THE DEVELOPMENT OF A COMMUNITY OF INQUIRY OVER TIME IN AN ONLINE COURSE: UNDERSTANDING THE PROGRESSION AND INTEGRATION OF SOCIAL, COGNITIVE AND TEACHING PRESENCE

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ABSTRACT

The purpose of this study was to explore the dynamics of an online educational experience through the lens of the Community of Inquiry framework. Transcript analysis of online discussion postings and the Community of Inquiry survey were applied to understand the progression and integration of each of the Community of Inquiry presences. The results indicated significant change in teaching and social presence categories over time. Moreover, survey results yielded significant relationships among teaching presence, cognitive presence and social presence, and students' perceived learning and satisfaction in the course. The findings have important implications theoretically in terms of confirming the framework and practically by identifying the dynamics of each of the presences and their association with perceived learning and satisfaction.

KEYWORDS

Online Learning; Community of Inquiry; Social Presence; Cognitive Presence; Teaching Presence; Group Identity; CoI Survey; Negotiated Coding; Perceived Learning; Satisfaction

I.   INTRODUCTION

It has long been recognized that meaningful and worthwhile learning is associated with collaborative communities of inquiry [1, 2, 3]. While communities of inquiry have been the ideal in higher education, little was known about the properties of an online learning environment and how online learning communities could be constituted. Of particular interest and challenge was how to create and sustain a community of learners in an online learning environment. The focus of this research is to explore the developmental nature of an online community of inquiry. More specifically, the focus is on using the Community of Inquiry framework [4] to study the dynamics of a community of learners over a course of study. We report on the progressive and developmental nature of each of the constituting elements of this framework (social, cognitive and teaching presence). In addition, the relationships among the three elements and perceived learning and satisfaction are explored.

II. THEORETICAL BACKGROUND

While there has been an explosion of research on online learning, much of this research has been atheoretical and fragmented [5, 6]. Many authors call for the need for development and refinement of theories to better understand learning and teaching in online environments [7, 8, 9]. One approach to online learning research that has gained some attention for its theoretical and methodological approach is that of Garrison, Anderson and Archer [4, 5]. The Community of Inquiry framework identified the key elements of an educational transaction that could be studied in concert such that their interdependencies could be understood. This framework is not a static model but attempts to explain the educational experience from a process perspective. As such, there is a strong need to study the dynamics of its constituting elements. One of the over-riding issues identified in a review of the research associated with this framework is understanding its dynamic nature [5]. The developmental issues associated with the Community of Inquiry framework have enormous theoretical and practical implications.

The Community of Inquiry (CoI) framework is formed by the intersection of three main elements—social presence, cognitive presence and teaching presence [4]. It has been shown to be a useful theoretical framework and tool to study and design online learning experiences [5]. All the presences were defined as multi-dimensional elements. Each of the presences is operationally defined in terms of the constituting categories (see Figure 1). Social presence was defined in terms of affective expression, open communication and group cohesion. Cognitive presence was defined by the practical inquiry model and consisted of the phases—triggering event, exploration, integration, and resolution. Teaching presence was defined in terms of design, facilitation and direct instruction. It should also be noted that correlations have been found between perceived learning and student satisfaction and each of the presences of the CoI [5, 10].

ELEMENTS	CATEGORIES	INDICATORS
		(examples only)
Social Presence	Open Communication	Learning Climate/Risk-Free Expression
	Group Cohesion	Group Identity/Collaboration
	Personal/Affective	Self Projection/Expressing Emotions
Cognitive Presence	Triggering Event	Sense of Puzzlement
	Exploration	Information Exchange
	Integration	Connecting Ideas
	Resolution	Applying New Ideas
Teaching Presence	Design & Organization	Setting Curriculum & Methods
	Facilitating Discourse	Shaping Constructive Exchange
	Direct Instruction	Focusing and Resolving Issues

Figure 1: Operational Definitions of the Presences

With the possible exception of cognitive presence, the internal dynamics of each of the presences has not been explicitly addressed. In terms of cognitive presence, the early research did focus on moving students through the phases of inquiry. In this regard it was noted that considerable teaching presence, including a well designed task with the expectation of a resolution, was required to move students through the phases. Teaching presence did imply a logical progression from design to facilitation and direct instruction when

required. The dynamic nature of social presence, however, was not quite so clear. The accepted doctrine was to focus on affective expression to establish a climate for learning with open communication and cohesion following. Recent speculation is that this may be more complex than originally conceived. Rogers and Lea [11] suggest that it is shared social identity with the group and not personal identity that is crucial for cohesive group behavior. As such, in a purposeful educational community, participants identify first with the course of study and personal relations follow from the goals of an educational experience.

If the intended result of social presence is to confer on the group greater capacity to communicate and collaborate, then the group will work more productively to the extent that group members identify with the group… [11, p. 153].

That is, open communication and cohesion are based on identifying with the group and the interests of the course. The implication is, therefore, that personal identity and relationships should be allowed to develop naturally and should not be forced on participants as the first order of business [12].

In addition to the internal dynamics of each of the presences, little is known about the relative developmental progression of each of the presences as a whole. For example, what is the relationship between teaching presence and cognitive presence as students progress through their course of studies? Similarly, what is the relationship between social presence and cognitive presence as students move through the phases of inquiry? And finally, what effect does each of the presences have on perceived learning and satisfaction? The literature review conducted by the authors did not yield much research that investigated how the Community of Inquiry framework changed over time in a specific context. However, one recent study examined cognitive presence over time by comparing the differences between two chat postings [13]. In short, the findings showed that exploratory statements increased over time indicating greater sharing of personal experience and previous knowledge. This study expanded the scope by focusing on all three elements of the CoI framework over a nine week period.

III. METHODOLOGY

A graduate course with 16 students given in the fall term of 2007 at University of Calgary was the focus of this study. The topic of the course was blended learning and the CoI framework provided the organizational structure for the course. The course was delivered fully online using asynchronous and synchronous formats (i.e., Blackboard and Elluminate). To increase accessibility to the course instructor, virtual office hours through Elluminate were also applied regularly. In the first Elluminate meeting, all students were welcomed, and the course, objectives, assignments, students' responsibilities and assessment strategies were introduced. Students were also asked to identify questions about course content and process.

