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Community of inquiry as a theoretical framework to foster "epistemic engagement" and "cognitive presence" in online education

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ABSTRACT

In this paper, several recent theoretical conceptions of technology-mediated education are examined and a study of 2159 online learners is presented. The study validates an instrument designed to measure teaching, social, and cognitive presence indicative of a community of learners within the community of inquiry (CoI) framework [Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*, 1–19; Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education, 15*(1), 7–23]. Results indicate that the survey items cohere into interpretable factors that represent the intended constructs. Further it was determined through structural equation modeling that 70% of the variance in the online students' levels of cognitive presence, a multivariate measure of learning, can be modeled based on their reports of their instructors' skills in fostering teaching presence and their own abilities to establish a sense of social presence. Additional analysis identifies more details of the relationship between learner understandings of teaching and social presence and its impact on their cognitive presence. Implications for online teaching, policy, and faculty development are discussed.

1. Introduction

Rapid growth in online teaching and learning is well documented and online learning environments continue to evolve. A recent national survey (Allen & Seaman, 2007) estimated that 3.5 million students are enrolled in fully online courses in the US, roughly 20% of all college students. These authors also conclude that, with enrollment growth rates about six times traditional, classroom-based learning, online courses will continue to represent the fastest growing instructional modality in higher education. With an aging population and increased demand for higher education this trend may not be surprising; the National Center for Education Statistics (US Department of Education and National Center for Education Statistics, 2007) indicates that there will be record numbers of college enrollments through 2016, increasingly populated with non-traditional students. Online education represents a significant means to higher education for this segment of the population.

Such rapid growth and evolution presents numerous challenges to educators. Some of these are related to technology and others to pedagogy. Designers of online courses, faced with a growing number of disciplines (online math, science, history, philosophy, etc.) and an ever changing array of new media (streaming video, blogs, wikis, etc.), are often confused about how to integrate these technologies into online learning environments in ways that will enhance student learning of diverse content. Frequently missing from attempts to address these challenges are the roles of theoretical and conceptual frameworks. It is argued here that what is needed is a model that provides online faculty and instructional designers a mechanism for integrating technology and pedagogy in ways likely to impact learning across the many disciplines now available via online education. This paper investigates, and seeks to articulate and extend recent promising theories and presents results of a study of one theoretical model, the community of inquiry framework.

At a descriptive level online education has been well defined and characterized through the three lenses proposed by Larreamendy-Joerns and Leinhardt (2006) which include presentational, performance-tutoring, and epistemic engagement views. Citing a long history of distance education and attendant technological advances the authors identify the recent multimedia and immersive online environments as the closest approximation to the versatility and corollary advantages of classroom teaching. This presentational conception of

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online educational environments is not unproblematic however, and the authors are careful to remind us that presentation alone is insufficient to the preservation and enhancement of learning in and beyond the classroom. In the absence of clear explanations provided by a capable instructor, for example, even the most dynamic technology-mediated representations may be of little use to learners.

Larreamendy-Joerns and Leinhardt also articulate a performance-tutoring view of online education suggesting that the promises of this conceptual perspective include the enactment of "learning by doing"; automated adaptation of instruction to the needs of the learner, and individualized critical assistance to many learners. This perspective is also not without concerns. The authors remind us that the development of performance-tutoring systems is expensive, and not readily adaptable to the many domains of instruction now being carried out online. The cognitive view of learning upon which performance-tutoring systems are founded is also seen as incompatible with social perspectives, predicated less on acquisition and more on participation metaphors of learning (Lave, 1997; Sfard, 1998; Sfard & Prusak, 2005).

The third perspective discussed by Larreamendy-Joerns and Leinhardt is referred to as the epistemic-engagement view. Here, the authors discuss the potential for online learning to reflect processes of participatory practice, with designs that gradually assist learners to develop the language and skills of a disciplinary discourse community. In this view, online environments can encourage knowledge construction through social interaction and negotiation of meaning largely through asynchronous communication. While research in this area is promising (e.g. Arbaugh, 2008; Correia & Davis, 2008; Liu, Magjuka, Bonk, & Lee, 2007; Moore, 2008; Wise, Duffy, & Padmanabhan, 2008) Larreamendy-Joerns and Leinhardt's caveat is that networked interaction per se is insufficient to the development of a community of reflective learners. This is an important note, one which requires further explication and to which we shall return in discussing the community of inquiry framework below.

A number of more specific and promising frameworks for technology-mediated teaching and learning exist. One recent approach is the technological pedagogical content knowledge (TPCK) model, which embodies both the presentational and performance-tutoring views of Larreamendy-Joerns and Leinhardt. The authors of TPCK, Mishra and Koehler (2006) review the historical separation of teacher knowledge of pedagogy and disciplinary knowledge. This divide was addressed by Shulman (1986) who found that teacher education programs often focused on either knowledge of content or general knowledge of pedagogy but seldom an integration of the two. Quoting Schulman (1986), Mishra and Koehler (2006), argue that the bifurcation of disciplinary knowledge and pedagogical knowledge was a major barrier to the improvement of instruction in schools.

With the advent of Schulman's pedagogical content knowledge model (PCKM) (1987) educators and researchers had a new tool with which to analyze, understand, and improve learning. Schulman described PCK as "the content knowledge that deals with the teaching process", such as "the ways of representing and formulating the subject that make it comprehensible to others" including "the most powerful analogies, illustrations, examples, explanations, and demonstrations." Citing Schulman, the authors Mishra and Koehler, suggest that technology has a large role to play in enacting PCK. They argue that in the 21st century, providing powerful analogies, illustrations, examples, and demonstrations to support learning requires knowledge of how to employ technologies to best effect.

> Ranging from drawings on a blackboard or interactive multimedia simulations to etchings on a clay tablet or web-based hypertexts to the pump metaphor of the heart or the computer metaphor of the brain, technologies have constrained and afforded a range of representations, analogies, examples, explanations, and demonstrations that can help make subject matter more accessible to the learner (Mishra & Koehler, 2006, p. 1023).

