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Developing a community of inquiry instrument: Testing a measure of the Community of Inquiry framework using a multi-institutional sample

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ABSTRACT

This article reports on the multi-institutional development and validation of an instrument that attempts to operationalize Garrison, Anderson and Archer's Community of Inquiry (CoI) framework (2000). The results of the study suggest that the instrument is a valid, reliable, and efficient measure of the dimensions of social presence and cognitive presence, thereby providing additional support for the validity of the CoI as a framework for constructing effective online learning environments. While factor analysis supported the idea of teaching presence as a construct, it also suggested that the construct consisted of two factors—one related to course design and organization and the other related to instructor behavior during the course. The article concludes with a discussion of potential implications of further refinement of the CoI measures for researchers, designers, administrators, and instructors.

1. Introduction

With at least 356 citations to date (Google Scholar, May 2008), Garrison, Anderson and Archer (2000) Community of Inquiry (CoI) framework is becoming increasingly influential for explaining and prescribing the effective conduct of online learning. However, as long as there are no valid and reliable measures to test the framework, its impact to influence online learning theory will be limited. While the CoI framework has been examined extensively in qualitative studies (Anagnostopoulos, Basmadjian, & McCrory, 2005; Garrison & Cleveland-Innes, 2005; Oriogun, Ravenscroft, & Cook, 2005; Schrire, 2004), and individual components of the framework have been examined empirically (Richardson & Swan, 2003; Shea, Fredericksen, Pickett, & Pelz, 2003; Wise, Chang, Duffy, & Del Valle, 2004), the number of studies that simultaneously examine all components of the framework empirically is extremely limited (Arbaugh, 2007; Garrison, Cleveland-Innes, & Fung, 2004). This concern has been noted recently by several scholars (Arbaugh, 2007; Garrison, 2007; Garrison & Arbaugh, 2007; Ho & Swan, 2007), and work to develop measures of the framework is underway. However, the fact that these initial verification studies were conducted using single-institution samples limits their generalizability.

This article attempts to address these concerns by reporting on the development and testing of an instrument to measure the CoI framework using a multi-institutional sample. In addressing calls for a more quantitative orientation to research on the CoI and for more efficient measures of the framework (Arbaugh, 2007; Garrison, 2007, Ho & Swan, 2007), it is hoped that the measure of this framework that emerged from this study subsequently can be used to help researchers examine the relationship of the CoI to variables such as course outcomes (Shea, Li, & Pickett, 2006).

The rest of the article is organized as follows. Because *The Internet and Higher Education* has given extensive coverage to the CoI framework in previous articles (i.e. Arbaugh & Hwang, 2006; Garrison et al., 2000; Goertzen & Kristjansson, 2007; Shea et al., 2006; Vaughn & Garrison, 2005), the first section provides a brief overview of the framework. The second section of the article discusses the methods and results of testing a thirty-four item instrument. The article's final section discusses these findings and identifies potential implications for future research.

2. The Community of Inquiry framework—an overview

The CoI framework was first proposed to guide research into online learning (Garrison et al., 2000). It provided a collaborative-constructivist perspective to understanding the dynamics of an online learning

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experience. This is consistent with the traditional values of higher education to support discourse and reflection in a community of inquiry.

The catalyst for the generation of the CoI Framework was the focus on social presence in the early days of exploring computer conferencing. The identified need at that time was a comprehensive view of a formal online educational experience. The solution was to propose three overlapping presences – social, cognitive and teaching – that were highly interdependent (Garrison et al., 2000). At the heart of the overlap of these elements was a deep and meaningful educational experience.

Notwithstanding the order provided by the CoI Framework, perhaps the main reason that the framework was widely adopted is the methodological guidelines for measuring each of the presences that constituted a community of inquiry. The first of these presences that required rigorous definition and operational rigor was social presence. Extending the original socio-emotional perspective, social presence is most recently defined as "the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (Garrison, in press). From a methodological perspective, the three categories of social presence (open communication, group cohesion and personal/affective projection) are used to operationalize the concept.

