The Community of Inquiry Framework Meets the SOLO Taxonomy: A Process-Product Model of Online Learning

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Abstract: This paper presents both a conceptual and empirical investigation of teaching and learning in online courses. Employing both the Community of Inquiry Framework (CoI) and the Structure of Observed Learning Outcomes Taxonomy (SOLO) two complete online courses were examined for the quality of both collaborative learning processes and learning outcomes. Responding to past criticism (e.g. Picciano, 2002; Rourke, 2009) of online education research, this study examines evidence beyond learner reported satisfaction and learning instead measuring both learning inputs and outcomes. Analysis of input includes quantitative content analysis of discussions using the Community of Inquiry (CoI) framework. Analysis of outcomes looks at both the quality of student learning artifacts such as case studies using the Structure of Observed Learning Outcomes (SOLO) taxonomy as well as instructor assigned grades of specific related assignments. Results suggest that understanding of online instructional effort, processes, and learning outcomes can be improved through this more comprehensive, conceptually-driven approach.

Objectives

Online education is undergoing rapid growth and acceptance at the college level in the United States and now represents a significant proportion of all learning for undergraduate students. It is estimated that there are more than 4 million students studying in online environments in US higher education (Allen & Seaman, 2009). These estimates further suggest that more than one in four college students in the United States are enrolled in at least one online course. Additionally, recent meta-analytic and traditional reviews of research indicate that the learning outcomes for online students are

equivalent (Abrami, Lou, Borokhovski, Wade, Wozney, Wallet, et. al, 2004; Allen, Bourhis, Burrell, & Mabry, 2002; Cavanaugh, Gillan, Kromey, Hess, & Blomeyer, 2004; Tallent-Runnels, Thomas, Lan, Cooper, Ahern, Shaw, et. al., 2006; Zhao, Lei, Yan, Lai, & Tan, 2005) or superior to (Means, Toyama, Murphy, Bakia & Jones, 2009) those of classroom students. However, a lack of conceptual understanding exists with regard to the circumstances under which online education promotes good learning outcomes. This paper seeks to empirically investigate such conditions.

Theoretical Framework

After more than a decade of work, the Community of Inquiry Framework (Garrison, Anderson & Archer, 1999) has become one of the leading models guiding research and practice in much of US online higher education (see e.g. Anderson, Rourke, Garrison, & Archer, 2001; Arbaugh, 2007; Garrison, 2007; Garrison & Arbaugh, 2007; Garrison, Anderson, & Archer, 2010; Meyer, 2003; Richardson & Swan 2003; Schrire, 2004; Shea & Bidjerano, 2009; Shea, Li, Swan & Pickett, 2005; Swan, 2003; Swan & Shih, 2005; Swan & Ice, 2010). The initial article outlining the framework (Garrison, Anderson, & Archer, 1999) has generated more seven hundred and fifty references in other scholarly publications since it was written. Reflecting a socio-cognitive view of learning (Dewey, 1933; Lipmann, 2003, Pierce, 1955) the model proposes theoretical elements requisite for successful knowledge construction in collaborative online environments. The Community of Inquiry (CoI) framework conceptualizes online knowledge building as a result of collaborative work among members in learning communities characterized by instructional orchestration appropriate to the online environments (*teaching presence*) and a supportive and collaborative online setting

(*social presence*). The teaching presence construct outlines task sets, for example - organization, design, discourse facilitation, and direct instruction (Anderson, Rourke, Garrison, & Archer, 2001) and articulates the specific behaviors likely to result in a productive community of inquiry (e.g. Shea, Li, Swan, Pickett, 2005). Social presence highlights online discourse that promotes positive affect, interaction, and cohesion (Rourke, Anderson,Garrison, & Archer, 2001) likely to result in a functioning community of inquiry. The model also references *cognitive presence*, a multivariate measure of significant learning that results from the cyclical process of practical inquiry (Garrison, Anderson, Archer, 2001) within such a community of learners.

Past factor analytic research has concluded that the model represents a coherent conceptual structure (Arbaugh, 2007; Ice, Arbaugh, Diaz, Garrison, Richardson, et. al., 2007; Shea & Bidjerano, 2008) components of which correlates with student satisfaction and learning (Shea, Li, Swan, & Pickett, 2005; Swan & Shih, 2005). Hypothesized relationships within this conceptual structure have also been analyzed. For example Shea and Bidjerano (2008) developed a structural equation model with more than 5000 online learners confirming that variance in student judgments of their own cognitive presence can be modeled from their ratings of instructor teaching presence mediated by their assessment of social presence in their online courses.

