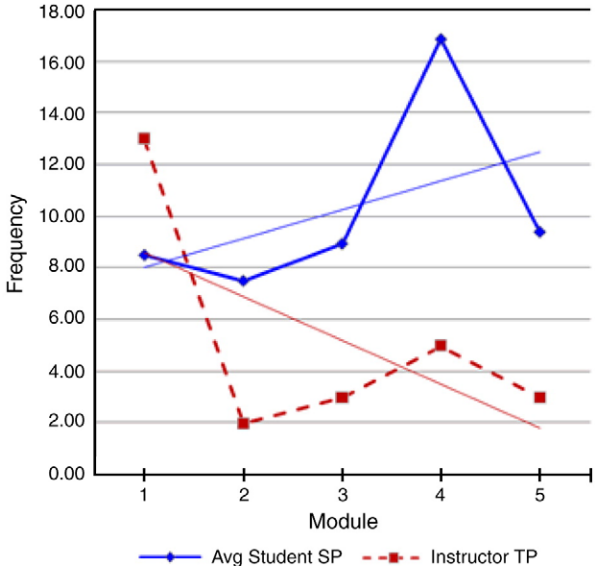

Fig. 4. Average student social presence vs. instructor teaching presence — course A.

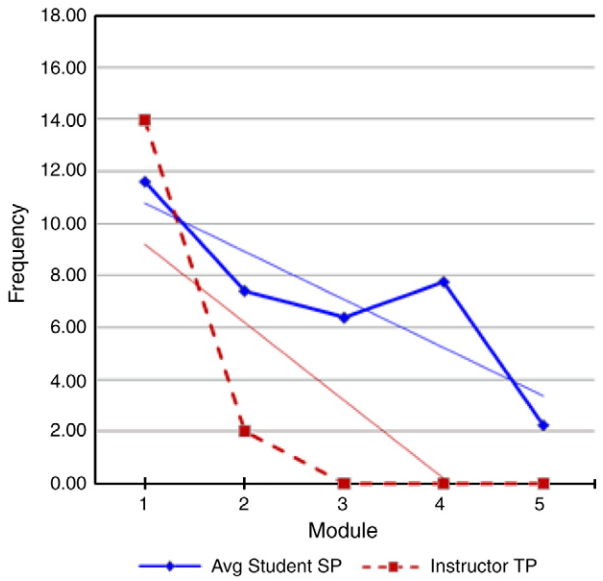

Fig. 5. Average student social presence vs. instructor teaching presence — course B.

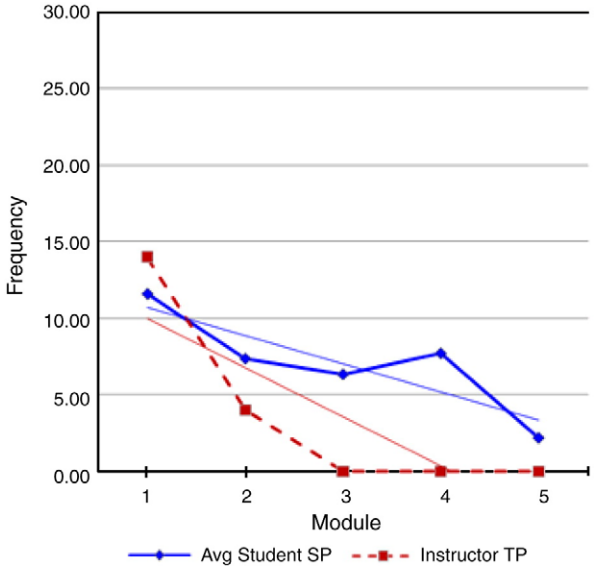

Fig. 7. Average student social presence versus instructor social presence — course B.

Figs. 6 and 7 further represent an examination of the second research question— i.e. that student social presence is more closely aligned with instructor social presence than instructor teaching presence. As can be seen an even closer pattern of association can be found between instructor social presence and student social presence.

Even including the first module of instruction the correlation between instructor social presence and student social presence is quite strong ($r = .51$). Excluding the first module in this course again results in a near perfect correlation ($r = .98$).

In contrast to course A course B shows a declining pattern in both instructor social presence and student social presence. Again when compared to course B the reverse pattern of association occurs when the first module is excluded from the analysis. With module one included the correlation is quite high ($r = .80$). With module one excluded from the analysis the correlation again drops ($r = .38$).

4.3. Teaching presence

With regard to research question 3, coding results for teaching presence, results of the process were similar to that of social presence. Inter-rater reliability measures are shown in Tables 4 and 5 in the Appendix. As can be seen, the process of negotiation also resulted in better levels of agreement, again, in many instances, because it allows for the discovery of coding errors and to understand the conceptualizations of meaning of each of the coders.