Mishra and Koehler argue that, much as knowledge of pedagogy and knowledge of content were treated as if they were independent before the work of Schulman and other scholars, we have also historically treated knowledge about technology independently from both pedagogy and content. They advocate for the integration of technology in the pedagogical content knowledge model. They add, "Teachers will have to do more than simply learn to use currently available tools; they also will have to learn new techniques and skills as current technologies become obsolete" (Mishra & Koehler, 2006, p. 1023).

Among these skills, the most significant for impacting cross discipline online course outcomes are those that focus not only on the provision of direct instruction, as is suggested by the TPCK, but also on learners and learning. The TPCK focuses on direct instruction with an emphasis on the instructor-provided representations, analogies, examples, explanations, and demonstrations with the aid of technologies. While an emphasis of teacher knowledge of technology-mediated direct instructional strategies is necessary for a model to ensure quality in online (and traditional) environments, it is not sufficient. Recent conceptions of knowledge development, especially those informed by socio-cognitive perspectives, indicate that learners must play a much larger role in the educational process. Ensuring that students become more equal participants in attaining learning goals requires that they become more active in and responsible for their learning. Further, the TPCK is a model that focuses primarily on classroom instruction that is augmented by the use of technology. While conceptually useful, such a model is less than adequate for describing, explaining, and enhancing student learning in purely online environments. A model that focuses more directly on teaching and learning in completely technology-mediated milieus is more likely to prove productive.

We have such a model in the community of inquiry framework (CoI) (Garrison, Anderson, & Archer, 2000). Much as the TPCK model embodies features of the presentational and performance-tutoring views, the community of inquiry model reflects the epistemic engagement view of Larreamendy-Joerns and Leinhardt. Accommodating their caution about the insufficiency of interaction per se to promote the development of online learning communities, the CoI framework is an attempt to understand the social, technological, and pedagogic processes that do lead to collaborative knowledge construction. As such it represents an effort to deal with the greatest challenge to the quality of online education discussed by Larreamendy-Joerns and Leinhardt through the epistemic engagement approach, dialogic pedagogy: "(...) successfully orchestrating a dialogue demands fairly sophisticated skills. Conversational contributions need to be simultaneously parsed according to their disciplinary value, their location within the chain of collective argumentation, their relevance to the instructional goals, and their role as indicators of the student's ongoing understanding. The outcome of this complex appraisal is a sense of the amount and quality of the guidance that specific contributions and the conversation as a whole require to support learning." (Larreamendy-Joerns & Leinhardt, 2006, p. 591)

The community of inquiry framework (CoI) focuses on the intentional development of an online learning community with an emphasis on the processes of instructional conversations that are likely to lead to epistemic engagement. The model articulates the behaviors and processes required to nurture knowledge construction through the cultivation of various forms of "presence", among which are teaching, social, and cognitive presence. According to the authors, it is through the skillful marshalling of these forms of presence that online faculty and students, in collaboration, develop a productive online learning environment through which knowledge is constructed. This emphasis on facilitating learning includes, but is not limited to, direct instructional approaches emphasized in the TPCK model. Beyond direct instruction (well described by TPCK) the teaching presence component of the CoI model also focuses attention on the design and organization of instruction, and especially the facilitation of productive discourse among students.

What is more, in it articulation of social presence the CoI model also emphasizes the needs for online learners to be able to address the challenge of projecting themselves as "real people". This facet of the model is significant for online education in that face-to-face interaction, and the conventions of non-verbal communication that underlie a great deal of the flow of instructional conversation (and understandings that emerge from it), is often not possible, especially in the dominant form of online learning, asynchronous learning networks. The model assumes that this is a necessary component of a productive community of inquiry and that the online instructor is responsible to foster an environment of satisfactory social presence (Garrison et al., 2000; Rourke, Anderson, Garrison, & Archer, 1999; Swan & Shea, 2005). This paper therefore investigates the impact of teaching presence on the development of social presence. Articulating the new affordances and constraints on social and affective processes foundational to learning, and strategies for leveraging or overcoming these, are necessary components of a conceptual framework that supports our understanding and development of current and future online environments.

In addition to social presence, the model also highlights "cognitive presence" which is defined as "the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry" (Garrison et al., 2000, p. 5). The notion of cognitive presence "reflects higher-order knowledge acquisition and application and is most associated with the literature and research related to critical thinking" (Garrison et al., 2000, p. 7). This focus on critical thinking as a foundation for the model is consistent with current conception of the role of higher education vis-a-vis student learning. This paper therefore investigates the relationship between teaching presence, and social presence and the development of cognitive presence.

It should be noted here that the CoI framework suggests that the components do not exist in isolation (Garrison, Anderson, & Archer, 2001; Garrison et al., 2000), but rather each can be seen as an overlapping set of lenses. While this representation implies that each of the forms of presence is related to the others, and that the three combine within a community of inquiry, specific relationships and direction of influence remain to be confirmed. In this study we investigate the conjecture that teaching presence, defined as learner ratings of explicit instructor actions involving instructional and organization, facilitation of discourse, and direct instruction, are a predictor of variance in learner ratings of social presence and cognitive presence. Furthermore it is hypothesized that social presence plays a mediating role in ratings of cognitive presence. The conceptual framework tested here is that teaching presence, i.e. the instructors design choices, discourse facilitation, and direct instruction impacts students' positive and negative perceptions of the quality of the online learning milieu (social presence) and their ratings of their ability to construct meaningful knowledge in this environment (cognitive presence). The hypothesized direction of influence is both mediated, that is, teaching presence predicts variance in social presence which itself predicts variance in cognitive presence, and unmediated, i.e. teaching presence predicts variance in cognitive presence directly. This framework is modeled and tested here with data from more than 2000 online students.