Limitations of past research practices on the model

We note that research in this area has grown out of inquiry into "computer conferencing" and has thus focused heavily on examination of threaded discussions within courses (Anderson, Rourke, Garrison, & Archer, 2001; Garrison, et al., 2000; Garrison, Anderson & Archer, 2001; Rourke & Anderson, 2002; Rourke, Anderson,

Garrison & Archer, 1999; Rourke, Anderson, Garrison & Archer, 2001). We believe that the research and indeed the CoI model itself are limited in light of these methods. We propose that progress can be made in the development of the framework by extending research into other areas of online courses including communicative processes outside of discussions and through analysis of learning artifacts directly related to discussions. Additionally we propose that while the CoI framework is appropriate for evaluating the quality of online interaction it was not designed to assess learning outcomes. Previous researchers have noted this and several have proposed the use of the Structure of Observed Learning Outcomes (SOLO) taxonomy as a complementary tool (Holmes, 2005; Kimber, Pillay & Richards, 2007; Schire, 2004; Slack, Beer, Armitt & Green, 2003). Using the taxonomy, student responses can be categorized according to complexity. Responses can be classified as prestructural, unistructural, multistructural, relational or extended abstract (Biggs & Collis, 1982). We therefore chose to use the SOLO taxonomy in this study to evaluate learning outcomes as reflected in student assignments related to online discussions.

Missing from past research is an investigation that documents hypothesized relationships between the CoI presence indicators reflected in student course work. The guiding hypothesis here is that significant learning *outcomes* should be strongly correlated with the quality of sustained learning *processes* reflected in the CoI framework. To address this gap we chose to examine two courses that differed with regard to teaching presence, hypothesizing that we should therefore find evidence of differences in social and cognitive presence as well as differences in the quality of learning artifacts reflected by assessment on the SOLO taxonomy.

Methods

The current study inquires into both learning inputs/processes as well as learning outcomes. We conceptualize inputs in terms of presence indicators reflected in the CoI model (Anderson, et. al 2001; Garrison et. al. 2001; Rourke, et. al, 1999) developed through content analysis of transcripts in multiple online settings. Minor modifications to these indicators were included as documented in Shea, Hayes, & Vickers (2009).

Coding was conducted in stages. First, online learning *processes*, then online learning *outcomes* were coded. In the initial stage at least two researchers coded all communicative processes in the two target courses for instances of teaching, social, and cognitive presence. This initially included all threaded discussions followed by course emails, question areas, and private folders. Initial inter-rater reliability metrics were established for each of these. Following suggestions from Garrison et. al. (2006) coders also met to check on coding disagreements. These resulted in better inter-rater reliability measures as coding errors and process differences were discovered. Similar procedures were followed for coding learning outcomes using the SOLO Taxonomy. Sample initial and negotiated inter-rater reliability metrics are included in appendix B.

Researchers analyzed instances of teaching presence within and external to threaded discussion specific to course topics. Additionally, correlations between the quality of threaded discussions and the quality of related learning artifacts were conducted. Finally an examination of instructor assessments of student performance reflected in assignment, discussion, and course levels grades was completed. Instructor assessments were then compared to cognitive presence levels and SOLO scores.

Data Sources

This research is based on a year-long examination of two fully online courses, one of which initially appeared to reflect a lower level of teaching presence in discussions, and thus seemed a good comparison for the second course that evidenced higher levels. The data thus includes all content in two upper level courses in Business Management offered by a state college in the northeastern United States that specializes in distance and adult education. Each course section was identical, designed by content experts and instructional designers, and taught by experienced instructors who were not the course designers. The course has five modules of instruction and contains a variety of learning activities including discussions, and individual and group assignments. The following data sources were used for this study: five two-week long discussion forums, course announcements, private folders for one-to-one student/instructor communication, general question sections, instructor e-mail, and 114 student case studies from three of the modules. All were coded by at least two researchers.

To perform the analysis of learning outcomes several factors had to be considered. The CoI model assumes a collaborative learning pedagogy in which outcomes are related to processes. For significant learning to occur there should be a correspondence between the content of the collaboration – typically conducted through asynchronous threaded communication - and the kinds of learning that are assessed – in our case individual learning as evidenced in students' analysis of case studies. For the SOLO analysis the researchers agreed that instructional design of Module three of the course represented the best match between the topic of threaded discussion and the requirements of the case study assignment. Therefore Module three is the focus of

analysis looking for correlations between CoI processes and meaningful learning outcomes in this study.

