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Network and Content Analysis in a Blog Training Course

By

Maria Maheridou, Panagiotis Antoniou, Efstratia Tsitskari, Thomas Kourtessis
Department of Physical Education and Sport Science
Democritus University of Thrace, Greece

Abstract

The purpose of this study was to evaluate interaction patterns among twenty (n=20) physical educators (PE) who voluntarily attended an eight week training course using blog, in order to enhance their professional development and their skills in effective teaching; the way they shared and constructed knowledge together was also a focus of our interest. The asynchronous online discussion between the learners formed the basis for the study. Social network analysis and content analysis were applied to analyze the data. The results showed that interaction patterns between the participants were rather centralized and network was relatively dense. Moreover, person to person communication was rather high. Content analysis revealed that the discussion was mainly focused on sharing and comparing information, as far as in negotiation and knowledge construction. A significant degree of social presence was established, which indicated that socio-emotional interaction between learners was essential in realizing meaningful and worthwhile educational outcomes.

Keywords: *Distance education, Blog, Social network analysis, Content analysis, Collaborative learning*

1. Introduction

In our so-called 'information age' online learning has become progressively more popular, mainly due to the many assumed benefits of the use of Computer mediated communication (CMC). The increasing popularity of the learning technology and the Internet, and its' ability to provide seemingly transparent synchronous or asynchronous forms of communication between different CMC applications, has simplified the processes of providing learning opportunities to remotely located learners (Erlin, Norazah & Rahman, 2009).

In recent years web 2.0 technologies have harnessed the social networking and community-building potential of the distance online learning environment (O'Reilly, 2005). The latest generation of collaborative web-based tools, such as blogs, offers many unique and powerful information sharing and collaboration features. Socio-constructive online learning approaches emphasize the socially and culturally situated context of cognition, in which knowledge is constructed through shared efforts, as the interactions through collaborations or asynchronous discussions on educational blogs, enable knowledge to be constructed individually but mediated socially (Minocha, 2009).

Additionally, although the use of asynchronous discussion can provide distance learners with unprecedented learning opportunities, educators are often faced with difficulties in how to evaluate such online educational environments. As Gunawardena, Carabajal and Lowe (2001) noted the development of appropriate methodologies for evaluating the multidimensional, ever changing forms of these Computer supported collaborative learning (CSCL) environments presents a critical challenge to distance educators. The open ended nature of online learning, the multiple threads of conversation, and fluid of participation patterns call for new ways of looking at evaluation. As a result, the issue of evaluating the interaction and

the quality of online learning processes in a CSCL environment has been an area of much discussion in the practice of distance education.

Previous research in text-based computer conferencing has reported that analysis of transcripts of online discussions can reveal how participants network socially, exchange information, and attempt to construct knowledge (Fahy, 2001). On the other hand, the analysis of computer conferencing proceeds at a number of different levels including measurement of the frequency and patterns of interaction, categorization of messages and message content. Arguably, none of these allow analysis of how collaborative learning takes place, but a combination of detailed interaction and content of the discourse can significantly contribute to such analysis (Donnelly & Gardner, 2009).

Many researchers' interest was focused on studying variables that affect the methodologies which are implemented in teachers' CSCL distance programs. In reverse, there is a limited number of studies oriented towards a quantitative along with a qualitative methodology approach and especially when web 2.0 tools, such as blogs, are the delivery medium (Maheridou, Antoniou, Kourtessis & Avgerinos, 2010). In addition, despite the growing popularity and the benefits of blogs' use in education, and especially in physical educators' (PE) distance training, empirical studies on its effectiveness in learning are also limited (Borja, 2005; Goh, Quek & Lee, 2010; Instone, 2005; Maheridou et al., 2010; Vivitsou & Gerouki, 2008). So, there is a need to investigate how the communication through web 2.0 based tools influence learning.

Therefore, the purpose of the present study was to evaluate PE interaction patterns and the way they shared and constructed knowledge together, in an eight week training course using blog. Social network analysis (SNA) and content analysis (CA) were used in order to examine the following research questions:

- How active were the participants in the discourse?
- Who were central participants in the discourse?
- How dense was the participation within the blog-network?
- What was the quality of the discourse?

Social Network Analysis Approach

The defining feature of SNA is its focus on the structure of relationships, ranging from casual acquaintance to close bonds. SNA assumes that relationships are important. It is a collection of measure and graph analysis methods that were developed to analyze formal and informal relationships, to understand what facilitate (or impede) the knowledge flows that bind interacting units. Also, visualization techniques are important aids in helping researchers understand social and conversational patterns in online interactions. SNA techniques contribute to get a clearer picture of what is happening in the online learning environment (Erlin et al., 2009).