Learning activities, strategies and assessment techniques were all developed to embed and reflect all three elements of the framework. The major assignments were article critiques and peer reviews, weekly online discussions and course redesign prototype projects. In the first online discussion, the instructor modeled how to facilitate the discussion in an effective way. To distribute teaching presence among students and teacher, in each of the remaining weeks students were responsible to moderate and facilitate the online discussions. This was the main reason that instructor postings were excluded in the transcript analysis. Garrison and Anderson [6] emphasize distribution of teaching presence also for the reason that student moderation can also attenuate the authoritative influence of a teacher and encourage freer discussion. The

final assignment was a course redesign project where students incorporated understandings from the discussions.

The complex nature of online learning calls for the use of multiple methods and multiple sources of data to understand group as well as individual learning [14]. Therefore, this study applied a mixed methodology approach which provides depth and breadth to the study not possible using either quantitative or qualitative data exclusively [15, 16]. With an eclectic approach, mixed method research is inclusive, pluralistic and complementary [17]. Moreover, collecting multiple data and using different strategies, approaches, and methods may increase the validity and reliability by eliminating limitations of each single method and complementing one another [16, 17, 18].

Transcript analysis was used to investigate how elements of the community of inquiry changes over time. Transcript analysis used here is a research technique for making replicable and valid inferences from data to their context [19]. Consistent with the research methodology, both manifest and latent content analysis strategies were applied to code and explore posting patterns of social presence, teaching presence and cognitive presence. The researchers coded each message based on category indicators defined in the CoI framework as well as the meaning of that message in the context of discussion. The first author and a research assistant analyzed the transcripts by applying a negotiated coding approach [20]. (The rationale behind the use of negotiated coding in an exploratory qualitative transcript analysis can be found in Garrison, et al. [20].) The researchers coded two discussion transcripts of a previous online course to get experience and gain familiarity with the process. The inter-rater reliability of the first training session for coding the transcripts was .75. This provided an estimate of reliability between the coders, notwithstanding the adoption and advantage of a negotiated coding approach. In the negotiated approach, the researchers coded transcripts and then actively discussed their respective codes to arrive at a final assessment of the code. Negotiation provided a means for on-going training, refining the coding scheme, controlling for simple errors, and thereby, increasing reliability.

A CoI survey instrument was also administered at the end of the class to assess the relationships among the three CoI presences and student perceived learning and satisfaction. The instrument was developed and validated by Ice and colleagues [21]. Cronbach's Alpha was 0.94 for teaching presence, 0.91 for social presence, and 0.95 for cognitive presence. The Community of Inquiry (CoI) survey included teaching presence perception (13 items), social presence perception (9 items), cognitive presence perception (12 items), one item for perceived learning, and one item for perceived satisfaction. The items were measured on a 5-point Likert-type scale with 1=Strongly Disagree and 5=Strongly Agree. Fifteen students (out of 16) completed the survey (see Appendix). The survey also included four open ended questions to provide the opportunity for students to identify their concerns or other issues about the course in terms of their learning and satisfaction. The analysis of students' responses to these questions was carried out using a constant comparative analysis method with three phases: open coding, axial coding and selective coding [22].

IV. RESULTS

A. Transcript Analysis

There were nine weekly discussion topics. The transcripts were generated from these discussions. Transcript analysis was applied to code and explore posting patterns of social presence, teaching presence and cognitive presence based on indicators defined in the CoI framework [4]. The indicators for the categories associated with each of the presences facilitated the coding of transcripts and the means to

explore the nature, magnitude and progression of social, cognitive and teaching presence in the online discussions.

1. Participation in Discussions

Students' participation in weekly discussions was regularly recorded. For the online course, the total average attendance in the discussion forums was 92 percent. The average number of postings per week was 63 (564/9) and the average number of postings of a student per week was 4.3. Figure 2 shows the participation rates in the discussion board in weekly segments. The messages that the course instructor or the guest speakers posted were excluded from the table and calculations.
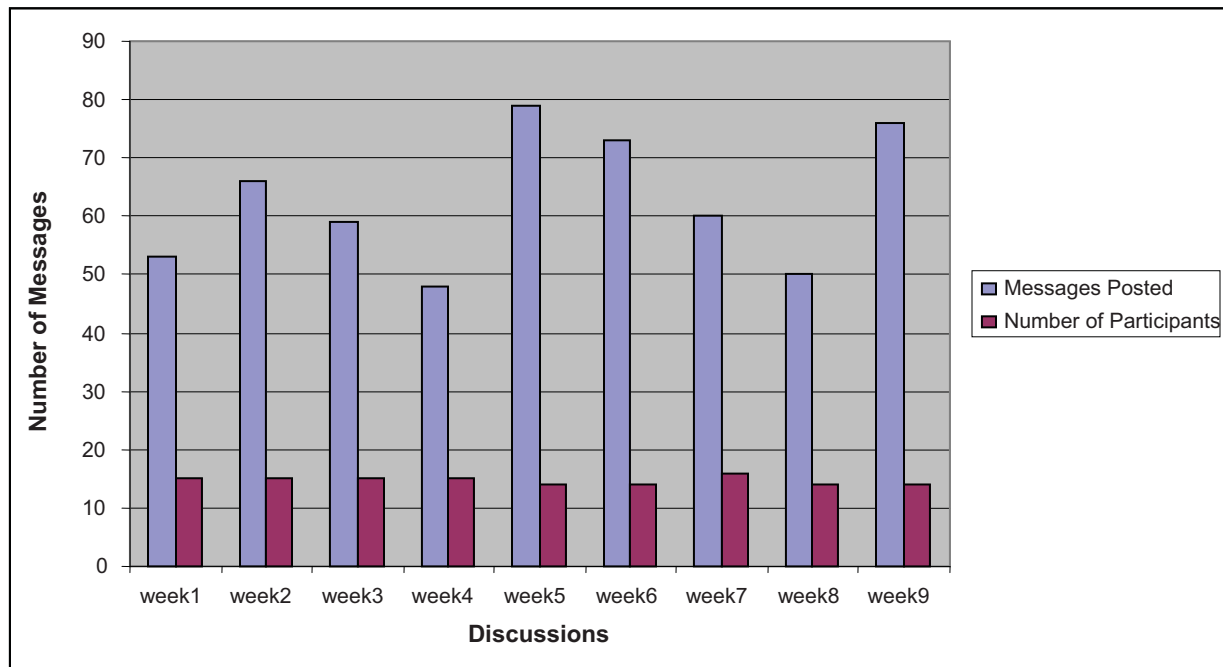