Research Questions:

1) What levels of teaching presence occur within and outside of the main threaded discussion areas?
2) What levels of social and cognitive presence occurs within threaded discussions?
3) What levels of cognitive complexity using the SOLO taxonomy are evident in sample student learning artifacts (case studies) related to threaded discussion?
4) How do SOLO scores compare to instructor evaluations of student performance?
5) Can CoI and SOLO metrics be used to predict instructor assessments of student learning?

Results

Tables 1 and 2 below shows total forms of teaching presence located both inside and outside of the threaded course discussions. As can be seen instructor teaching presence levels evidenced within course discussions presents and incomplete picture of total instructor teaching presence. The majority of teaching presence, a measure of productive instructional effort in the Community of Inquiry framework, occurs external to threaded discussion.

Table 1. Instructor A Teaching Presence (TP) within and outside of threaded discussion

	Instructor A					
Discussion	DE	FD	DI	AS	NC	All TP*
In	0	12	11	3	26	26
%	0.00%	100.00%	78.57%	7.50%	20.47%	**16.05%**
Outside	96	0	3	37	101	136

%	100.00%	0.00%	21.43%	92.50%	79.53%	**83.95%**
Total	96	12	14	40	127	162

*NC is not included in "All TP" column

Table 2. Instructor B teaching presence (TP) within and outside of threaded discussion

	Instructor B					
Discussion	DE	FD	DI	AS	NC	All TP*
In	5	6	2	3	16	16
%	11.63%	66.67%	25.00%	2.75%	11.85%	**9.47%**
Outside	38	3	6	106	119	153
%	88.37%	33.33%	75.00%	97.25%	88.15%	**90.53%**
Total	43	9	8	109	135	169

*NC is not included in "All TP" column
DE = Instructional Design; FD = Facilitation of Discourse; DI = Direct Instruction; AS = Assessment; NC = No Code

Social presence scores are listed in table 3 below. This data indicates that course A had 219 more instances of social presence than course B. Course A contained more indicators of affective forms of social presence and somewhat fewer instances of open communication.

Table 3. Distribution of SP indicators

	Course A		Course B	
	Total	%	Total	%
Affective	264	30.35	174	26.73
Open Communication	403	46.32	345	53.00
Group Cohesion	203	23.33	132	20.28
Total	870	100	651	100

Cognitive presence scores are included in Table 4 indicating that the majority of instances of cognitive presence in these courses were at the exploration stage. While an

initial view of instructor teaching presence within the discussions might predict higher cognitive presence levels for instructor A, who was more active within discussions we note that students in instructor B's course demonstrated more instances of the higher phases of integration and resolution.

Table 4. Distribution of CP indicators

	Course A		Course B	
	Total	%	Total	%
Triggering Event	38	7.21	39	8.04
Exploration	324	61.48	294	60.62
Integration	89	16.89	109	22.47
Resolution	0	0.00	2	0.41
No code	76	14.42	41	8.45
Total	527	100	485	100

Cognitive Presence as a Function of Teaching and Social Presence

Previous research (Shea & Bidjerano, 2008) employing structural equation modeling indicated that online student ratings of their own cognitive presence can be accounted for by their assessments of the quality of teaching and social presence in their courses. To further test the nature of these relationships we conducted a regression analysis of cognitive presence scores for the discussion in the third module of the course. The research team purposely selected this module for this and subsequent analysis because of the close association between the topic of the discussion and the case study assignment in the module. As can be seen, a majority of the variance in cognitive presence scores can be predicted based on scores for teaching and social presence frequency.