Recall that in the CoI framework teaching presence refers to the instructional design, facilitation of discourse, and direct instruction demonstrated by participants, both teacher and students. An analysis of teaching-presence indicator patterns in threaded discussion across the duration of the semester reveals that teaching presence varied widely both within and between the courses for both the instructor and the students. Both instructors began the courses with a relatively intense level of involvement in terms of teaching presence, then reduced their presence substantially as can be seen in the Figs. 8 and 9 below.

Results suggest that students' teaching presence may have a "floor" threshold level and when the instructor's teaching presence drops to zero students attempt to recreate "instructional equilibrium". Fig. 10 documents slightly higher levels of teaching presence on the part of the students in course B despite the lack of instructor teaching presence after the second module.

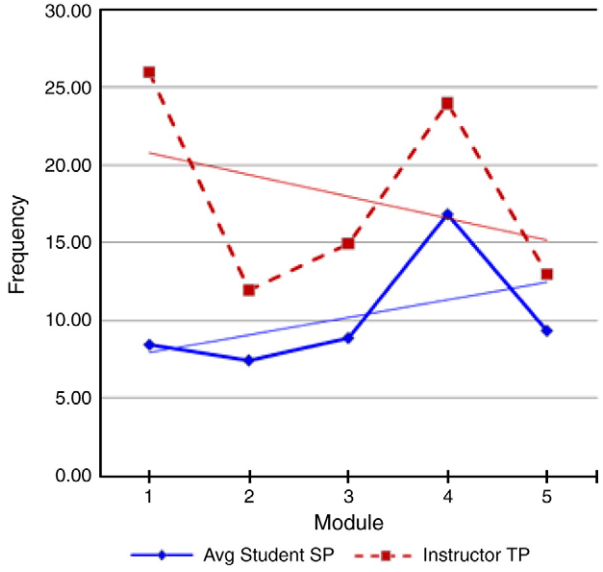

Fig. 6. Average student social presence versus instructor social presence — course A.

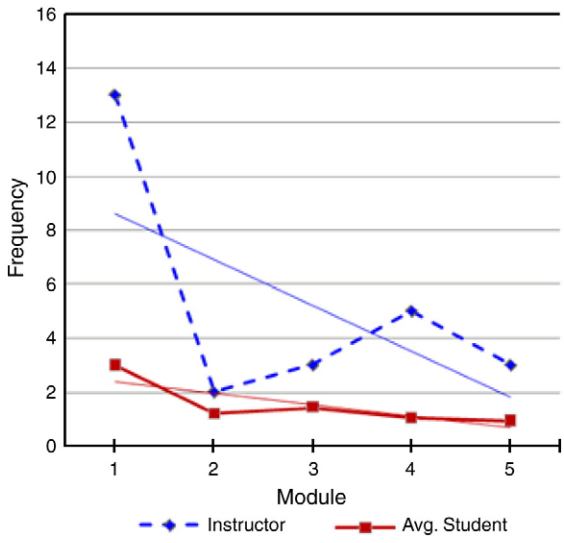

Fig. 8. Instructor teaching presence vs. student teaching presence — course A.

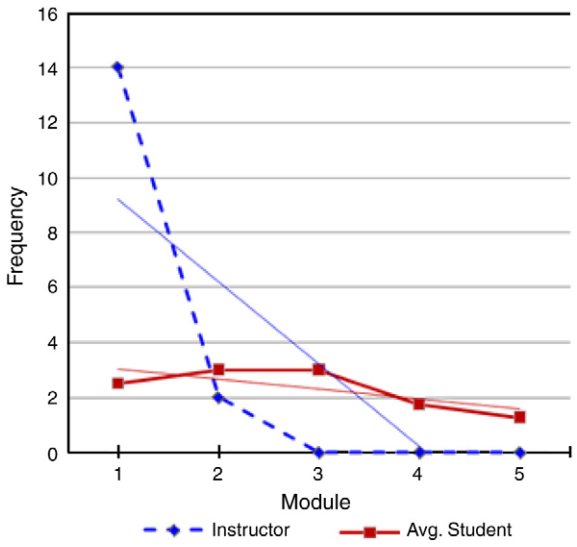

Fig. 9. Instructor teaching presence vs. student teaching presence — course B.

4.4. Cognitive presence

Continuing with research question 3, the cognitive presence patterns demonstrated in these courses are not necessarily intuitive. On the surface cognitive presence appears to follow logically from what one might hypothesize from the CoI framework. The course with higher and more consistent teaching and social presence resulted in higher levels of student cognitive presence as documented in Fig. 11 below:

A closer examination of cognitive presence points to two complicating factors. First, the cognitive presence in Course A was higher from the outset. This may point to initial differences between courses that need to be accounted for and which we are currently examining. Second, the quality of the cognitive presence within the courses was somewhat different. Recall that cognitive presence in the CoI model is reflective of a four stage model and that higher levels, indicative of integration and resolution are more desirable.