Finally, student characteristics have been of interest to a variety of researchers of online environments (see Hiltz and Shea (2005) for example). The demographics investigated here are of interest because of their potential to impact the students' sense of connectedness and learning—their levels of online "learning community" within the CoI framework. A number of researchers have hypothesized connections between age and levels of satisfaction and engagement with text-based online environments. This line of inquiry suggests that the emergent "net generation" is or will soon be too technologically sophisticated to find the typical, largely text-based, asynchronous learning management systems in use today relevant or useful for their learning (e.g. Dede, 2005; Manuel, 2002; Oblinger & Oblinger, 2005; Prensky, 2001). Academic level is included in the analysis for similar reasons, i.e. student age tends to vary by whether they are freshman, sophomore, juniors, or seniors of graduate students.

Others have reported previously (Shea, Li, Swan, & Pickett, 2005) on research that suggests an association between gender and capacity to establish and maintain social connections (Bostock & Lizhi, 2005; Goldstein & Sadhana, 2004; Shumaker & Hill, 1991;Vandervoort, 2000) which may carry over into online learning environments, and thus considered gender as a variable of possible interest.

A significant and growing body of conceptual and empirical literature exists which has attempted to articulate and expand upon the community of inquiry framework. These include attempts to outline (Garrison, 2007; Garrison & Arbaugh, 2007) and validate particular aspects of the model (Arbaugh & Hwang, 2006; Garrison & Cleveland-Innes, 2005; Shea, Fredericksen, Pickett, & Pelz, 2003; Shea, Li, & Pickett, 2006; Shea, Pickett, & Pelz, 2003; Shea et al., 2005; Swan & Shih, 2005). However, relatively little work has been undertaken to evaluate the model as a whole (although see Arbaugh (2007) and Ice et al. (2007)) or to investigate the relationships of the components of the model.

To begin to determine the utility of the community of inquiry framework in describing, explaining, and ultimately improving learning in online educational environments it is useful to depict and test the constructs within it. This study uses several methodologies to achieve this objective. First, it was determined that a collaboration to develop a single instrument was necessary. The instrument used in this study was developed in cooperation with several other researchers interested in the community of inquiry framework (see acknowledgments below). To develop the overall CoI instrument, researchers who had developed previous scales and subscales (Arbaugh, 2007; Arbaugh & Hwang, 2006; Garrison & Cleveland-Innes, 2005; Garrison, Cleveland-Innes, & Fung, 2004; Ice et al., 2007; Richardson & Swan, 2003; Shea et al., 2005, 2006; Swan, 2003; Swan & Shih, 2005) collaborated to integrate these validated works into a new, single coherent instrument. Items were discussed for inclusion or exclusion based on criteria for reflection of the CoI model as well as practical concerns such as overall length, redundancy, and readability. The instrument consisted of two sections: demographic information and the CoI survey items. Additional questions about the students overall satisfaction and learning were also asked. A provision for general comments in the form of an open ended question was also included. The CoI instrument contained 34 items, the content of which is displayed in Table 1. Responses to the items were to be provided on a five-point Likert type scale ranging from 1: "strongly agree" to 5 "strongly disagree". For each question, the participants had the option to indicate that they choose not to answer the question by selecting "N/A".

Research questions: Three research questions were examined through three complementary types of analysis.

Question 1: Does the instrument designed to measure learner perceptions of teaching, social, and cognitive presence result in and interpretable factor structure, reflecting the intended constructs? To address this question a factor analysis attempting to demonstrate construct coherence was conducted.

Table 1
Results from principal axis factoring with Oblimin rotations.

Item	Cognitive presence	Teaching presence	Social presence
1. The instructor clearly communicated important course topics	−.07	−.88	−.01
2. The instructor clearly communicated important course goals	−.07	−.84	.03
3. The instructor provided clear instructions on how to participate in course learning activities	−.08	−.80	.06
4. The instructor clearly communicated important due dates/time frames for learning activities	−.07	−.74	.05
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn	.02	−.86	−.01
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking	.09	−.87	−.09
7. The instructor helped to keep course participants engaged and participating in productive dialogue	−.01	−.85	.03
8. The instructor helped keep the course participants on task in a way that helped me to learn	.02	−.87	.01
9. The instructor encouraged course participants to explore new concepts in this course	.12	−.77	−.02
10. Instructor actions reinforced the development of a sense of community among course participants	.03	−.79	.08
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn	.11	−.74	.03
12. The instructor provided feedback that helped me understand my strengths and weaknesses	.09	−.75	−.05
13. The instructor provided feedback in a timely fashion	.03	−.75	−.06
14. Getting to know other course participants gave me a sense of belonging in the course.	.25	−.05	.41
15. I was able to form distinct impressions of some course participants	.28	−.01	.40
16. Online or web-based communication is an excellent medium for social interaction	.18	−.01	.50
17. I felt comfortable conversing through the online medium	−.03	−.05	.81
18. I felt comfortable participating in the course discussions	−.06	−.04	.87
19. I felt comfortable interacting with other course participants	−.08	−.02	.94
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust	−.01	.01	.78
21. I felt that my point of view was acknowledged by other course participants	.03	.00	.78
22. Online discussions help me to develop a sense of collaboration	.08	−.01	.75
23. Problems posed increased my interest in course issues	.67	.01	.09
24. Course activities piqued my curiosity	.75	−.05	.03
25. I felt motivated to explore content related questions	.79	−.02	.02
26. I utilized a variety of information sources to explore problems posed in this course	.72	.01	.03
27. Brainstorming and finding relevant information helped me resolve content related questions	.74	.03	.06
28. Online discussions were valuable in helping me appreciate different perspectives	.44	−.00	.37
29. Combining new information helped me answer questions raised in course activities	.74	−.06	.06
30. Learning activities helped me construct explanations/solutions	.76	−.11	.00
31. Reflection on course content and discussions helped me understand fundamental concepts in this class	.75	−.10	.03
32. I can describe ways to test and apply the knowledge created in this course	.81	−.03	−.07
33. I have developed solutions to course problems that can be applied in practice	.84	.03	−.05
34. I can apply the knowledge created in this course to my work or other non-class related activities	.74	−.04	−.02
Eigenvalue	17.02	3.27	1.33
Percent of variance	50.63	9.63	3.90
Reliability	.95	.96	.92

Question 2: What are the relationships between the teaching, social, and cognitive presence factors? Do teaching and social presence measures "predict" variance in cognitive presence measures as would be hypothesized by the model? Is perception of teaching and social presence a more powerful predictor of cognitive presence than demographics such as age or gender? We conducted a structural equation model to provide this further conceptual ordering and insight into the relationships within the framework.