Table 5. Correlation Matrix

		Module 3 Discussion CP Weighted Total	Module 3 Teacher Presence - Frequency	Module 3 Social Presence - Frequency
Pearson Correlation	Module 3 Discussion CP Weighted Total	1.000	.664	.646
	Module 3 Teacher Presence - Frequency	.664	1.000	.508
	Module 3 Social Presence - Frequency	.646	.508	1.000
Sig. (1-tailed)	Module 3 Discussion CP Weighted Total	.	.000	.000
	Module 3 Teacher Presence - Frequency	.000	.	.002
	Module 3 Social Presence - Frequency	.000	.002	.

b Dependent Variable: Module 3 discussion CP weighted total

Table 6. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change	R Square Change	F Change	df1	df2
1	.755(a)	.569	.540	5.466	.569	19.168	2	29	.000

a Predictors: (Constant), Module 3 Social Presence - Frequency, Module 3 Teacher Presence - Frequency

ANOVA(b)

Table 7. Significance Test

Mode	Sum of	df	Mean	F	Sig.

l		Squares		Square		
1	Regression	1145.405	2	572.703	19.168	.000(a)
	Residual	866.470	29	29.878		
	Total	2011.875	31			

a Predictors: (Constant), Module 3 Social Presence - Frequency, Module 3 Teacher Presence - Frequency
b Dependent Variable: Module 3 Discussion CP Weighted Total

Comparison of Instructor Evaluations and CoI and SOLO Scores

As can be seen in the following regression analyses of student case study grades for module three, SOLO scores employed in combination with CoI metrics account for a significant proportion of the variance in instructor assessments of students' performance. From the correlation matrix below (table 8), teaching presence is significantly correlated with social presence ($r = .593$, $p < .05$) and cognitive presence ($r = .630$, $p < .01$), but neither of those are significantly correlated with SOLO analysis. Table 9 present grades for the case study assignment in module three as well as average frequencies of social presence and teaching presence in that module. Also presented in table 9 are average SOLO scores for the case studies in module 3.

Table 10 indicates that teaching presence, cognitive presence, and SOLO codes are significantly correlated with student performance on the case study assignment ($r = .549$, $p < .05$; and $r = .432$, $p < .05$ respectively). When the SOLO codes were used as a single predictor for module performance, R^2 was only .187, but when teacher presence and social presence were added to the model, R_2 increased to .521, indicating that the latter model explained over 50% of the variance in student performance. When all

predictors (SOLO coding, social presence, teacher presence and cognitive presence) are included CoI and SOLO combine to yield a more powerful model accounting for the majority of variance in instructor assessment of students' performance as indicated by their case study grades.

Table 8. Correlation matrix

	Module 3 Case Study Grade	Module 3 Social Presence	Module 3 Teacher Presence	Module 3 Cognitive Presence	Module 3 Case SOLO Analysis
Module 3 Case Study Grade	1.000				
Module 3 Social Presence	.409	1.000			
Module 3 Teacher Presence	.549*	.593**	1.000		
Module 3 Cognitive Presence	.425*	.927**	.630**	1.000	
Module 3 Case SOLO Analysis	.432*	-.218	.059	-.122	1.000

* $p < .05$.
** $p < .01$.

Table 9. Descriptive statistics for case study grades, social presence, teaching presence and SOLO

	Mean	Std. Deviation	N
Module 3 Case Study Grade [a]	87.65	6.224	17
Module 3 Social Presence – Frequency [b]	6.82	5.548	17
Module 3 Teacher Presence – Frequency [c]	2.76	2.078	17
Module 3 Case SOLO Analysis [d]	1.971	.9597	17

a. Case study grade range 0-100; b. average SP frequency for module 3; c. average TP frequency for module 3; d. average SOLO score for Module 3 case studies – range 1-5.

Table 10. Correlations

		Module 3 Case Study Grade	Module 3 Social Presence - Frequency	Module 3 Teacher Presence - Frequency	Module 3 Case SOLO Analysis
Pearson Correlation	Module 3 Case Study Grade	1.000	.409	.549	.432
	Module 3 Social Presence - Frequency	.409	1.000	.593	-.218
	Module 3 Teacher Presence - Frequency	.549	.593	1.000	.059
	Module 3 Case SOLO Analysis	.432	-.218	.059	1.000
Sig. (1-tailed)	Module 3 Case Study Grade	.	.052	.011	.042
	Module 3 Social Presence - Frequency	.052	.	.006	.200
	Module 3 Teacher Presence - Frequency	.011	.006	.	.411
	Module 3 Case SOLO Analysis	.042	.200	.411	.