Figure 2. Participation in Computer Mediated Discussion Forum

2. Social Presence Over Time

Social Presence was analyzed in the transcripts by coding for affective expression, open communication and group cohesion. Table 1 illustrates the coding results for categories of social presence in three week periods. The majority of the messages throughout the course were open communication. However, the most obvious change occurred in terms of group cohesion as the percentage of group cohesion indicators increased over time.

Social Presence	First 3 Weeks of Discussion		Second 3 Weeks of Discussion		Last 3 Weeks of Discussion	
	Totals	%	Totals	%	Totals	%
Affective Expression	61	34%	77	39%	46	25%
Open Communication	104	58%	85	43%	80	43%
Group Cohesion	13	7%	31	16%	37	20%
No category detected	0	0%	7	4%	23	12%

| Totals | 178 | 100% | 200 | 100% | 186 | 100% |

Table 1. Comparison of Coding Results for Social Presence within Three Time Periods

A 3X3 ANOVA with repeated measures was conducted to explore whether there were any changes in social presence posting patterns over time. The factors for the analysis were time (first 3 weeks, second 3 weeks and last 3 weeks) and categories of social presence (affective expression, open communication and group cohesion). As reflected in Table 2, the results did not yield a statistically significant time effect over social presence as a whole (p=.075), although the probability was approaching significance. However, the results showed a significant category effect on social presence which means that categories of social presence differed from each other (p<.001).

There is also a statistical significant time by category interaction effect (p=.009). To understand how this interaction affect occurred, testing of simple effects was performed. The analysis yielded that affective expression (p=.037) and group cohesion (p=.014) categories of social presence changed significantly over time. Figure 3 indicates that the affective expression category decreased over time while the group cohesion category increased over time. The analysis also yielded that, apart from the last time period, there is a significant variation among categories of social presence throughout the course.

	F	Sig. (p)
Time	F(2,30)=2.823	.075
Category	F(2,30)=14.159	.000
Time*Category	F(4,60)=3.755	.009

Table 2. F and p Values for 3X3 ANOVA with Repeated Measures and Social Presence Category Effect

		F	Sig. (p)
Category	Affective Expression	F(2,30)=3.70	.037
	Open Communication	F(2,30)=3.15	.057
	Group Cohesion	F(2,30)= 4.96	.014
Time	First three weeks	F(2,30)=12.93	.000
	Second three weeks	F(2,30)=16.78	.000
	Last three weeks	F(2,30)=1.91	.166

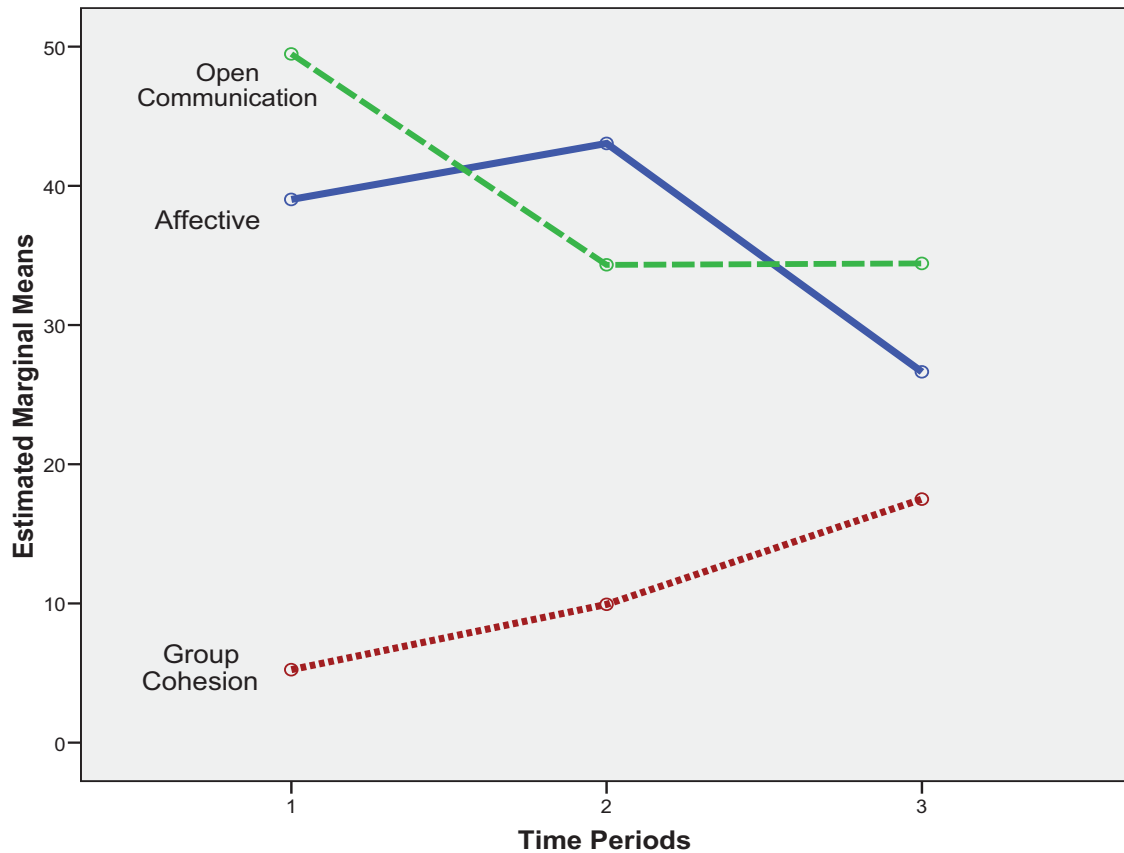**Table 3. F and p Values for Category and Time Interaction Effect**

Figure 3. Plot of Social Presence Categories over Time

3. Cognitive Presence Over Time

Cognitive presence was analyzed in the transcripts by coding for the triggering event, exploration, integration and resolution. Table 4 illustrates the coding results for categories of cognitive presence over the three segments of time. As the distribution of percentages for each category of cognitive presence showed, the integration phase was the most frequently coded category of messages posted by students throughout the course.