Question 3: If teaching and social presence predict variance in measures of cognitive presence, what item level responses best demonstrate the relative significance of these two constructs in predicting cognitive presence? To better articulate the significant relationships that predict students' understanding of their own knowledge construction – or "cognitive presence" we performed a CHAID analysis, which is described in more detail below.

2. Method

2.1. Sample

The sample used in this study ($n = 2159$) was drawn from students participating in a multi-institutional fully online learning network. A random sample of students was requested to complete the survey when they logged into the online system. This sample has several advantages – it is broad in that it represents dozens of institutions and it is large, with more than 2000 responses – a figure that is appropriate for factor analytic studies such as this one. The sample also represents learners studying in a program with a single course management system, a single faculty development and training program, a single technology infrastructure provider, and a single student and faculty helpdesk. The sample thus avoids many common pitfalls associated with multi-institutional analysis in which learning environment differences in technology, support, or training are uncontrolled variables themselves. Finally, the 30 public institutions in this higher education virtual learning environment are quite diverse, representing community colleges, four-year liberal arts colleges, and university centers offering degrees from one large, public state university system.

The data were collected from December 11, 2007 to January 9, 2008. The total number of respondents was 2605 students. The gender distribution of the sample was 25% male and 75% female. The majority of the respondents (45%) were less than 25 years old; 26% were between 26 and 35 years old, and the rest (29%) represented age groups older than 36. Respondents were asked to indicate their employment status as well. Approximately 29% were employed part time, 51% were employed full time, 18% were not employed, and 3% choose not to answer the question. In terms of registration status, 56% of the sample indicated that they were enrolled at the respective institutions full time, and the rest were either enrolled part time (42%) or did not indicate their registration status (2%).

The variable academic level consisted of six categories: freshman, sophomore, junior, senior, and graduate. The distribution by academic level was as follows: 16% freshman, 27% sophomore, 14% Junior, 12% senior, 15% graduate, and 7% who did not indicate their academic level as well as 9% who were non-matriculated. The participants had varying levels of online course experience: for more than half of the sample (54%), this was their first online course; for 15% it was the second online course, 10% third, 7% fourth, and 14% had taken five or more online classes.

2.2. Data preparation

The data were screed for missing values, univariate and multivariate outliers. Cases with missing values on any of the 35 items were deleted listwise. Any cases with standardized *z*-scores on each of the 34 items in excess of 3.29 were excluded. Multivariate outliers were evaluated by calculating Mahalanobis distances and excluding cases with Mahalanobis distances greater than 65.25 ($p < .001$). The resulting dataset comprised 2159 cases, which represents 17% reduction of the original ($n = 2605$).

3. Results

3.1. Factor analysis

Principal axis factoring with Oblimin rotations was carried out. We attempted four and three factor solutions. Both the Kaiser rule of eigenvalues greater than 1 and the scree plot (see Fig. 1) indicated that three factor solution would fit the data the best. The results of the factor analysis are presented in Table 1. The first extracted factor was consistent with the items included in the cognitive presence subscale, with all items loading on the expected factor. The factor consisted of 12 items, explained 50.63% of the variance and produced a Cronbach α of .95. The second and third extracted factors were teaching presence and social presence, respectively. The factor of teaching presence had 13 items with loadings greater than .30, accounted for 9.63% additional variance and had a reliability estimate of .96. The last extracted factor, social presence, was comprised of nine items, explained 3.90% of the total variance and had an internal consistency of .92. All factors accounted for 63% of the variance. The factor correlations were −.69 between cognitive presence and teaching presence; .70 between cognitive presence and social presence; and −.49 between teaching presence and social presence.

3.2. Results from structural equation modeling

Consistent with previous literature, the model predicts a direct effect of student gender, age and academic level on their perceptions of teaching presence. In addition, perceptions of teaching presence predict student perceptions of cognitive presence. The model hypothesizes also a partial mediation of social presence on the link between teaching presence and cognitive presence.

The model was assessed by the means of structural equation modeling (SEM) with the use of AMOS 5.0. Prior to analysis, the univariate normality of each continuous variable was assessed in SPSS 16. Some of the variables had kurtosis greater than 1.00, however, they were within an acceptable range (−3 to +3) and were not expected to affect the results of SEM. The multivariate normality was assessed using statistical methods in AMOS 5.0 and was found to be satisfactory. The hypothesized structural relationships were tested by comparing the hypothesized covariance matrix with the observed covariance matrix based on the sample data.

The fit of the model was evaluated using maximum likelihood estimation. The model was statistically overidentified. The following fit indices were produced: $\chi^2 = 11155.16$ ($df = 623$), $p < .000$; GFI = .95; CFI = .95; NFI = .95; TLI = .94; SRMR = .05; RMSEA = .08; and *p* of close