Table 11. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.722(a)	.521	.410	4.781

a Predictors: (Constant), Module 3 Case SOLO Analysis, Module 3 Teacher Presence - Frequency, Module 3 Social Presence - Frequency

Table 12. ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	322.725	3	107.575	4.706	.020(a)
	Residual	297.158	13	22.858		
	Total	619.882	16			

a Predictors: (Constant), Module 3 case study SOLO analysis, module 3 teacher presence -frequency, module 3 social presence frequency

b Dependent Variable: Module 3 case study grade

Discussion

Our analysis indicated that overall teaching presence in the two courses was roughly equivalent but that the majority of instructor teaching presence occurs outside of threaded discussions that are the traditional object of research on the CoI framework. We believe that this fuller account of instructor teaching presence is often missing from research in this area. Particularly striking are results for instructor feedback provided through assessments of student work which account for the bulk of teaching presence in general and the majority of instructor effort conducted outside of threaded discussion. These results may help explain why, despite the near absence of one of the instructors from the online threaded discussions, cognitive presence scores for the two courses were quite similar. We suggest that future research inquiring into this concept also focus on communicative processes external to the main discussion area *and* examine other course documents such as instructions and the orientation and syllabus sections of online courses to develop a more complete picture of online instructional roles.

Results presented here confirm, at the individual course level, previous research describing the nature of the relationship of the various forms of presence in the CoI framework. Coding for cognitive presence conducted in this study results in scores against which predictions can be made through regression analysis. Using frequency measures of teaching presence and social presence as predictors of cognitive presence resulted in a significant regression model which replicates previous research (Shea & Bidjerano, 2009) that utilized learner assessments of the quality of their own cognitive presence. These results are significant in that they lend additional support to the validity

of the model but employ more direct measures of learning processes reflected by cognitive presence indicators residing in learning artifacts. Additional research investigating the relationships between the presences is recommended.

Also warranting comment is the correlation of student grades as dependent measures with CoI and SOLO scores and predictors. This study demonstrates that instructor assigned outcome measures (grades) on specific college-level online learning tasks such as a case study analysis can be predicted through collaborative learning processes reflected in CoI and SOLO constructs. Notable also were distinctions in correlations between instructor grades and SOLO scores in isolation versus SOLO in combination with CoI metrics. Results presented here suggest that the two models (CoI and SOLO) may have complimentary attributes in that they can be employed together to account for variance in student outcomes scores assigned by course instructors. Additional research combining CoI and SOLO metrics is thus also recommended.

Limitations - These results also appear to replicate previous studies that utilized quantitative content analysis with the CoI framework. For example in previous research (Fahy, 2005; Garrison, Cleveland-Innes, 2005; Kanuka & Anderson, 1998; Kanuka, Rourke, & Laflamme, 2007; McClin, et.al, 2002; Meyer, 2003; Rourke & Kanuka, 2009; Stein, Wanstreet, Engle, et. al, 2006; Vaughn & Garrison, 2006) students in online courses failed to consistently achieve higher stages of cognitive presence, i.e. integration, application and resolution, but instead appear to halt at lower levels reflecting introduction to, and surface exploration of, course topics and issues. Similar, though less consistent results were reported with regard to the SOLO taxonomy (Holmes, 2005; Rourke & Kanuka, 2009). At least two alternative conclusions can be inferred. The first

is that students, who are rated highly by instructors, receive excellent grades on assignments, and score a grade of A for their performance in the course are not learning. The second is that a distinction exists between outcomes valued by online instructors and outcomes deemed desirable by researchers employing the CoI Framework and SOLO taxonomy. Some students in the present study clearly achieved objectives considered essential by the course instructor as demonstrated in the assignment grades and final grades. The distribution of instructor grades also indicates that some students did not. However, it seems clear that the higher stages within the critical inquiry process reflected in the CoI framework is not a priority for all courses, and that successful learner acquisition of discipline specific content sometimes excludes the kinds of significant learning ideally described by the CoI and SOLO models.

That students in both courses did not score highly on either the cognitive presence coding or the SOLO taxonomy opens the question about similar outcomes in previous research. While not reported it seems unlikely that online students in the various studies documenting relatively low levels of cognitive presence (and the shorter list documenting mixed results on the SOLO taxonomy) actually failed their classes. We therefore suggest that results to date may not represent a failure of meaningful learning but rather differences in cultures of measurement between researchers and teachers. Again, it may be that CoI and SOLO metrics are not applicable to all outcomes across higher education. Evidence for this is indicated by results reported by Schrire (2004) who found consistently higher levels on SOLO scores among doctoral students as opposed to low score for undergraduates students reported here, in Holmes (2005) and in Rourke and

Kanuka (2009). Additional research documenting the correlation between SOLO, cognitive presence and instructor assessments of learning is recommended.