Cognitive Presence	First 3 Weeks of Discussion		Second 3 Weeks of Discussion		Last 3 Weeks of Discussion	
	Totals	%	Totals	%	Totals	%
Triggering Event	26	15%	14	7%	15	8%
Exploration	32	18%	59	30%	50	27%
Integration	83	47%	90	45%	96	52%
Resolution	12	7%	19	10%	11	6%
No category detected	25	14%	18	9%	14	8%
Totals	**178**	**100%**	**200**	**100%**	**186**	**100%**

Table 4. Comparison of Coding Results for Cognitive Presence within Three Time Periods

A 3X4 ANOVA with repeated measures was conducted to explore whether there are any changes on cognitive presence postings patterns over time. The factors for the analysis were the time (first 3 weeks, second 3 weeks, and last 3 weeks) and categories of cognitive presence (triggering event, exploration, integration and resolution). The results in Table 4 showed a significant category effect on cognitive presence which means that categories of cognitive presence varied from each other (p<.001). However, the results did not yield a statistically significant time effect (p=.829) or time by category interaction effect (p=.523). Figure 4 shows the scatter plot for each category of cognitive presence over the three time periods.

	F	Sig. (p)
Time	F(2,30)=.189	.829
Category	F(3,45)=81.00	.000
Time*Category	F(6,90)=.866	.523

Table 5. F & p Values for 3X4 ANOVA with Repeated Measures and Cognitive Presence Category Effect
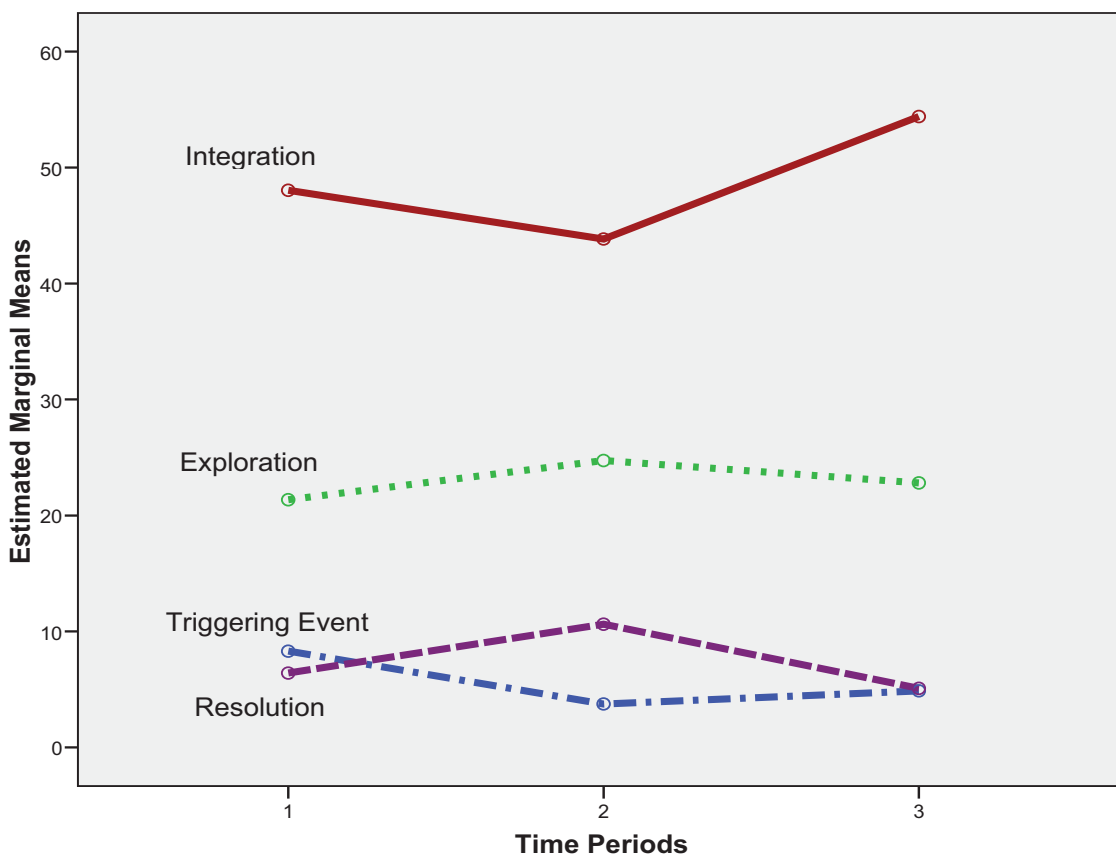

Figure 4. Plot of Cognitive Presence Categories over Time

4. Teaching Presence Over Time

Teaching presence was coded for design and organization, facilitating discourse, and direct instruction. Table 6 illustrates the coding results for categories of teaching presence in terms of three week segments. Design and organization was coded the least. There was also an increase in the number of messages coded

as direct instruction while facilitating discourse stayed more or less the same over time.