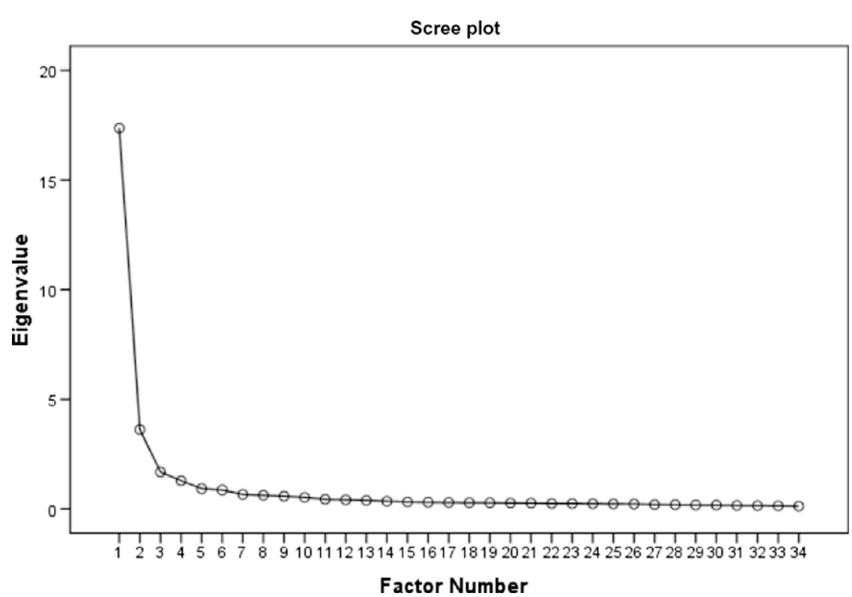

Fig. 1. Scree plot of the eigenvalues.

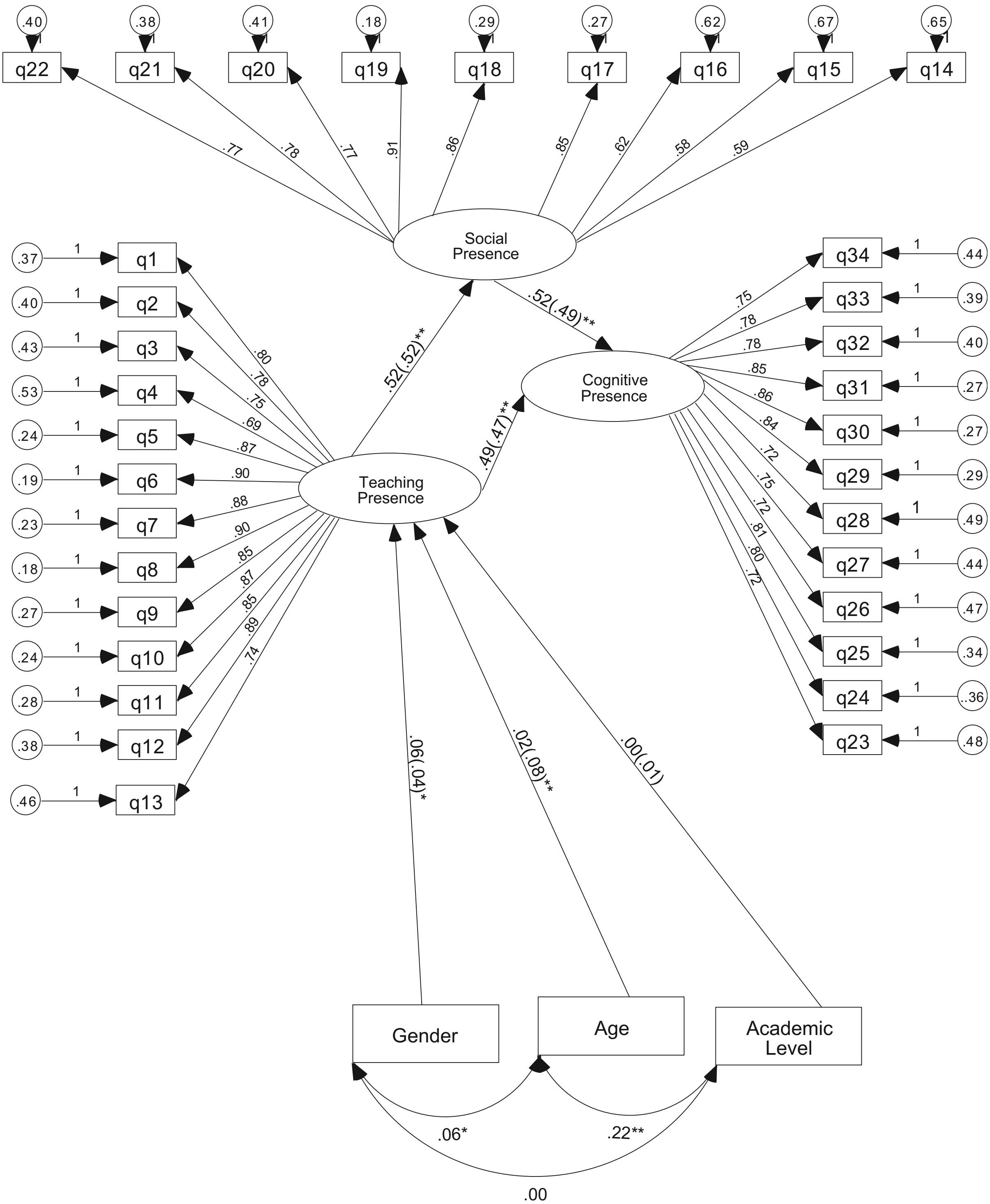

Fig. 2. A model of the relationship between teaching presence and cognitive presence with social presence as a partial mediator.

fit = .00. With the exception of the chi-square statistic (which is sensitive to large samples), the fit indices uniformly pointed to a good fitting model. Fig. 2 displays the unstandardized regression coefficients with the standardized regression coefficients given in parentheses. The structural equation modeling allowed also the estimation of the total effects of age, gender, academic level, and perceptions of teaching presence on social and cognitive presence. The estimated total effects are reported in Table 2. All variables in the model accounted for 70% of the variance in cognitive presence – see Fig. 2.

CHAID analysis: An additional multivariate method of analysis that can shed light on the relationship between teaching and social presence on the development of cognitive presence is chi-square automatic interaction detection (CHAID) (Kass, 1980; Magidson, 1993; Magidson & Vermunt, 2005). Through the use of CHAID one can produce a decision tree that indicates the most significant breaks in responses to items that predict responses to another item or construct. CHAID analysis has specific advantages as a method of identifying patterns in complicated datasets such as this one. The level of measurement for the independent and dependent variables can be nominal,

Table 2
Unstandardized path coefficient and total effects.