Acknowledgement

This work was supported in part by the SUNY Learning Network, Office of the Provost, State University of New York.

References

Abrami, Bernard, M., P., Lou, Y. Borokhovski, E., Wade, A., Wozney, L., Wallet, P., Fiset, M. Euang, B. (2004). How does distance education compare with classroom instruction? A meta-analysis of the empirical literature. *Review of Educational Research,* 74(3) pp 379-439.

Allen, E. & Seaman, J. (2007). *Online nation: Five years of growth in online learning.* Needham, MA: Sloan Consortium.

Allen, E. & Seaman, J. (2008). *Staying the course: Online education in the United States, 2008.* Wessley, MA: Sloan-C.

Allen, M., Bourhis, J., Burrell, N., & Mabry, E. (2002). Comparing student satisfaction with distance education to traditional classrooms in higher education: A meta-analysis. *American Journal of Distance Education*, 16(2), 83–97.

Anderson, T., L. Rourke, D.R. Garrison and W. Archer (2001). Assessing teaching presence in a computer conferencing context, *Journal of Asynchronous Learning Networks* 5 (2).

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

Biggs, J.B., and Collis, K.F. (1982). *Evaluating the Quality of Learning - the SOLO Taxonomy.* New York: Academic Press.

Cavanaugh, C., Gillan, K., Kromey, J. Hess, M., Blomeyer, R. (2004). *The Effects of Distance Education on K–12 Student Outcomes: A Meta-Analysis*. North Central Regional Educational Laboratory.

Dewey, J. (1933) *How We Think. A restatement of the relation of reflective thinking to the educative process*. Boston, MA: D. C. Heath.

Fahy, P. J. (2005). Two methods for assessing critical thinking in computer-mediated communications (CMC) transcripts. *International Journal of Instructional Technology and Distance Learning.* Available from http://www.itdl.org/Journal/Mar_05/article02.htm

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., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education* 2 (2-3), 87-105.

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *The American Journal of Distance Education, 15*(1), 7–23.

Garrison, D. R., Anderson, T., & Archer, W. (2010). The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education* 13(1-2), 5-9.

Garrison, R. & Arbaugh B. (2007). Researching the community of inquiry framework: Review, issues, and future directions. *Internet and Higher Education, 10,* 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*(3), pp. 133-148.

Garrison, D. R., Cleveland-Innes, M. Koole, M. & Kappelman, J. (2006). Revisiting methodological issues in the analysis of transcripts: Negotiated coding and reliability. *The Internet and Higher Education,* 9(1), 1-8.

Holmes, K. (2005). Analysis of asynchronous online discussion using the SOLO taxonomy. *Australian Journal of Educational & Developmental Psychology* 5, 117-127.

Ice, P., Arbaugh, B., Diaz, S., Garrison, D. R., Richardson, J. Shea, P., & Swan, K. (2007). Community of Inquiry Framework: Validation and Instrument Development. *The 13th Annual Sloan-C International Conference on Online Learning*, Orlando, November.

Kanuka, H. & Anderson, T. (1998). Online social interchange, discord, and knowledge construction. *Journal of Distance Education*,13(1), 57-74.

Kanuka, H., Rourke, L., & Laflamme, E. (2007). The influence of instructional methods on the quality of online discussion. *British Journal of Educational Technology*, *38*(2), 260-271.

Kimber, K., Pillay, H., & Richards, C. (2007). Technoliteracy and learning: An analysis of the quality of knowledge in electronic representations of understanding. Computers & Education, 48(1), 59-79.

Lipmann, M. (2003). *Thinking in Education*. New York: Cambridge University Press.

McKlin, T., Harmon, S., Evans, W., & Jones, M. (2002). Cognitive presence in web-learning: A content analysis of students online discussions. *Instructional Technology Forum*. Retrieved, July 10, 2009, from http://it.coe.uga.edu/itforum/paper60/paper60.htm

Means, B., Toyama, Y., Murphy, R., Bakia, M. & Jones, K. (2009). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. Washington, D.C.: U.S. Department of Education, Office of Planning, Evaluation, and Policy Development.

Meyer, K. (2003). Face-to-face versus threaded discussions: The role of time and higher-order thinking. *Journal of Asynchronous Learning Networks*, 7(3), 55-65.