Teaching Presence	First 3 Weeks of Discussion		Second 3 Weeks of Discussion		Last 3 Weeks of Discussion	
	Totals	%	Totals	%	Totals	%
Design and Organization	1	1%	2	1%	0	0%
Facilitating Discourse	50	28%	46	23%	46	25%
Direct Instruction	33	19%	65	33%	70	38%
No category detected	94	53%	87	44%	70	38%
Totals	178	100%	200	100%	186	100%

Table 6. Comparison of Coding Results for Teaching Presence within Three Time Periods

A 3X3 ANOVA with repeated measures was conducted to explore whether there are any changes in teaching presence posting patterns. The factors for the analysis were time (first 3 weeks, second 3 weeks and last 3 weeks) and categories of teaching presence (design and organization, facilitating discourse, and direct instruction). As shown in Table 7, the results did not yield a statistically significant time effect over teaching presence as a whole (p=.272). However, the results showed a significant category effect on teaching presence which means that categories of teaching presence varied from each other (p<.001).

There is also a statistical significant time by category interaction effect (p=.001) which means that the category effect varies with time. To understand time by category interaction effect, testing of simple effects was performed.

	F	Sig. (p)
Time	$F_{(2,30)}= 1.361$	.272
Category	$F_{(2,30)}=23.721$	.000
Time*Category	$F_{(4,60)}=5.140$	.001

Table 7. F and p Values for 3X3 ANOVA with Repeated Measures and Teaching Presence Category Effect

Table 8 shows the results of simple effect analysis for category by time effect. As shown in the table, direct instruction changes over time whereas there is no statistically significant change in terms of the design and organization or facilitating discourse categories over time. The design and organization category is likely coded the lowest because these activities were largely organized before the course began. Figure 5 shows the scatter plot of three categories of teaching presence over the three time periods. The graph illustrates the increase in direct instruction.

The simple effect analysis also yielded that there is a significant variation among categories of teaching presence across the three time segments.

		F	Sig. (p)
Category by Time	Design and Organization	F(2,30)=.96	.395
	Facilitating Discourse	F(2,30)=1.62	.215
	Direct Instruction	F(2,30)= 5.43	.010
Time	First three weeks	F(2,30)=7.76	.002
	Second three weeks	F(2,30)=11.31	.000
	Last three weeks	F(2,30)=31.12	.000

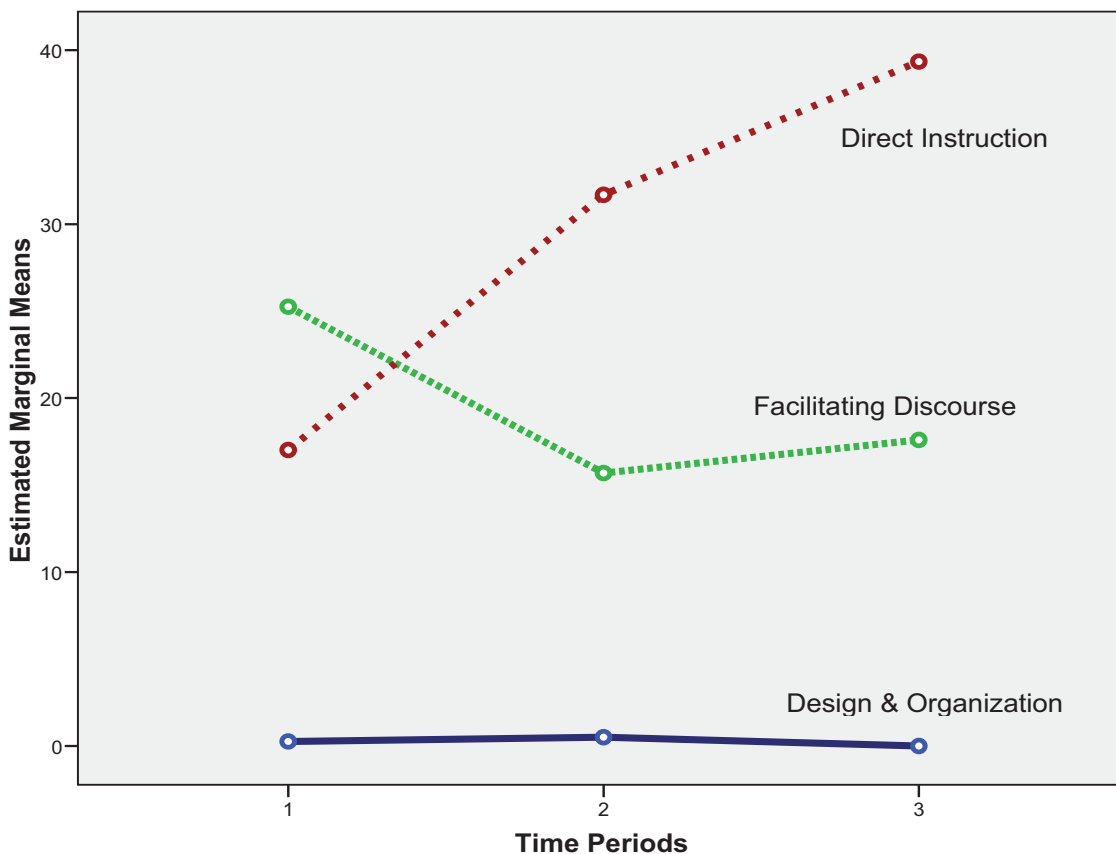**Table 8. F and p Values for Category and Time Interaction Effect**

Figure 5. Plot of Teaching Presence Categories over Time

5. Community of Inquiry Over Time

A 3X3 ANOVA with repeated measures was conducted to explore community of inquiry changes over time. For this analysis, the factors were defined as time (first 3 weeks, second 3 weeks, and last 3 weeks) and each element of community of inquiry framework (social presence, teaching presence and cognitive presence). Table 9 shows the F and p values for this analysis. The analysis yielded a significant category effect ($p<.001$) and a significant time and element effect ($p<.001$). However, the results did not indicate a significant time effect on community of inquiry as a whole.

	F	p value
Time	F(2,30)=.024	.976
Element	F(2,30)=41.266	.000
Time*Element	F(4,60)=7.769	.000

Table 9. F and p values for 3X3 ANOVA with repeated measures and CoI Element Effect

To explore time and element interaction effect, testing of simple effect analysis was conducted. Table 10 shows the F and p values for this analysis. According to the results, throughout the course each presence significantly varied from each other for first three weeks (p<.001); for second three weeks (p<.001); and for last three weeks (p<.001).