Path	Unstanderdized coefficient	Standardized coefficient
Direct effects		
Gender to teaching presence	.06*	.04*
Age to teaching presence	.02**	.08**
Academic level to teaching presence	.00	.01
Teaching presence to social presence	.52**	.52**
Teaching presence to cognitive presence	.49**	.47**
Social presence to cognitive presence	.52**	.49**
Total effects		
Gender to social presence	.03	.00
Gender to cognitive presence	.05	.00
Age to social presence	.01	.00
Age to cognitive presence	.02	.00
Academic level to social presence	.00	.01
Academic level to cognitive presence	.00	.01
Teaching presence to cognitive presence	.77**	.72**

* $p < .05$.
** $p < .001$.

ordinal, or interval in CHAID. Multivariate dependent variables can also be utilized (Magidson & Vermunt, 2005). Because we are combining what can be considered nominal and ordinal data (factors and survey items) in this CHAID analysis, it is a useful method.

Given that cognitive presence coheres as a single construct through factor analysis performed here, it is useful to determine the item level responses that segregate students reporting cognitive presence at higher and lower levels. What follows is a CHAID analysis that depicts the teaching and social presence items that offer the most significant break points in students' reported cognitive presence. This analysis allows us to unpack the factors to examine the specific item level relationships that predict variance in reports of cognitive presence. While the structural equation models provides a general description of the contributions of teaching presence and social presence to the establishment of cognitive presence, the CHAID analysis allows us to understand the item level indicators that sort out respondents with regards to their perception of their own knowledge construction process. As predicted by the CoI model and confirmed by the SEM analysis, both teaching and social presence play a major role in predicting online students' ratings of cognitive presence. At a more granular level though it is useful to return to the items in the teaching and social presence factors to better understand the interplay between these constructs.

As can be seen in Fig. 3 the social presence indicator "I felt comfortable participating in the course discussions" is the highest level item that sorts the respondents on the cognitive presence factor. The 968 respondents who agreed more strongly with this statement reported significantly higher levels of cognitive presence than those who were more neutral or who disagreed.

Further categorizing the data, even within this high scoring group, were responses to the teaching presence item "The instructor helped focus discussions on relevant issues that helped me to learn". Again, as indicated in Fig. 4, respondents reported significantly higher average cognitive presence scores when they also agreed more strongly with this teaching presence item as compared to those who rated their instructors' competency lower on this indicator.

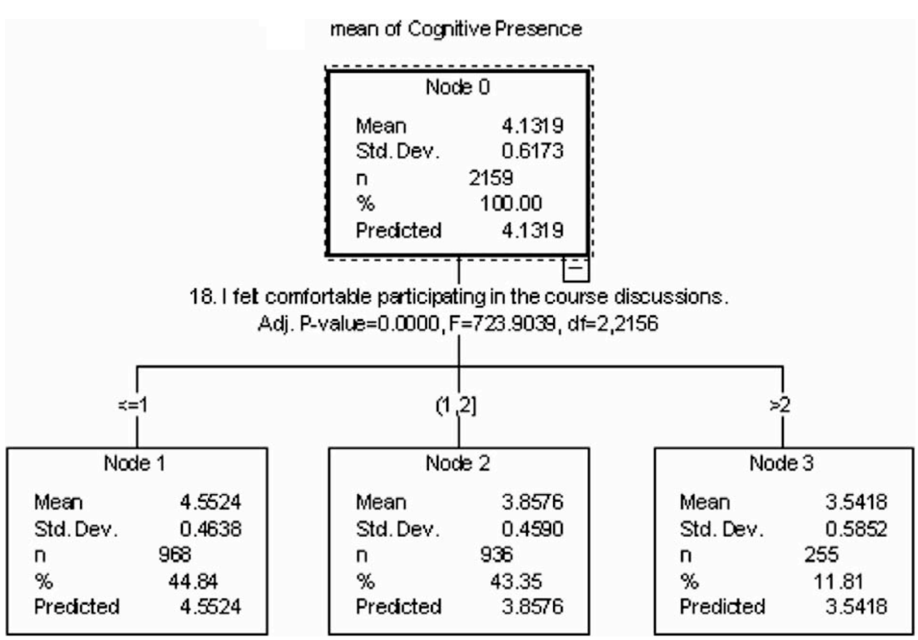

Fig. 3. CHAID analysis of cognitive presence scores – level 1.

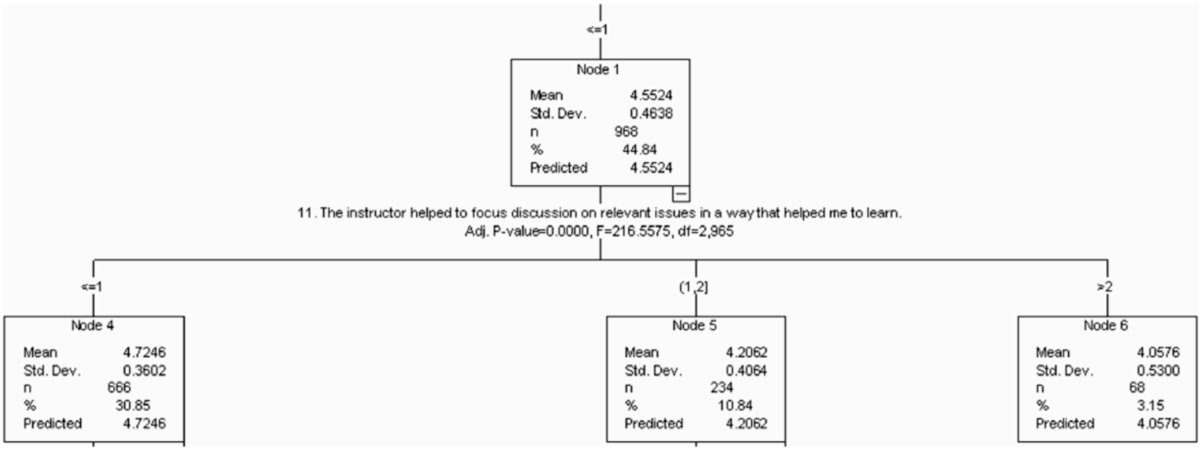

Fig. 4. CHAID analysis of cognitive presence scores – level 2.