The original definition of cognitive presence has been the most stable. It was defined by the Practical Inquiry Model consisting of four phases—triggering event, exploration, integration and resolution/application (Garrison, Anderson, & Archer, 2001). As such, cognitive presence is reflective of the purposeful nature of collaborative knowledge construction inherent in constructivist educational experiences. Although there are a limited number of studies that have focused on cognitive presence using this model, the model has been successful in measuring the developmental nature of the learning process across disciplines.

Teaching presence has been shown to be crucial in the satisfaction and success of a formal educational community of inquiry (Garrison & Arbaugh, 2007). Very much like the other presences, teaching presence is multi-dimensional and consists of three areas of responsibility—design, facilitation and direct instruction. Each of these is associated with the integration of social and cognitive processes in terms of the purposeful nature of the learning experience. The literature suggests that quantitative methodological techniques are required to validate the structure of teaching presence (Garrison & Arbaugh, 2007).

This framework has been used in a large number of studies, although most have followed the original methodology of analyzing transcripts. This exploratory, interpretivist approach certainly has shown to be fruitful, but it may be time to move from a descriptive to an inferential approach to studying online communities of inquiry. This would permit large studies of online and blended learning across institutions and disciplines. For this to happen we need to develop a structurally valid and psychometrically sound survey instrument with the potential to expand the study of online and blended learning. Such an instrument would also provide the means to study the structure of each of the presences and their inter-relationships.

3. Method and results

The 34-item Community of Inquiry framework survey instrument was administered at four institutions in the Summer of 2007. Participating institutions were located in the United States and Canada. Participants in the study were enrolled in graduate-level courses in either Education or Business. 287 students volunteered to complete the survey, yielding a response rate of 43%.

Table 1
Eigenvalues from principal component analysis

	Initial eigenvalues			
Component	Total	% of variance	Cumulative %	Total
1	17.382	51.124	51.124	17.382
2	1.923	5.656	56.781	1.923
3	1.527	4.490	61.270	1.527
4	1.181	3.474	64.744	1.181

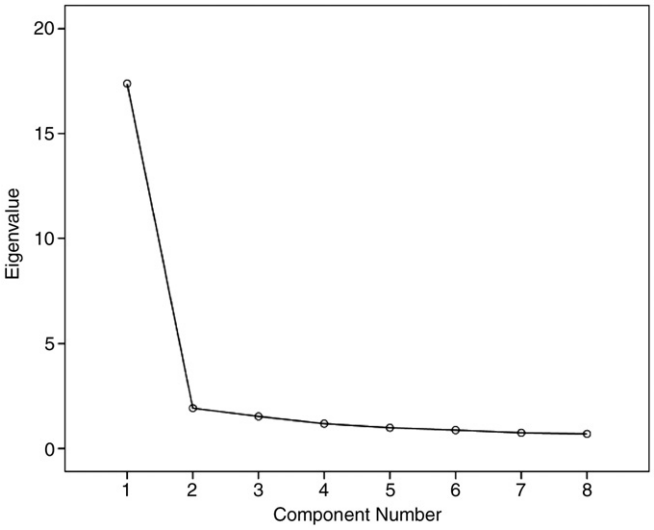

Fig. 1. Results of scree test.

Ordinal responses were scored using the scale (0=Strongly Disagree) to (4=Strongly Agree). Mean responses for the 34 items ranged from 2.90 for Item 16 (*Online or web-based communication is an excellent medium for social interaction*) to 3.63 for Item 4 (*The instructor clearly communicated important due dates/time frames for learning activities*). Standard deviations were highest for Item 16 (S.D=1.04), and lowest for Item 1 (SDs.d.=0.66) (*The instructor clearly communicated important course topics*). When considering all respondents' ratings, *Teaching Presence* items collectively yield a mean score of 3.34 (SDs.d=0.61). *Social Presence* items collectively yield a mean score of 3.18 (SD=0.65), and *Cognitive Presence* items yield a mean score of 3.31 (SD=0.60).