Although best practices for leading online discussions suggest that the instructor should neither dominate the discussion nor go missing, there may be some benefit to Instructor B's approach if we examine more closely the distribution of CP indicators between the two course sections. Course B's per student integration indicators, which are indicative of higher level thinking, exceeded Course A's in three of the five course modules (see Fig. 12). This is significant even though

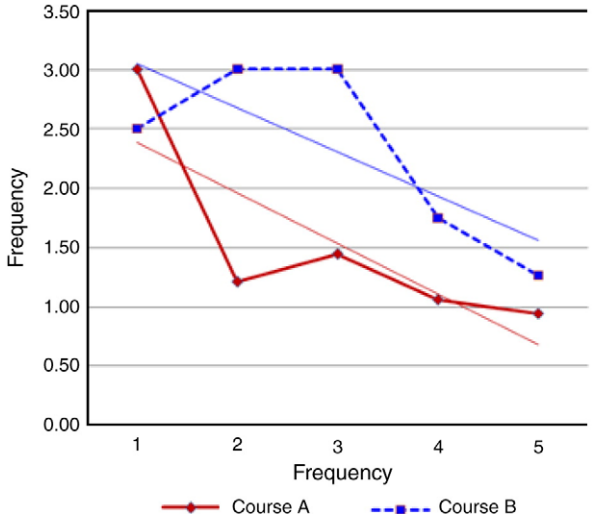

Fig. 10. Average teaching presence indicators per student per module.

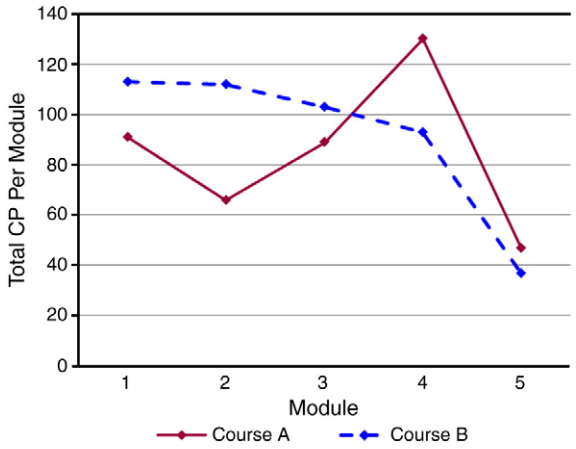

Fig. 11. Comparison of overall cognitive presence.

Instructor A's students showed relatively higher levels of cognitive presence in the course overall (see Fig. 13) due to the larger average number of per student exploration indicators (see Fig. 14).

First, this highlights the complications that result from using quantity rather than quality as criteria for evaluating cognitive presence. Secondly, this stands as a caution against placing too much emphasis on the lower phases of the cognitive presence process, i.e., triggering and exploration, particularly if we believe that deep and meaningful learning does not occur until students move to the integration and resolution stages.

These results parallel findings by previous researchers attempting to find evidence of higher levels of cognitive presence in threaded discussion transcripts (Garrison et al., 2000, 2001; Kanuka et al., 2007; Rourke & Kanuka, 2009; Stein et al., 2007; Vaughan & Garrison, 2005). However, as stated in the introduction to this study, we believe looking only at threaded discussion for this evidence is misguided. We need to recall that online courses are not simply threaded discussions. If we are seeking to uncover evidence of the higher stages of cognitive presence, i.e. integration and application of new knowledge then we need to move beyond activities in which these capacities are unlikely to appear. Clearly these more abstract phases of knowledge construction will *not* be most evident in student interactive discourse (threaded discussions) but should, instead, be evident in activities designed to allow for their demonstration, such as integrative papers, projects, case studies and the like. We are currently in the process of reviewing other course artifacts for evidence of such higher order thinking as reflected in the CoI framework.

5. Social network measures

Social network analysis (SNA) offers both visual and statistical analyses of human relationships. Given the importance of interaction in the CoI framework and the special emphasis on social presence,

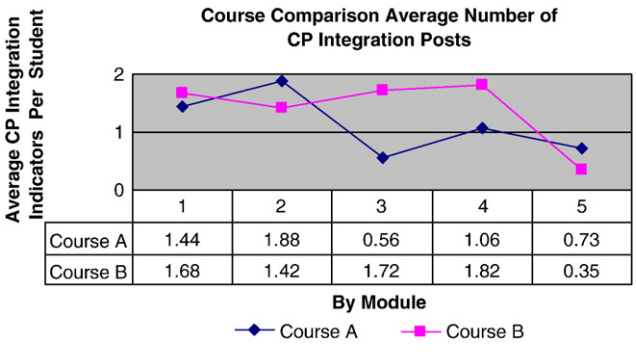

Fig. 12. Average cognitive presence indicator — integration stage.