The simple effect analysis did not yield a significant difference on any of the presences over time. Although the scatter plot in Figure 6 shows a continual decrease on social presence and continual increase on teaching presence, the probability did not reach significance.

		F	Sig. (p)
Category by Time	Cognitive Presence	F(2,30)=.19	.829
	Social Presence	F(2,30)=2.82	.075
	Teaching Presence	F(2,30)= 1.36	.272
Time	First three weeks	F(2,30)=33.94	.000
	Second three weeks	F(2,30)=35.87	.000
	Last three weeks	F(2,30)=19.81	.000

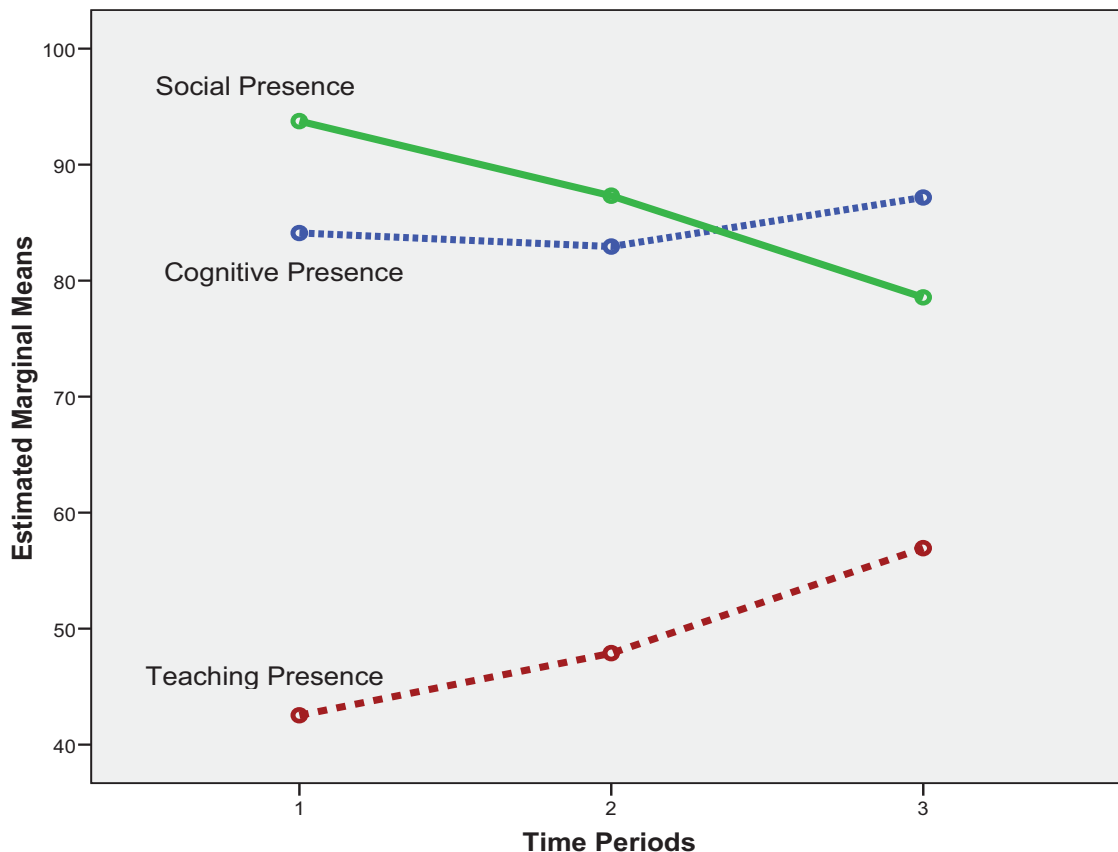**Table 10. F and p Values for Category and Time Interaction Effect**

Figure 6. Plot of the Elements of Community of Inquiry over Time

B. Survey Analysis

The purpose of administering this instrument was to help gain a quantitative measure of the relationships among the presences as well as quantitatively associating each of the presences to common outcome measures such as perceived learning and satisfaction. It was expected that exploring the relationships of learning and satisfaction with the presences may provide some insights with regard to the different roles of social and cognitive presence. The descriptive analysis of the CoI survey showed that 15 out of 16 students completed the survey. Students had high perceptions of each presence in the course (see Table 11). The mean responses for all the presences were greater than 3. The students also agreed that they learned much in this course (M=4.21) and that they were satisfied with the course overall (M=4.42). The Spearman Rank Correlation Coefficient was conducted to explore the relationships among variables (teaching presence, cognitive presence, social presence, perceived learning and satisfaction). The analysis revealed significant relationships among perceived learning, perceived satisfaction, and levels of teaching, social and cognitive presence. As shown in Table 11, there was a positively significant relationship between teaching presence and cognitive presence (r=.78, p=.001), between teaching presence and perceived learning (r=.55, p=.03), between teaching presence and satisfaction (r=.63, p=.01) indicating that students who perceived higher levels of teaching presence also perceived higher levels of cognitive presence, learning and satisfaction.

Correlations

			Teaching Presence	Social Presence	Cognitive Presence	Perceived Learning	Satisfaction
Spearman's rho	Teaching Presence	Correlation Coefficient	1.000	.182	.779**	.548*	.634*
		Sig. (2-tailed)	.	.517	.001	.034	.011
		N	15	15	15	15	15
	Social Presence	Correlation Coefficient	.182	1.000	.490	.463	.539*
		Sig. (2-tailed)	.517	.	.064	.082	.038
		N	15	15	15	15	15
	Cognitive Presence	Correlation Coefficient	.779**	.490	1.000	.666**	.650**
		Sig. (2-tailed)	.001	.064	.	.007	.009
		N	15	15	15	15	15
	Perceived Learning	Correlation Coefficient	.548*	.463	.666**	1.000	.504
		Sig. (2-tailed)	.034	.082	.007	.	.055
		N	15	15	15	15	15
	Satisfaction	Correlation Coefficient	.634*	.539*	.650**	.504	1.000
		Sig. (2-tailed)	.011	.038	.009	.055	.
		N	15	15	15	15	15

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 11. Relationships among Teaching Presence, Social Presence, Cognitive Presence, Learning and Satisfaction

The correlation coefficient also showed significant relationships between cognitive presence and perceived learning (r=.67, p=.007) and between cognitive presence and satisfaction (r=.65, p=.009), indicating that students who perceived higher levels of cognitive presence in the course also perceived higher levels of perceived learning and satisfaction. The analysis did not find a significant relationship between social presence and perceived learning, but found a significant relationship between social presence and satisfaction (r=.54, p=038).