Parsad, B., and Lewis, L. (2008). *Distance Education at Degree-Granting Postsecondary Institutions: 2006–07 (NCES 2009–044).* National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Picciano, A.G. (2002). Beyond student perceptions: Issues of interaction, presence, and performance in an online course. Journal of Asynchronous Learning Networks, 6(1).

Pierce, C. S. (1955). The fixation of belief. In J. Buchler (Ed.), *Philosophical writings of Pierce* (pp. 5-22). New York: Dover.

Richardson, J., & Swan, K. (2003). Examining social presence in online courses in relation to students' perceived learning and satisfaction. *Journal of Asynchronous Learning Networks, 7*(1).

Rourke, L., Anderson, T. Garrison, D. R., & Archer, W. (2001). Assessing social presence in asynchronous, text-based computer conferencing. *Journal of Distance Education,* 14(3), 51-70.

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Methodological issues in the content analysis of computer conference transcripts. *International Journal of Artificial Intelligence in Education,* 12 , 8-22.

Rourke, L., & Anderson, T. (2002). Exploring social communication in computer conferencing. *Journal of Interactive Learning Research,* 13 (3).

Rourke, L. & Kanuka, H. (2009). Learning in Communities of Inquiry: A Review of the Literature. *Journal of Distance Education*, 23(1), 19-48.

Schrire, S. (2004). Interaction and cognition in asynchronous computer conferencing. *Instructional Science* 32: 475–502, 2004.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14.

Shea, P. & Bidjerano, T. (2009). Community of inquiry as a theoretical framework to foster "epistemic engagement" and "cognitive presence" in online education. *Computers and Education*, 52 (3), 543 – 553.

Shea, P., & Bidjerano, T. (2008). Measures of quality in online education: An investigation of the community of inquiry model and the net generation. *Journal of Educational Computing Research,* 39 (4), 339-361.

Shea, P. & Bidjerano, T. (in press). Cognitive presence: A cluster analysis. *Journal of Computing in Higher Education.*

Shea, P., Hayes, S., & Vickers, J. (2009). *A reexamination of the community of inquiry framework: Social network and content analysis.* American Educational Research Association annual meeting, San Diego, CA.

Shea, P., Li, C. S., Swan, K., & Pickett, A. (2005). Developing learning community in online asynchronous college courses: The role of teaching presence. *The Journal of Asynchronous Learning Networks* 9(4), 59-82.

Slack, F, Beer, M, Armitt, G. & Green, S. (2003). Assessment and Learning Outcomes: The Evaluation of Deep Learning in an On-line course. *Journal of Information Technology Education*, 2, 305-317.

Stein, D.S., Wanstreet, C.E., Glazer, H.R., Engle, Harris, R.T., Johnston, S.M., Simons, M.R., & Trinko, L.A.(2007). Creating shared understanding through chats in a community of inquiry. *The Internet and Higher Education, 10*, 103-115.

Swan, K. (2003). Developing social presence in online discussions. In S. Naidu (Ed.*), Learning and Teaching with Technology: Principles and Practices* (pp. 147-164). London: Kogan Page.

Swan, K., & Ice, P. (2010). The community of inquiry framework ten years later: Introduction to the special issue. *The Internet and Higher Education* 13(1-2), 1-4.

Swan, K., & Shih, L. F. (2005). On the nature and development of social presence in online course discussions. *Journal of Asynchronous Learning Networks, 9*(3), 115-136.

Tallent-Runnels, Mary K.; Thomas, Julie A.; Lan, William Y.; Cooper, Sandi; Ahern, Terence C.; Shaw, Shana M.; Xiaoming Liu. (2006). Teaching courses online: A

review of the research. *Review of Educational Research*, Spring, 76 (1), pp 93-135.

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

Zhao, Y., Lei, J., Yan, B., Lai, C., Tan, H.S., (2005). What makes the difference? A practical analysis of research on the effectiveness of distance education. *Teachers College Record*, 107(8), pp 1836–1884.

Appendices

Table 13. Cognitive 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 [a]	0.99 [a]	0.77 [b]	0.98 [b]
Module 2	0.68 [b]	0.97 [b]	0.80 [a]	0.99 [a]
Module 3	0.75 [a]	0.98 [a]	0.84 [b]	0.99 [b]
Module 4	0.67 [b]	0.99 [b]	0.69 [a]	0.95 [a]
Module 5	0.82 [a]	1.00 [a]	0.48 [b]	1.00 [b]

a: Coding Pair A

b: Coding Pair B