Finally, as indicated in Fig. 5, respondents who agreed strongly to the social presence item, "Getting to know other course participants gave me a sense of belonging in the course", were also significantly more likely to report higher cognitive presence average scores, again even within this higher scoring group.

In examining the response of students who reported lower levels of cognitive presence the same initial indicators sort the group. The most significant differences that classify low cognitive presence levels were their comfort in participating in asynchronous online threaded discussions. When students report less comfort with this form of communication they also report lower average cognitive presence scores. Respondents with even lower cognitive presence scores were further classified by responses to the teaching presence item "The instructor helped focus discussions on relevant issues that helped me to learn". The lowest cognitive presence scores of the more than 2000 respondents were reported by students who rated their instructors' skills in this area of teaching presence as weak.

4. Discussion and recommendations

This paper set out to investigate the roles of theoretical frameworks in describing, explaining, and improving online learning processes. Several recent theoretical conceptions of technology-mediated education were thus examined, including presentational, performance-tutoring, and epistemic engagement models (Larreamendy-Joerns & Leinhardt, 2006). Additionally, the technological pedagogical content model (TPKC) was examined with regards to its commonalities and distinctions from these views. It was concluded that TPKC reflects elements of the presentational and performance-tutoring perspectives with an emphasis on improving direct instructional approaches with technology. Limitations on this model were identified, including its emphasis on direct instruction with relatively little weight given to the role of learners in building knowledge. It was further concluded that the epistemic engagement approach, which foregrounds the role of learners as collaborative knowledge builders, is more fully articulated and extended through the community of inquiry model (CoI). The CoI

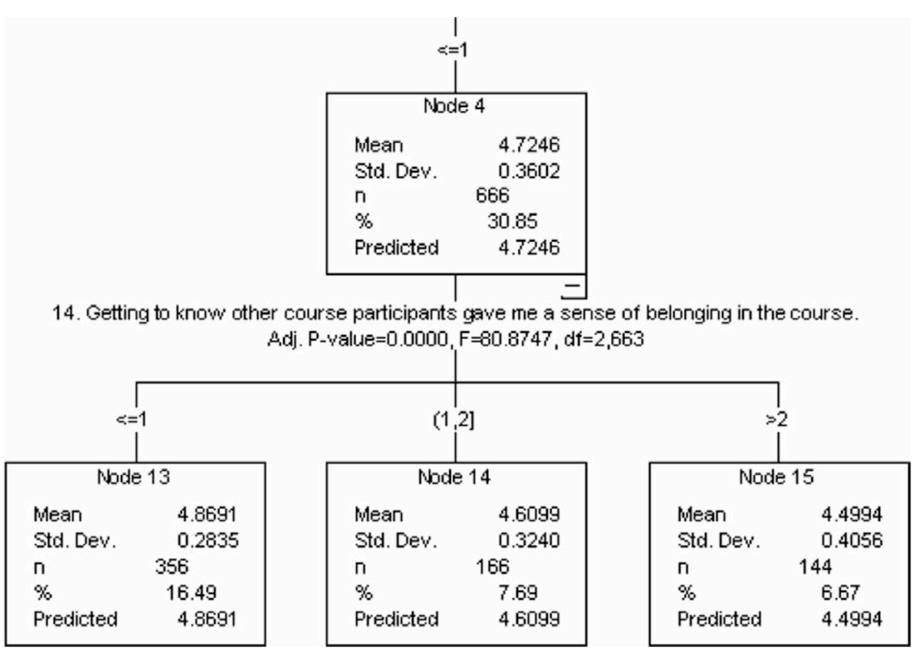

Fig. 5. CHAID analysis of cognitive presence – level 3.

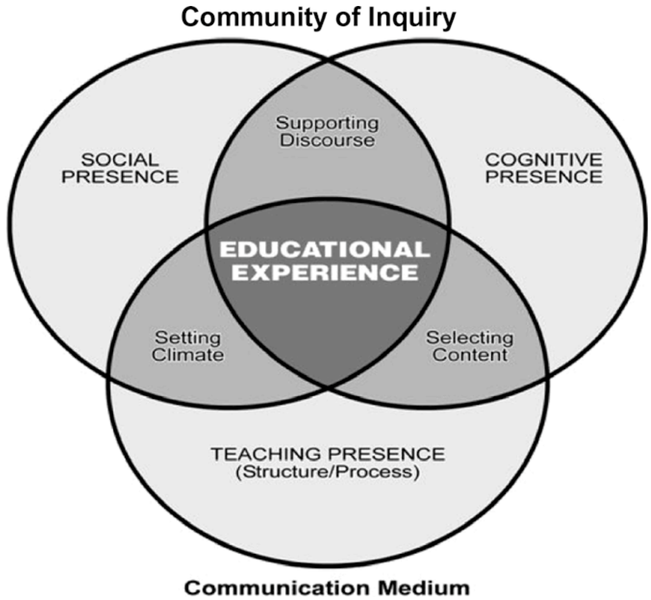

Fig. 6. The community of inquiry framework.

posits that the ability to construct knowledge in online environments is contingent on the capacity of teachers and learners to move beyond direct instruction to establish forms of "presence". Through the skillful marshaling of teaching and social presence participants are able to engage in reflection and dialogue that provides opportunities to extend current understandings. The implication is that teaching and social presence represent the processes needed to create paths to epistemic engagement and cognitive presence for online learners.