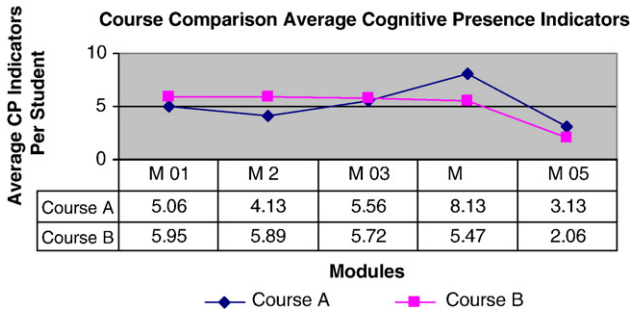

Fig. 13. Average cognitive presence indicators by course.

SNA offers a promising methodology for gaining insight into online teaching and the utility of the CoI model. Because instructors have considerable latitude in how they choose to exercise their teaching and social presence, SNA measures, such as centrality and prestige, can assist in quantifying their interactions with students and uncover important patterns based on mutual as well as unreciprocated responses that evolve in online discussions.

The two course instructors exhibited very similar levels of centrality, a measure of prominence associated with an actor's position in a network, based on the number of ties or relations they have with others (Wasserman & Faust, 2007, p 170). At the course level neither instructor took central positions in their online discussions. Both had comparable normalized Freeman's Degree centrality measures (Instructor A = 14.0; B = 13.3) which were slightly above the mean for their respective groups (Class A = 12.26; Class B = 11.07).

In contrast, the two instructors diverged on prestige, the degree to which others in a network seek out specific individual for interaction (Wasserman & Faust, 2007, p. 169). Significantly, Instructor B ranked highest in prestige among all participants in his course (Nodes = 16; Ties = 137; Directed Pairs = 240; Density 57.1). Instructor A ranked in line with the class mean (Nodes = 11; Ties = 80; Directed Pairs = 110; Density 72.7). It is striking that Instructor B participated in only two of the five discussions with a total of 14 posts, versus instructor A's 38 posts across the five discussions. This raises important questions regarding the relative significance of centrality as an indicator of instructor influence and may point to a more important relationship between teaching presence and instructor prestige. These are initial analyses and we need also to consider other forums in which instructors communicate with students. We are in the process of examining these as a component of this ongoing project of research.

An examination of Instructor B's 14 posts, predominantly concentrated in Module 1, revealed that they explicitly addressed his expectations of how students should participate in the discussion by redirecting their attention to critiquing the readings, explaining how to frame their written reactions to them, and suggesting approaches to help integrate their understanding of theoretical concepts with the real world — all evidence

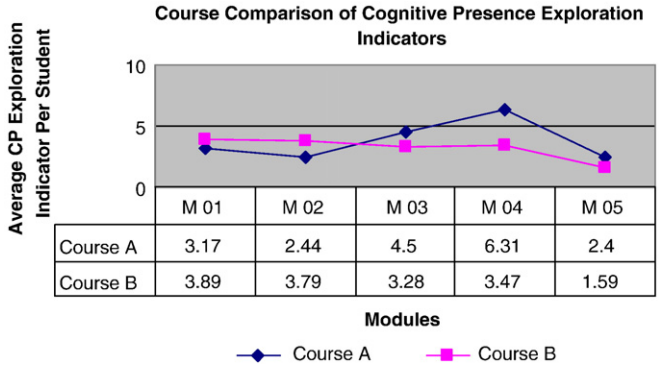

Fig. 14. Average cognitive presence indicator — exploration stage.

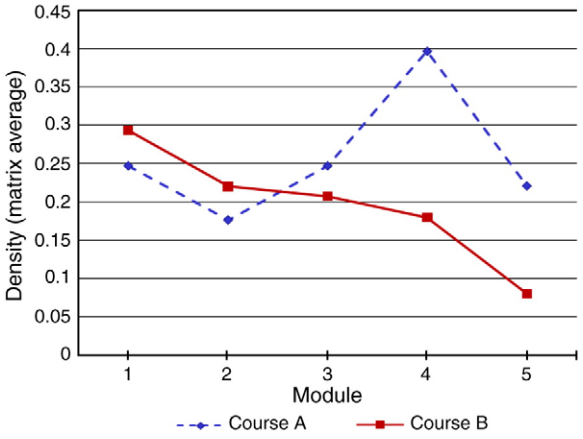

Fig. 15. Social network analysis density by course.

of teaching presence focused on helping students to make optimum use of the medium for knowledge construction through discourse. Most significantly, these three instructor threads elicited over 23 direct student responses, accounting for the instructor's rank as first in prestige in his network. In contrast, Instructor A's postings were focused on introducing or making explicit reference to outside material and encouraging, acknowledging, or reinforcing student contributions. Their less directive tone and content yielded far fewer direct responses from students.