The *Principal Components Analysis* (PCA) approach in SPSS version 15.0 was used to verify the three subscale structure of the 34 items comprising the CoI inventory. PCA was chosen to conform with two conditions of the study. First, development of the cognitive presence subscale required significantly more additions than the teaching and social presence subscales. Given the relative newness of the cognitive presence subscale, suggestions by Gorsuch (1983) and Thompson (2004) were applied and a more conservative exploratory approach to analysis was utilized. Second, PCA allowed for a more comprehensive analysis of variance, revealing significant detail related to the nature of the factors (Tabachnik & Fidell, 2007).

Assuming some degree of association among Teaching, Social, and Cognitive presence (Heckman & Annabi, 2005; Garrison et al., 2004), oblique rotation (*Direct Obliminal* in SPSS) was utilized with the default value δ=0 specified to limit reasonably the level of correlation among the factors. The use of an oblique rotation was justified on theoretical grounds that the three presences were considered to be interdependent.

The sample size (n=287) for this study is reasonably adequate depending on the rule of thumb utilized. The study meets Kass and Tinsley's (1979) recommendation for five to 10 participants per item, yet fails to meet other recommendations of at least 10 or more respondents per item (Nunnally, 1978). Some authors suggest absolute sample sizes of n=300 being adequate (Tabachnik & Fidell, 2007). More specifically, Comrey and Lee (1992) rate sample sizes of 200 as Fair and 300 as Good.

The Keyser–Meyer–Olkin (KMO) measure of sampling adequacy is 0.96, suggesting factor analysis should yield distinct and reliable factors given the data utilized. Respective KMO values for individual items are all very good, ranging from 0.921 to 0.983.

Table 2
Factor pattern matrix

Pattern matrix[a]			
	Component		
	1	2	3
1. The instructor clearly communicated important course topics.	**0.826**	0.088	0.067
2. The instructor clearly communicated important course goals.	**0.877**	−0.021	0.046
3. The instructor provided clear instructions on how to participate in course learning activities.	**0.592**	0.246	−0.035
4. The instructor clearly communicated important due dates/time frames for learning activities.	**0.611**	0.078	0.040
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	**0.579**	0.162	−0.138
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	**0.575**	0.091	−0.281
7. The instructor helped to keep course participants engaged and participating in productive dialogue.	**0.633**	0.149	−0.160
8. The instructor helped keep the course participants on task in a way that helped me to learn.	**0.579**	0.042	−0.285
9. The instructor encouraged course participants to explore new concepts in this course.	**0.523**	0.099	−0.233
10. Instructor actions reinforced the development of a sense of community among course participants.	**0.569**	0.174	−0.176
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.	**0.425**	0.146	−0.374
12. The instructor provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives.	**0.649**	−0.123	−0.201
13. The instructor provided feedback in a timely fashion.	**0.513**	−0.025	−0.103
14. Getting to know other course participants gave me a sense of belonging in the course.	0.050	**0.619**	−0.233
15. I was able to form distinct impressions of some course participants.	0.172	**0.473**	0.013
16. Online or web-based communication is an excellent medium for social interaction.	−0.181	**0.674**	−0.226
17. I felt comfortable conversing through the online medium.	−0.039	**0.814**	0.015
18. I felt comfortable participating in the course discussions.	0.109	**0.788**	0.005
19. I felt comfortable interacting with other course participants.	0.286	**0.701**	0.038
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	0.103	**0.620**	−0.034
21. I felt that my point of view was acknowledged by other course participants.	0.319	**0.556**	0.025
22. Online discussions help me to develop a sense of collaboration.	0.047	**0.561**	−0.340
23. Problems posed increased my interest in course issues.	−0.099	0.172	**−0.785**
24. Course activities piqued my curiosity.	0.064	0.070	**−0.712**
25. I felt motivated to explore content related questions.	0.082	−0.031	**−0.770**
26. I utilized a variety of information sources to explore problems posed in this course.	0.078	−0.158	**−0.759**
27. Brainstorming and finding relevant information helped me resolve content related questions.	−0.106	0.130	**−0.794**
28. Online discussions were valuable in helping me appreciate different perspectives.	−0.096	0.286	**−0.699**
29. Combining new information helped me answer questions raised in course activities.	0.101	0.043	**−0.716**
30. Learning activities helped me construct explanations/solutions.	0.128	0.030	**−0.732**
31. Reflection on course content and discussions helped me understand fundamental concepts in this class.	0.008	0.237	**−0.640**
32. I can describe ways to test and apply the knowledge created in this course.	0.239	−0.097	**−0.619**
33. I have developed solutions to course problems that can be applied in practice.	0.147	0.026	**−0.653**
34. I can apply the knowledge created in this course to my work or other non-class related activities.	0.171	−0.041	**−0.687**