Overall, it was found that all three presences showed a significant relationship with students' satisfaction. However, only two presences (teaching and cognitive presence) showed a significant relationship with perceived learning. This finding indicates that students think that they learn more when they perceive sufficient levels of teaching and cognitive presence. Their responses to open ended questions in the survey were also consistent with this result. Responses related to how and which aspects of teaching, social and cognitive presence affected their satisfaction and learning indicated that most of them emphasized the role teaching and cognitive presence had on their learning. With regard to the teaching presence, three students found teaching presence as the most important and critical one, whereas two students indicated both teaching presence and cognitive presence are key for their learning. Four students expressed that they were very satisfied with teaching presence in the course and teaching presence had the greatest impact on their learning. One student's statement about teaching presence was "*an instructor who has a strong presence and communicates effectively is a determining factor in whether or not I enjoy the course.*" Six students, who stated that they were satisfied with cognitive presence in the course, pointed out that cognitive presence created a deeper awareness, provided meaningful learning, and led to construct-based learning. Only two students emphasized that social presence encouraged participation and was needed for cognitive presence. Two students indicated that all three presences were important to achieve meaningful learning.

With regard to the impact of sense of community on their learning, students indicated that it was particularly powerful for participation. One student indicated that he felt greater comfort in participating in course discussions. Another student compared the sense of community to reading paper material and sending in assignments in response and stated that "*The difference is, I've gotten to know the teacher and*

some of the students. I know that if I learn something I will be able to share it." On the other side, two of the students who indicated that they did not feel a sense of community expressed that they learned a lot from the instructor and course readings.

V.   DISCUSSION

The primary focus of this study was how each of the presences and their categories evolved over time. However, at the outset, it should be noted that the categories of each of the presences were clearly distinguishable in the coding. Distinguishability provided the opportunity to analyze the development of the presences and their respective categories over time. Distinguishability also provided indirect support for the theoretical construct of the presences.

When analyzing the results of social presence it was found that affective expression decreased significantly while group cohesion increased significantly over the three time periods. Interestingly, affective expression remained high in the first part of the course, but as group cohesion began to rise, there would appear to be less need to overtly attend to affective expressions such as personal disclosure. It can be argued that collaborative activities increase students' sense of belongingness to the group which led them from an individual perspective to a group perspective. Moreover, some of the students' responses to open-ended questions also confirmed the importance of collaborative activities for their learning.

Another point worth noting, although not statistically significant, is that open communication was very high during the first two weeks and then dropped during the latter two time periods. Again, this would seem reasonable as students try to connect with others online by recognizing previous contributions. As they begin to feel more comfortable with the online discussion, the explicit personal recognition appears to drop. This is also not inconsistent with the findings that productive collaboration is likely dependent upon identity with a group and its purposes and less on individuals [11]. Another reason for the increase in group cohesion may be due to the nature of the online discussion board. Recent studies [23, 24] have shown the impact of different tools on social presence. There is evidence that group cohesion increases when students use a discussion board compared to traditional or email dialogue. While a definitive explanation of the social presence findings is not possible at this point, it does suggest that social presence is a dynamic multidimensional construct that is in need of further study.

With regard to cognitive presence, again we see a clear distinction among the phases of inquiry. However, notwithstanding the apparent increase in activity around integration, there were no statistically significant changes in the frequencies of the four phases of practical inquiry (i.e., cognitive presence). This was very likely due to the fact that the weekly discussion topics were similar in that they were progressively focused on designing a blended learning course (their final major assignment). The apparent spike in integration during the last three week period could be explained by the increase in knowledge injection from diverse sources, which is an indicator of the direct instruction category of teaching presence. As they began to use more sources, students' ability to support and to integrate their ideas with various resources increased. In general, it was encouraging to see the frequency of integration contributions considerably higher than exploration. This has not been typical of previous online studies [5]. One explanation is the design of questions in weekly discussions. The questions that triggered the discussion required students to explain and discuss the topics focusing on a specific aspect of their major assignment which enabled students to connect and synthesize their ideas for the purpose of resolution. The relatively reduced number of postings associated with resolution is explained by the fact that students very likely applied their resolution thoughts to their major course redesign project. There was not the expectation to share project insights with the other students. The length of the course is not enough for students to put their

projects in action and share the application results with the other students. The fewer number of messages at the resolution phase is also reported in previous studies [see 25, 26, 27].

The three categories of teaching presence were clearly distinguishable. While there was no significant shift in the categories over time, there was a significant interaction between categories and time. That is, direct instruction contributions rose over the three time segments while facilitating discourse dropped between the first and second time periods. The tentative explanation for the drop in facilitating discourse category is that students needed more encouragement and support during the first three weeks to express their ideas and then as they began to understand the expectations of online discussion, the need decreased and then stabilized.

However, the increase in direct instruction may have more than one explanation. The first explanation is that each week a group of students were responsible to facilitate the discourse. This encouraged them to be more active in terms of direct instruction (e.g., focusing the discussion on specific issues, diagnosing misconceptions, confirming understanding or injecting knowledge from diverse sources). Therefore, as time passed, more students gained experience and confidence in directing the discussion. Previous studies showed that taking the responsibility to lead a discussion is an effective way to enable students to fulfill each of the three roles of teaching presence and contribute to their learning [28]. A second explanation is that the triggering questions in course discussions were integrated with their major assignment. This encouraged the students to increasingly focus on their assignment which required more direction and clarity. Keeping in mind the increase on group cohesion, another reason can be that students felt more comfortable in the community to share and inject knowledge from diverse resources. As many have emphasized, social presence plays a critical role in creating an atmosphere of safety and trust for learning in community [29, 6].