To gain insight into the applicability of social network analysis as a useful tool for understanding the dynamics of online learning through the CoI model we conducted a comparison of several SNA metrics against measures of presence conducted through quantitative content analysis. Specifically we compared patterns of social presence in the two courses with measure of density in SNA. Fig. 15 documenting SNA density measures indicates a very similar pattern when compared to the average social presence patterns found through quantitative content analysis in Fig. 16.

These results suggest that measures of network density derived from social network analysis may be a useful proxy for understanding the development of social presence in online environments. The advantage to this method is that, rather than spending scores of hours coding transcripts for indicators of social presence, network density measures can be generated automatically using adjacency matrices captured in threaded discussion files commonly found in learning management systems. However, while suggestive, clearly these results require replication and additional research.

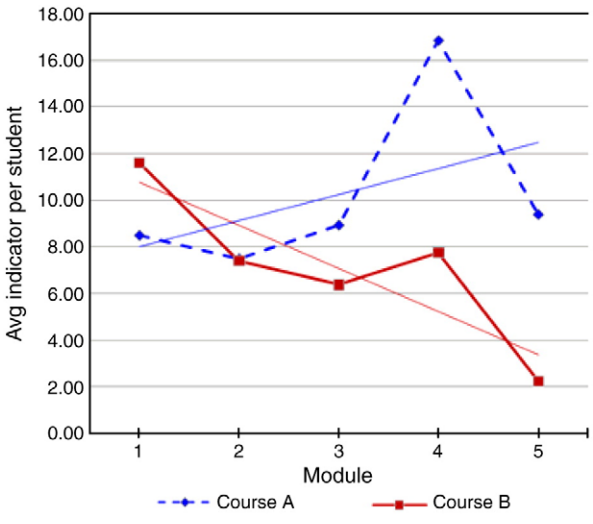

Fig. 16. Average social presence indicators per student per module.

6. Discussions and recommendations

The number of online learners in US Higher Education has surpassed 3.9 million and continues to grow at rates much higher than classroom based college enrolments (Allen & Seaman, 2007, 2008). Given this explosion, it is crucial that we gain insight into how people learn online. This research advances work on one of the most influential theoretical frameworks for achieving this goal, the CoI model. Below we discuss specific results of this research and provide recommendation for future online learning research and practice.

6.1. Methodological issues

This and previous work suggest that great care needs to be applied in order to successfully utilize quantitative content analysis for research into online teaching and learning. Results reported here imply that several specific indicators of social presence are very difficult to interpret reliably. All of these issues indicate that the social presence construct is somewhat problematic and requires further articulation and clarification if it is to be of use to future researchers seeking to inform our understanding of online teaching and learning. We attempted to improve on previous research in this area by including additional results related to coding issues and more information and metrics regarding inter-rater reliability. It is suggested that future researchers provide similar detail in order to allow for easier comparison, and assessment of reliability and validity of results.

6.2. Results related to previous research on social presence patterns

Preliminary results suggest that the development of social presence may be contingent on instructors and students working in concert rather than a stable pattern related to the passage of time in a course. These results highlight therefore the importance of instructor contributions and raise additional questions about the relation of social presence to learning. These results also raise some concerns about the viability of other aspects of the social presence component of the model. Reliably identifying affect in online courses, an element deemed important to the development of trust characteristic of a community of inquiry, continues to present significant challenges to researchers. We suggest that the social presence construct is crucial to understanding online learning and requires additional specification.

6.3. Results related to correlations between instructor and student presence

Analysis inquiring into the relative strength of relationships between instructor teaching presence or social presence and student social presence presented interesting results. While previous research findings (Shea and Bidjerano, 2009; Garrison and Cleveland-Innes, in press) indicated that reported cognitive presence levels can be predicted by teaching presence with social presence playing a mediating role, questions with regards to the direction of causality of the model remained. Previous research did not inquire into the role of instructor social presence in the development of student social presence, instead presenting a structural equation model in which it is was assumed that instructor teaching presence facilitates student social presence. While in that research, the model fit the data to a significant degree, the alternate hypothesis, that instructor social presence facilitates student social presence was not examined. The current study did inquire into this hypothesis and revealed a complex relationship, outlined below.

First, in examining the relationship between instructor teaching presence and student social presence it was found that there is a strong correlation between the two constructs when instructor teaching presence is relatively high as in course A. However, the correlation between instructor teaching presence and student social presence is lower when instructor teaching presence is low as in course B. This pattern becomes especially apparent when the first module of the course, wherein roles and relationships are being negotiated, is excluded from the analysis. Second, the correlation between instructor social presence and student social presence appears even stronger than between instructor teaching presence and student social presence. This is especially apparent when instructor social presence is relatively high as in course A. However, when instructor social presence is low as in course B, the correlation is weaker. Both trends become more apparent when the first module of each course is excluded from the analysis.