In order to assess the value of this model in actual educational settings, a large-scale study of more than 2000 online learners was conducted to validate an instrument designed to measure teaching, social, and cognitive presence indicative of a community of learners within the CoI framework. The study of the CoI model indicated that items cohere into interpretable factors that represent the intended constructs. Further it was determined through structural equation modeling that 70% of the variation in students' levels of cognitive presence can be modeled based on their reports of their instructors' skills in fostering teaching and social presence. Further, the establishment of social presence is contingent on the establishment of teaching presence. Each of these relationships is predicted by the community of inquiry model and is reflected in the representation of the framework in Fig. 6 below.

As can be seen from the representation, the model hypothesizes that both social presence and teaching presence will be correlated with cognitive presence. This study confirms these relationships and adds specificity regarding the contribution of each in accounting for variance in cognitive presence. In this regard the structural equation model predicting an impact of teaching and social presence on cognitive presence fits the data presented in this study.

These findings were augmented by CHAID analysis that teases out the interplay between social and teaching presence. Results indicated that the social presence element associated with comfort in online discussion was the most significant item correlated with variance in the cognitive presence of the respondents. Lower level of comfort with online discussion is strongly correlated with lower levels of cognitive presence. When students see their instructors taking an active role in focusing online discussions on relevant issues, they also report higher cognitive presence as measured by this factor.

In light of this connection it is suggested that the community of inquiry framework and the associated constructs of teaching, social, and cognitive presence represents a useful model for describing, explaining and improving online education. Given that variations of students' report of cognitive presence can be predicted by their reports of teaching and social presence, it is recommended that instructional designers and faculty can benefit from understanding, emphasizing, and integrating the components of the model to guide the development of online courses across the many discipline now represented in online higher education. Using the model as a lens through which to make instructional design choices is one option. Focusing attention on the most significant elements that foster cognitive presence online, the CoI can serve as a conceptual touchstone for online instructional design. These results suggest that highlighting the components of teaching and social presence can help guide the development of courses and inform the integration of new technologies to improve learning across the many content areas now represented in online education. Before adopting new technologies for online instruction, for example, faculty and instructional designers might do well to consider how these innovations can support the development of teaching and social presence.

The CHAID analysis conducted here suggests that it is crucial to assist learners to gain comfort and confidence in the online discussion format in order to foster cognitive presence. Without this comfort, epistemic engagement in online learning suffers. A sensible approach would be to encourage students to reflect on their comfort levels with online discussion. If some students report lower levels of comfort, one strategy would be to promote reflection on why they feel this way and how they might overcome this discomfort, at the same time emphasizing that facility with online discussion appears essential to productive learning in this environment.

The CHAID results also indicated that the instructor's ability to focus these collaborative conversations on relevant topics in the online forum is also a crucial feature of the development of online epistemic engagement. Faculty development efforts around the creation of online courses and programs should examine, reflect, and help develop these skills among course designers and instructors. Students greatly appreciate instructors' judicious participation in online discussion with the goal of focusing participants on relevant topics. Exploration of strategies for accomplishing this goal should be a key component in an online faculty development effort.

Finally the CHAID analysis reveals that respondents who felt that getting to know their online classmates gave them a sense of belonging in the course were also more likely to report higher levels of cognitive presence. Given this result it is suggested that faculty development efforts should consider the exploration of strategies to assist students to establish connections with their classmates in the service of promoting effective collaborative knowledge construction.

4.1. Limitations

While this study examined the responses of more than 2000 online learners from two-year, four-year and graduate level colleges, results should be interpreted with a degree of caution. The design was not experimental in nature and findings must be understood in light of this research design limitation. While structural equation models can be interpreted as causal, limitations associated with the use of correlational data in developing such models must be appreciated. Another possible limitation may be seen in one of the statistical tests of the SEM, that is, the chi-square statistic was statistically significant. However, the chi-square test statistic is notorious for being sensitive to large datasets (Jöreskog, 1969) and with more than 2000 observations in the reported study we were likely to obtain a significant chi-square. Despite this issue, we believe that the other fit indices (GFI, CFI, etc.) – indicate a good fitting model and should provide sufficient support for its credibility. Finally, the study reveals patterns that may be important to the design of online educational environments, but we need to know a great deal more about the kinds of discourse that lead to higher levels of engagement, a variable that was not examined here.

4.2. Future research

In previous research (Shea et al., 2003; Shea et al., 2006) studying teaching presence in isolation it was found that the construct does not cohere into the three facets of instructional design/organization, facilitation of discourse, and direct instruction as one might expect. Rather it was concluded that the items included in the teaching presence factor resulted in a two factor solution. These results, supported by other research, (Arbaugh, 2007) indicated that the teaching presence instrument consisted of "directed facilitation" and instructional design and organization. Given that these same items were used in this study it is recommended that future research in this area make efforts to more clearly distinguish direct instruction from the other components. The description of direct instruction provided by Shulman (1986), Shulman (1987) and updated by Mishra and Koehler (2006) is useful in this regard and it is suggested that the community of inquiry instrument be modified to reflect this more distinctive characterization of direct instruction. In this regard it is suggested that we define direction instructional items more around the capacity of the instructor to:

1. Provide valuable analogies.
2. Offer useful illustrations.
3. Present helpful examples.
4. Conduct supportive demonstrations.
5. Supply clarifying explanations.

In modifying the instrument to integrate this more precise view of that construct it is believed that an apposite definition of teaching presence will be established.

Additional research on the community of inquiry framework might employ alternative methodologies including comparative research on online courses with pedagogies that reflect differing assumptions about the nature of learning then were applied here. It may be that higher average cognitive presence scores can be attained through, for example, a strict emphasis on direct instructional approaches. A study designed to compare direct instruction with collaborative, dialogic approaches could provide evidence to support such a position. Additionally, qualitative research that examines the nature of the discourse in online threaded discussions would shed light on the kinds of instructional conversations that lead to social and cognitive presence as well as those that result in lower levels of engagement and learning. It is only through such varied research approaches that we will gain further insight into the ways that online education can benefit from ongoing advances in technology, pedagogy, and the science of learning.

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