Rotation method: Oblimin with Kaiser Normalization. Survey items that loaded on a component at .5 or higher are in bold.
[a]Rotation converged in 12 iterations.

Table 1 and Fig. 1 show the eigenvalues and the scree plot for our principal components analysis. When specifying a three-factor solution within SPSS, factor loadings for the 34 items support the validity of the CoI's conceptual framework of Teaching, Social, and Cognitive Presences. These three factors accounted for 61.3% of the total variance in scores. Principal Components Analysis did yield an additional fourth factor with an eigenvalue >1.0. However, the respective scree plot fails to inform the possibility of an additional fourth factor given the marked decrease in magnitude of the first and second factor's eigenvalues. Over half (51.1%) the total variance in this three- factor solution is attributed to the first factor.

Table 2 lists for the 34 CoI items factor loadings on each of the three factors. These results reflect the Pattern Matrix generated by SPSS. Although factor loadings for the respective Structure Matrix differ slightly, results from both output matrices support the three-factor model. Consistent with the design of the instrument, Items 1–13 (Teaching Presence) loaded most heavily on Factor 1. Items 14–22 (Social Presence) loaded most heavily on Factor 2. Finally, Items 23–34 (Cognitive Presence) loaded most heavily on Factor 3. Cronbach's Alpha yielded internal consistencies equal to 0.94 for Teaching Presence, 0.91 for Social Presence, and 0.95 for Cognitive Presence.

4. Discussion

The Principal Components Analysis of the data supports the construct validity of Teaching Presence, Social Presence and Cognitive Presence as measured by the CoI. However, when allowing for any possible number of factors in the analysis, eigenvalues indicate a potential fourth factor, while the scree plot yields inconclusive results.

The factor loadings are consistent with recent studies that suggest a two-dimensional orientation of items used to measure teaching presence. Studies by both Arbaugh (2007) and Shea et al. (2006) have found that pre-course activities (design and organization) and in course activities (facilitation and direct instruction) load on separate factors. Arbaugh (2007) suggested that this loading may reflect the time orientation during which these activities take place. Since most of the activities related to design and organization take place before the course begins, and facilitation and instruction are activities that take place during the course, it is possible that the timing of activities influences the operationalization of the framework.

The results of this study support the use of the CoI instrument as a valid measure of Teaching, Social, and Cognitive Presence. As subsequent research is conducted with the CoI, investigators in this study hope to explore further the inconsistencies between factor analysis results and the intended structure of CoI items when the number of factors is not specified a-priori. These inconsistencies may simply result from subtleties in how particular items are worded. On the other hand, such inconsistencies may point to more fundamental issues regarding theoretical assumptions on which the subscale items are created. Comparisons among the factor loadings lend support that in some instances, the wording of CoI items measuring Teaching Presence may simply need to be refined slightly. For example, with Items 1 and 12, the primary factor loadings are not as distinct. That is, they are not as dissimilar from the next highest loading as compared to other items. These loadings suggest that overall such items do not factor out "as cleanly," and may thus be due to vagueness in how they are worded.