As outlined in the community of inquiry framework, teaching presence is defined as a type of online instructional orchestration. Clearly, these results indicate that, when the online instructor is leading, students tend to follow; higher levels of teaching (and social) presence on the part of the instructor tend to lead to higher levels of social presence from the students. However, when the instructor does not take on this role, students do not have an educational orchestrator and their corresponding level of presence diminishes. Finally, we need to continue to examine other areas of the courses to more comprehensively identify instructor presence — an ongoing activity in this research project.

6.4. Results related to cognitive presence

These results are similar to those of other researchers inquiring into the development of higher levels of cognitive presence reflective of significant learning in the CoI framework. While students did reach the integration stage in threaded discussions, levels of cognitive presence reflecting triggering and exploration were far more common. We do not see this as problematic however and the long term goal of this research project is to continue to develop and verify a coding scheme appropriate for the identification of significant learning in other course artifacts. We expect to find more evidence of integration and resolution stages of cognitive presence in documents such as case studies, papers, and projects.

6.5. Result related to social network analysis

Given the high priority online learning research gives to the many types of interaction made possible by asynchronous learning networks the use of SNA to examine learners within their networks of interaction appears warranted. In this study it was disclosed however that measures of centrality, typically used in SNA, appear to be relatively poor indicators of productive interaction, especially when applied to what might be considered a very central participant, the instructor. This study concludes that network prestige, which is measured in terms of the number of responses generated by an actor in a network, appears to be a better indicator of the interactions that strategic instructors can elicit. While posting fewer comments than instructor A, instructor B was able to develop more ties to students by focusing his discourse on essential course requirements. This was the result of requiring students to respond in kind to his questions which were focused on specific content issues and concerns. This study thus begins to identify more appropriate measures within SNA for future research into online learning. Additionally, in this study it was found that measures of density patterns commonly utilized in social network analysis appear to align well with patterns measuring social presence derived through quantitative content analysis, a far more labour intensive method. These results are significant in that, if they can be replicated, it appears that SNA may be utilized as a tool to automate the measurement of theoretically-derived desirable behaviors in online learning environments.

Acknowledgement

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Appendix A

Table 4
Teaching presence initial and negotiated inter-rater reliability measures: Cohen's Kappa.

Initial and negotiated inter-rater reliability using Cohen's Kappa				
	Course A (KS)		Course B (JY)	
	Initial *k*	Negotiated *k*	Initial *k*	Negotiated *k*
Module 1	0.46	0.99	0.58	0.96
Module 2	0.34	0.84	0.67	1.00
Module 3	0.31	0.83	0.60	0.86
Module 4	0.28	1.00	0.40	0.95
Module 5	0.41	1.00	0.85	0.90

Table 5
Teaching presence initial and negotiated inter-rater reliability measures: Holsti's Coefficient of Reliability.

Initial and negotiated inter-rater reliability using Holsti's Coefficient of Reliability				
	Course A (KS)		Course B (JY)	
	Initial CR	Negotiated CR	Initial CR	Negotiated CR
Module 1	0.74	0.99	0.86	0.99
Module 2	0.76	0.95	0.89	1.00
Module 3	0.75	0.96	0.86	0.95
Module 4	0.88	1.00	0.83	0.99
Module 5	0.91	1.00	0.96	0.97

Appendix B

Table 6
Coding scheme for teaching presence.

Categories	Indicators	Code	Definition	Examples
Design and organization (DE)	Setting curriculum and communicating assessment methods to be used in the course	DE1	Communicates important course outcomes, e.g. documentation of course goals, topics, rubrics and instructor expectations	This week we will be discussing… Please refer to your discussion rubric
	Designing methods	DE2	Provides clear instructions (delete: and expectations) how to participate in course learning activities, e.g., clear explanation of how to complete course assignments successfully	I am going to divide you into groups and you will debate
	Establishing time parameters	DE3	Communicates important due dates/time frames for learning activities to help students keep pace with the course, e.g. accurate course schedule	Please post a message by Friday
	Utilizing medium effectively	DE4	Assists students to take advantage of the online environment to enhance learning e.g., (delete: provides clear instructions on how to participate in discussions, submit assignments and) using LMS features for learning activities and resolving technical problems	Try to address issues that others have raised when you post (remove this example because not technology or CMS related?) When you submit your written assignment first save your file as a word document then attach it to the drop box for this module.
	Establishing netiquette	DE5	Helps students understand and practice the kinds of behaviors that are acceptable in online learning, e.g., providing documentation on polite forms of online interaction	Keep your posts short. Remember, all uppercase letters is the equivalent of "shouting."
	Making macro-level comments about course content	DE6	Provides rationale for assignment/topic	This discussion is intended to give you a broad set of tools which you will be able to use in deciding when and how to use different research techniques
Facilitating Discourse Indicators (FD)	Identifying areas of agreement/disagreement	FD1	Helps to identify areas of agreement and disagreement on course topics in order to enhance student learning	Joe, Mary has provided a compelling counter-example to your hypothesis. [Would you care to respond? This is second sentence is actually TP-5]
	Seeking to reach consensus	FD2	Assists in guiding class toward agreement about course topics in a way to enhance student learning	I think that Joe and Mary are saying essentially the same thing.
	Encouraging, acknowledging or reinforcing student contributions	FD3	Acknowledges student participation in the course, e.g., replied in a positive encouraging manner to student submissions	Thank you for your insightful comments….
	Setting climate for learning	FD4	Encourages students to explore concepts in the course, e.g., promotes the exploration of new ideas	Don't feel self-conscious about "thinking out loud" on the forum. This is the place to try out ideas after all
	Drawing in participants, prompting discussion	FD5	Helps keep students engaged and participating in productive dialog	Any thoughts on this issue?
	Presenting follow-up topics for discussions (ad hoc)	FD6	Presents content or questions (delete: that enhance learning) i.e., tangential (confirm use of tangential) or related (delete: but are outside of the initial design questions??)	Bates says….. What do you think? (Need a better example than this)