The fourth repeated measures analysis looked at the community of inquiry as a whole through the progression of the three presences over time. The results showed both a clear distinction among the presences but not a significant time effect. Detailed analysis also confirmed that each presence was significantly different from the others at each time period. However, although the scatter plot showed a continual decrease on social presence and a continual increase on teaching presence, the analysis did not yield statistically significant differences on any of the presences over time. Of course, as discussed previously, time effects were evident within the presences.

Another point perhaps worth noting and speculating on is the corresponding rise of three categories in each of the three presences—group cohesion, integration and direct instruction. The question is whether there is any causal influence. It could be argued from a practical perspective that these three elements may in fact reinforce each other. That is, social presence through group cohesion and teaching presence through direct instruction supports integration and higher levels of cognitive presence (i.e., integration). While this is clearly hypothetical at this point, it is deserving of further study.

Finally, the survey results revealed a number of significant positive relationships between teaching presence and cognitive presence; teaching presence and perceived learning; teaching presence and satisfaction. This very much reinforces previous findings in terms of the crucial role of teaching presence in a community of inquiry [5, 30, 31]. The other set of significant relationships were between cognitive presence and perceived learning, and cognitive presence and satisfaction. Compared to teaching presence, cognitive presence was found to be a more influential factor on students' learning. It has been postulated from the inception that cognitive presence goes to the heart of the CoI framework. Although previous studies found significant relationships among social presence, perceived learning and satisfaction [32], the

results reported here only found a significant relationship between social presence and satisfaction. The question is how significant a role did social presence play? Does social presence significantly affect perceived learning? As one student indicated in his response to open ended questions in the survey, social presence allowed students to express their thoughts more comfortably, especially at the beginning of the course as they got used to their class mates and the learning environment. At the same time, it would seem that personal identity is secondary to the subject matter (i.e., cognitive presence) [33]. This may suggest that social presence is an important but perhaps not sufficient element in a community of inquiry. A recent study [13] indicated that social presence and teaching presence exhibited by the learners themselves supported cognitive presence.

VI.   CONCLUSION

The results of this study strongly confirmed the distinction among the elements of the Community of Inquiry framework. The distinction has important theoretical implications. The findings also provide useful practical implications in that the three elements appear to develop and progress in different ways in an online learning environment. It was found that social presence and teaching presence along with their respective categories changed over time while the proportions of cognitive presence categories remained steady. Moreover, cognitive presence and teaching presence were important factors in influencing student learning and satisfaction. On the other hand, social presence had no impact on learning but was associated with satisfaction. It is suggested that the development and progression of each presence may well vary in contexts different from that studied here. For example, in this context, social presence was not found as important as teaching presence or cognitive presence in terms of student learning. However, social presence may well have more influence in informal learning environments, K-12 settings, or in online learning where students are new to this medium. Based on these results, it is suggested that the integration of the elements of a community of inquiry should be designed, facilitated and directed based on the purpose, participants and technological context of the learning experience.

The findings here are clearly limited by the small sample size. Notwithstanding this limitation, this study has taken an important first step in understanding the dynamic nature of a community of inquiry and each of its constituting elements and categories. It has been shown that both social and teaching presence showed evidence of significant dynamic changes over time. This was not the case for cognitive presence. There is some reason to believe that the nature of social and teaching presence will shift over time in the support of cognitive presence. The relatively constant nature of cognitive presence may well be a result of the design of the activities and the sample. While the results are interesting, only when we have a good understanding of the developmental progression of the presences and each of their categories will we be able to optimally integrate these elements in creating and sustaining a collaborative community of inquiry.

VII.   REFERENCES

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VIII. APPENDIX

CoI QUESTIONNAIRE

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Teaching Presence					
The instructor clearly communicated important course topics					
The instructor clearly communicated important course goals.					
The instructor clearly communicated important course topics					
The instructor clearly communicated important due dates/time frames for learning activities.					
The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.					
The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.					
The instructor helped to keep course participants engaged and participating in productive dialogue.					
The instructor helped keep the course participants on task in a way that helped me to learn.					
The instructor encouraged course participants to explore new concepts in this course.					
Instructor actions reinforced the development of a sense of community among course participants.					

The instructor helped to focus discussion on relevant issues in a way that helped me to learn.					
The instructor provided feedback that helped me understand my strengths and weaknesses.					
The instructor provided feedback in a timely fashion.					
Social Presence					
Getting to know other course participants gave me a sense of belonging in the course.					
I was able to form distinct impressions of some course participants.					
Online or web-based communication is an excellent medium for social interaction.					
I felt comfortable conversing through the online medium.					
I felt comfortable participating in the course discussions.					
I felt comfortable interacting with other course participants.					
I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.					
I felt that my point of view was acknowledged by other course participants.					
Online discussions help me to develop a sense of collaboration.					
Cognitive Presence					
Problems posed increased my interest in course issues.					
Course activities piqued my curiosity.					
I felt motivated to explore content related questions.					
I utilized a variety of information sources to explore problems posed in this course.					
Brainstorming and finding relevant information helped me resolve content related questions.					
Online discussions were valuable in helping me appreciate different perspectives.					
Combining new information helped me answer questions raised in course activities.					
Learning activities helped me construct explanations/solutions.					
Reflection on course content and discussions helped me understand fundamental concepts in this class.					
I can describe ways to test and apply the knowledge created in this course.					
I have developed solutions to course problems that can be applied in practice.					

I can apply the knowledge created in this course to my work or other non-class related activities.					
Satisfaction					
Overall, I was satisfied with this course					
Learning					
I learned much in this course.					

Please answer the following questions below.

    a) How has teaching, social and cognitive presence positively affected you in terms of satisfaction and learning?

    b) Which aspects of teaching, social and cognitive presence has negatively affected your satisfaction and learning?

    c) How has your sense of community positively or negatively affected your satisfaction and learning in this course?

    d) Any other insights do you have in terms of the effectiveness of this course?