Results also point to other problems with the items comprising Teaching Presence. Correlations among the four factors obtained when not specifying a factor solution, illustrated in Table 3, suggest that Factor 1, comprised of 7 of the 13 items designed to measure

Table 3
Correlations between components

Component	1	2	3	4
1	1.000	0.318	−0.479	0.348
2	0.318	1.000	−0.568	0.382
3	−0.479	−0.568	1.000	−0.543
4	0.348	0.382	−0.543	1.000

Teaching Presence, is more highly correlated with the Cognitive Presence factor (r=−0.479) than it is with the factor containing the remainder of Teaching Presence items (r=0.348). If Factors 1 and 4 were more closely correlated, one would suspect less that a separate construct actually exists. However, these results suggest that given respondents' perceptions, items comprising Teaching Presence might measure two distinct constructs.

It is important to distinguish however, the validity of the Teaching Presence construct per se, and the validity of the items designed to measure that construct. That is, in keeping with not "throwing the baby out with the bathwater," CoI items used to measure Teaching Presence may need to be refined, yet the theoretical basis of the construct itself remains intact based on the valuable work conducted in this area. Moreover, as alluded to above, construct validity is highly dependent on the context in which measurement occurs. For example, were these Teaching Presence items administered to respondents independent of the remaining items for Social and Cognitive Presence, respondents' perceptions of those items may be markedly different. In attempting to merge three separate constructs into one instrument, investigators assume the risk of unintentionally creating new and complex phenomena resulting from the interactions among the three constructs. In fact, the results of this study suggest there is such overlap, as evidenced by correlation among factors. Furthermore, when considering the sample of respondents, investigators need to anticipate that, rather than take a survey at face value, students possessing higher cognitive intelligence than the general population will invariably attempt to "decode" a survey as they complete it. In summary, one must consider carefully when attempting to validate an instrument to do so.

Another scenario needs to be considered when scrutinizing the Teaching Presence construct. Much as the more general construct of *Presence* in an online learning environment can be explained more in depth by separating out Teaching, Social, and Cognitive subfactors, it may be that the Teaching Presence construct's potential bifurcation reflects a strength, and not necessarily a weakness in the subscale's construction. That is, since this factor represents a greater chunk of the total variance, results may simply be pointing to the Teaching Presence subscale itself having two or more subscales. At this early stage of development of measures to operationalize the CoI framework it is important not to assume that a subscale's multidimensionality is necessarily a weakness. Further studies conducted with larger samples and within other contexts will help clarify this issue.

In spite of potential concerns with the conceptualization of teaching presence, the results of this study suggests that this attempt to operationalize the CoI framework builds upon prior work in at least two ways. First, the survey items measuring cognitive presence appear to capture the dimensions of that construct in a valid yet efficient manner. Second, the multi-institutional sample provides increased external validity to the findings. As such, the instrument could be used both in studies that examine the CoI elements as predictor variable of course outcomes and as criterion variables in studies examining the extent to which course characteristics encourage or inhibit the development of social, teaching, and/or cognitive presence. We encourage other researchers to work to further refine these measures.

We also encourage exploratory works that use the CoI as a dependent measure in comparing courses and the implementation of emerging technologies within courses. Initial work in this area indicates that the CoI may be quite effective in determining the impact of specific strategies and technologies (Ice, 2008). Further experimental or quasi-experimental studies of this nature would be of significant benefit in defining best practices in online environments.

The increasing reliability and validity of CoI measurements carries implications not only for researchers interested in the framework, but also for course designers, degree program administrators, and instructors. As CoI measures are further refined, should they be used as a course and program assessment tool in addition to research purposes? Also, regardless of the definition of the construct of teaching presence, our findings suggest that instructors play significant roles both in helping students understand and apply appropriate conduct within the course before it begins and in guiding the course activities once the course is underway.

References

Anagnostopoulos, D., Basmadjian, K. G., & McCrory, R. S. (2005). The decentered teacher and the construction of social space in the virtual classroom. *Teachers College Record*, *107*, 1699–1729.

Arbaugh, J. B. (2007). An empirical verification of the community of inquiry framework. *Journal of Asynchronous Learning Networks*, *11*(1), 73–85.

Arbaugh, J. B., & Hwang, A. (2006). Does "teaching presence" exist in online MBA courses? *The Internet and Higher Education*, *9*, 9–21.

Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis.* Hillsdale, NJ: Erlbaum.