Table 6 (*continued*)

Categories	Indicators	Code	Definition	Examples
Facilitating Discourse Indicators (FD)	RE-Focusing discussion on specific issues	FD7	Helps focus discussion on relevant issues (delete: that enhance understanding and) keeps participants on topic	I think that's a dead end. I would ask you to consider Be sure to address the differences between theory and practice.
	Summarizing discussion	FD8	Reviews and summarizes discussion contributions to highlight key concepts and relationships to further facilitate discourse	The original question was…. Joe said…Mary said… We concluded that…We still haven't addressed…..
Direct instruction (DI)	Providing valuable analogies	DI1	Attempts to rephrase/reformulate course material in ways that highlight similarities between content assumed to be understood and new content with the goal of making the material more comprehensible	"Pump in the heart chamber"
	Offering useful illustrations	DI2	Attempts to make course content more comprehensible by providing examples that are substantive and advance understanding	My employer uses the following two methods to address the skills gap…
	Conducting supportive (informative?) demonstrations	DI3	Attempts to make course content more comprehensible through the exhibition of processes	For example — multimedia; links to online demonstrations
	Supplying clarifying information	DI4	Attempts to reduce confusion or misconceptions about course content by providing additional explanations.	Let me provide you with some additional detail explaining how this staffing process works with employees who have disabilities.
	Making explicit reference to outside material	DI5	Provides useful information from a variety of sources, e.g., articles, textbooks, personal experiences, or links to external web sites.	I was at a conference with Bates once, and he said….. You can find the proceedings from the conference at http://www….; you can also look at…
Assessment (AS)	Giving formative feedback for discussions	AS1	Explicitly evaluates discussion/offers feedback OR diagnoses misconceptions to help students learn	Your posting would be even better if you talk about what changes are necessary and how you would implement them.
	Providing formative feedback for other assignments	AS2	Explicitly evaluates other assignment types/offers feedback OR diagnoses misconceptions to help students learn	
	Delivering summative feedback for discussions	AS3	Provides post mortem feedback on discussions, including grades	
	Supplying summative feedback for other assignments	AS4	Provides post mortem feedback on other assignments, including grades	
	Soliciting formative assessment on course design and learning activities from students and other participants	AS5	Seeks feedback upon completion of modules or during mid-course.	
	Soliciting summative assessment on course design and learning activities from students and other participants	AS6	Seeks meta-level feedback at close of course.	

Table 7
Coding scheme for social presence.

	SP categories	Indicators	Code	Definition	Examples
Social presence (SP)	Affective (AF)	Expressing emotions	SP-AFI	Conventional expressions of emotion	I'm really annoyed… I'm so happy….
		Use of humor	SP-AF2	Teasing, cajoling, irony, understatements, sarcasm	The banana crop in Edmonton is looking good this year ;-)
		Self-disclosure	SP-AF3	Presents details of life outside of class, or expresses vulnerability; includes expressions of likes, dislikes and preferences	Where I work, this is what we do… I just don't understand this question
		Use of unconventional expressions to express emotion	SP-AF4	Unconventional expressions of emotion. includes repetitious punctuation, conspicuous capitalization, emoticons	I just can't stand it when…!!!; ANYBODY OUT THERE!; What does this mean!?!?; Good idea :-)
		Expressing value	SP-AF5	Expressing personal values, beliefs and attitudes	I think it is a necessary evil; I feel our children have the same rights.
	Open communication (OC)	Continuing a thread	SP-OC-1	Using reply feature of software, rather than starting a new thread	Software dependent, e.g. Subject: Re- or Branch from
		Quoting from others' messages	SP-OC-2	Using software features to quote others' entire message or cut and passing selections of others' messages	Software dependent_ e.g. "Martha writes;" or text prefaced by less than symbol <
		Referring explicitly to others' messages	SP-OC-3	Direct references to contents of others' posts	In your message you talked about Moore's distinction between…
		Asking questions	SP-OC4	Students ask questions of other students or the moderator	Anyone else had experience with BlackBoard?
		Complimenting. expressing appreciation	SP-OC-5	Complimenting others or contents of others' messages	I really like your interpretation of the reading.
		Expressing agreement	SP-OC-6	Expressing agreement with others or contents of others messages	I was thinking the same thing. You really hit the nail on the head.
		Expressing disagreement	SP-OC7	Expresses disagreement with other or contents of others messages	I don't think… I think it is different…
		Personal advice	SP-OC-8	Offering specific advice to classmates	The CEC web site might have some references
	Group Cohesion (CH)	Vocatives	SP-CH-I	Addressing or referring to the participants by name	I think John made a good point. John, what do you think?