Garrison, D. R. (2007). Online community of inquiry review: Social, cognitive, and teaching presence issues. *Journal of Asynchronous Learning Networks*, *11*(1), 61–72.

Garrison, D. R. (in press). Communities of inquiry in online learning: Social, teaching and cognitive presence. In C. Howard et al. (Eds.), Encyclopedia of distance and online learning. Hershey, PA: IGI Global.

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*, 87–105.

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.

Garrison, D. R., & Arbaugh, J. B. (2007). Researching the Community of Inquiry Framework: Review, issues and future directions. *The Internet and Higher Education*, *10*(3), 157–172.

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *American Journal of Distance Education*, *19*, 133–148.

Garrison, D. R., Cleveland-Innes, M., & Fung, T. (2004). Student role adjustment in online communities of inquiry: Model and instrument validation.*Journal of Asynchronous Learning Networks*, *8*(2) Retrieved September 1, 2004 from http://www.aln.org/publications/jaln/v8n2/v8n2_garrison.asp

Goertzen, P., & Kristjansson, C. (2007). Interpersonal dimensions of community in graduate online learning: Exploring social presence through the lens of Systemic Functional Linguistics. *The Internet and Higher Education*, *10*, 212–230.

Gorsuch, R. (1983). *Factor analysis*, 2nd Edition Hillsdale, NJ: Lawrence Erlbaum.

Heckman, R., & Annabi, H. (2005). A content analytic comparison of learning processes in online and face-to-face case study discussions.*Journal of Computer-Mediated Communication*, *10*(2) article 7. http://jcmc.indiana.edu/vol10/issue2/heckman.html

Ho, C. -H., & Swan, K. (2007). Evaluating online conversation in an asynchronous learning environment: An application of Grice's cooperative principle. *The Internet and Higher Education*, *10*, 3–14.

Ice, P. (April, 2008). The impact of asynchronous audio feedback on teaching, social and cognitive presence. *Banff, Alberta: First International Conference of the Canadian Network for Innovation in Education*.

Kass, R. A., & Tinsley, H. E. A. (1979). Factor analysis. *Journal of Leisure Research*, *11*, 120–138.

Nunnally, J. C. (1978). *Psychometric Theory*, (2nd ed.) New York: McGraw-Hill.

Oriogun, P. K., Ravenscroft, A., & Cook, J. (2005). Validating an approach to examining cognitive engagement in online groups. *American Journal of Distance Education*, *19*, 197–214.

Richardson, J. C., & Swan, K. (2003). Examining social presence in online courses in relation to students' perceived learning and satisfaction.*Journal of Asynchronous Learning Networks*, *7*(1) Retrieved June 1, 2004 from: http://www.aln.org/publications/jaln/v7n1/index.asp

Schrire, S. (2004). Interaction and cognition in asynchronous computer conferencing. *Instructional Science: An International Journal of Learning and Cognition*, *32*, 475–502.

Shea, P. J., Fredericksen, E. E., Pickett, A. M., & Pelz, W. E. (2003). A preliminary investigation of "teaching presence" in the SUNY learning network. In J. Bourne, & Janet C. Moore (Eds.), *Elements of Quality Online EducationInto the Mainstream*, *Vol. 4.* (pp. 279–312) Needham, MA: Sloan-C.

Shea, P., Li, C. S., & Pickett, A. (2006). A study of teaching presence and student sense of learning community in fully online and web-enhanced college courses. *The Internet and Higher Education*, *9*, 175–190.

Tabachnik, B. G., & Fidell, L. S. (2007). *Using multivariate statistics.* Boston: Pearson Education.

Thompson, B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications.* Washington, DC: American Psychological Association.

Vaughan, N., & Garrison, D. R. (2005). Creating cognitive presence in a blended faculty development community. *The Internet and Higher Education*, *8*, 1–12.

Wise, A., Chang, J., Duffy, T., & del Valle, R. (2004). The effects of teacher social presence on student satisfaction, engagement, & learning. *Journal of Educational Computing Research*, *31*, 247–271.