Table 7 (*continued*)

	SP categories	Indicators	Code	Definition	Examples
	Group Cohesion (CH)	Addresses or refers to the group using inclusive pronouns	SP-CH-2	Addresses the group as we., us, our, group	Our textbook refers to…; I think we veered off track…
		Phatics, salutations and greetings	SP-CH-3	Communication that serves a purely social function; greetings or closures	Hi all; Hi John; That's it for now; We're having the most beautiful weather here.
		Social sharing	SP-CH-4	Sharing information unrelated to the course	Happy Birthday!! To both of you!!
		Course reflection	SP-CH5	Reflection on the course itself	A good example was the CD-ROM we read about

Table 8
Coding scheme for cognitive presence.
Adapted from Community of Inquiry Model (Garrison, Anderson and Archer, 2000).

Phase	Descriptor	Code	Indicators	Socio-cognitive processes	Examples
Triggering event	Evocative (inductive) ▪ Stimulate one's curiosity ▪ Core organizing concept or problem ▪ Dilemma or problem that learners can relate to from their experience or previous studies ▪ Framing the issue and eliciting questions or problems that learners see or have experienced ▪ Assessing state of learners knowledge and generating unintended but constructive ideas	CP-TE-1	Recognize problem	Presenting background information that may culminate in a question or presents a problem/issues	It has been argued that the only way to deliver effective distance education is through a systems approach. However, this approach is rarely used. Why do you think that is?
		CP-TE-2	Sense of puzzlement	Asking questions or Messages that take discussion in a new direction	
Exploration	Inquisitive ▪ Understand the nature of the problem and then search for relevant information and possible explanation ▪ Group activities – brainstorming ▪ Private activities – literature searches ▪ Manage and monitor this phase of divergent thinking in such away that it begins to be more focused	CP-EX-1	Exploration within the online community	Unsubstantiated agreement or disagreement/ contradiction of previous ideas Includes "good point" or "I agree" with or without unsubstantiated elaboration. Personal experience IS substantiated and may be considered Integration	One reason that I think a systems approach is seldom used is that it is too complicated to get cooperation. Another may be the mind-sets of those in charge to change practices. Just thinking out loud; Here's a thought; What if; How about; Stab in the dark
		CP-EX-2	Exploration within a single message	Many different ideas/themes presented in one message (use even if prompt requires pro/con instructions)	
		CP-EX-3	Information exchange	Personal narratives or description (not necessarily regarding personal experiences) or facts (ie., from sources such as websites, articles, programs, etc.) Adds points but does not systematically defend/justify/ develop situation	
		CP-EX-4	Suggestions for consideration	Author explicitly characterizes message as exploration	
		CP-EX-5	Leaps to conclusions	Offers unsupported opinions	
		CP-IN-1	Integration among groups members	Reference to previous message followed by substantiated agreement or disagreement (I agree/disagree because…) Building on, adding to others' ideas	
Integration	Tentative ▪ Focused and structured phase of making meaning ▪ Decisions are made about integration of ideas ▪ Teacher must probe for understanding and misconceptions If IN is coded, do not include EX1, 2, or 3 when coded (would be included under IN). EX 4 or 5 could be considered if applicable depending on content.	CP-IN-2	Integration within a single message (response to prompt)	Justified, developed, defensible, yet tentative hypotheses	We also had trouble getting cooperation. Often the use of new tools requires new organizational structures. We addressed these issues when we implemented a systems approach, and I think that's why we were successful.
		CP-IN-3	Connecting ideas, synthesis	Integrating information from one or more sources – textbook, articles, personal experience, other posts or peer contributions.	
		CP-IN-4	Creating solutions	Explicit characterization of message as a solution by participant	
		CP-RE-1	Vicarious application to real world testing solutions	Providing examples of how problems were solved	
Resolution/application	▪ Resolution of the dilemma or problem ▪ Reducing complexity by constructing a meaningful framework or discovering a contextually specific solution ▪ Confirmation or testing phase may be accomplished by direct or vicarious action	CP-RE-2	Defending solutions	Defending why a problem was solved in a specific manner	How we solved this problem was…

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