Using SNA methods for analyzing online networks, and in particular learner networks, was suggested by many researchers as a methological tool that provides baseline information, against which distance educators can then prioritize and plan interventions to improve knowledge flows (de Laat, 2002; Erlin et al., 2009; Neuendorf, 2002). Moreover, SNA may help in identifying patterns of relationship between people who are part of a social network. It may assist in the analysis of these patterns by illuminating the flow of information and/or other resources that are exchanged among network members (de Laat, Lally, Lipponen & Simon, 2007).

For the purposes of the present study, adjacency matrix, graph theory and a set of network analysis' technique (degree centrality, density, reciprocity, multi dimensional scaling) were applied to quantitatively define the network interaction patterns among PE, as participating aspects of their learning (Scott, 1991; Wasserman & Faust, 1997).

Content Analysis Approach

Many researchers have constructed coding schemes for what they wanted to explore in the content and process of online discussion. Henri (1992) was a pioneer in utilizing content analysis to analyze the transcripts of discussions, in order to evaluate the quality of online learning communities. Henri's analytical framework consists of five dimensions (i.e., participative, social, interactive, cognitive and meta-cognitive) and her work has laid the foundation for subsequent research.

On the other hand, Gunawardena, Lowe and Andersons' (1997) model, initiated the interaction analysis for examining social construction of knowledge, reflecting one of the key characteristics of CSCL, to counteract the limitations of Henri's model in which the progression of ideas being reflected at different phases of the interaction is not captured. They used the phases of a discussion to determine the amount of knowledge constructed within the discussions analyzed; it distinguishes between five phases reflecting the complete process of negotiation of knowledge construction, from phase I to phase V, indicating progress from the lower to higher mental functions and revealing how learners contribute toward the construction of knowledge.

Phase I is one of sharing and comparing information; learners exchange opinions, ask questions, and provide descriptions about the topic of their discussion. Phase II concerns the discovery and exploration of dissonance or inconsistency among ideas, concepts or statements. In this stage, learners try to identify their areas of disagreement, ask and answer questions to further clarify the topic of discussion. In the next phase (phase III), they are negotiating or constructing knowledge by making new proposals, integrating or accommodating knowledge, or compromising. In phase IV, these newly constructed statements are being tested against personal experience, collected data, or acceptance in their culture. This leads to the final phase (phase V), in which statements of agreements are being made, or applications of newly constructed meaning will be applied.

Although Gunawardena et al.'s (1997) model focuses in an important aspect of learners' cognitive development, according to other researchers collaboration should also be seen as an essential aspect of cognitive development, since cognition cannot be separated from learners' social presence, which reflects a supportive context for emotional expression, open communication, and group cohesion for building understanding (Garrison, Anderson & Archer, 1999). Based on this point of view, Garrison et al.'s (1999) "Community of Inquiry" coding scheme consists of three dimensions: cognitive, social and teaching presence. The authors hypothesize that high levels of social presence with accompanying high degrees of participation, along with an effective teacher are necessary for the development of higher-order thinking skills and collaborative work. Particularly, in the social presence category are included three sub-categories/indicators, which were refined through an exploratory analysis of a computer conference transcript.

In the present study Gunawardena et al.'s (1997) model was adapted as our CO research tool, because it provides a more holistic view of discussion flow, directly connected to knowledge construction (Marra, Moore & Klimczak, 2004). Specifically: (a) it focuses on interaction as the vehicle for the co-construction of knowledge, (b) it focuses on the overall pattern of knowledge construction emerging from a conference, (c) it is most appropriate in a collaborative learning context, in which instructor has only a moderator role (d) it is a relatively straightforward schema, and (e) it is adaptable to a range of teaching and learning contexts (Ma, 2009). Due to the lack of the social dimension element in Gunawardena et al.'s (1997) model, messages identified as social talks between learners were coded in respect to Garrison et al.'s (1999) social presence category.

Finally, Gunawardenas et al.'s approach to code a message as a whole was applied, mainly because a message unit is objectively identifiable; thus, multiple raters can agree consistently on the total number of cases. This way the process of social knowledge construction is efficiently accessed (Gunawardena et al., 1997; Rourke, Anderson, Garrison & Archer, 2001).

2. Method

Sample

The participants in this study were 20 PE (n=20), all skilful users of the web, with teaching experience of 1.67 to 13.5 years (M=6.84, SD=3.17). They teach in elementary and secondary schools of nine provincial Greek regions; they applied online to attend a training course using blog, related to effective physical education teaching. The participants were given a choice on whether to be anonymous or identified when blogging and their participation was voluntary, without any gain; the experience and knowledge on issues of their professional interest in an innovative way motivated them.

The Training Course

The main aim of the course was to provide participants with further insight in effective physical education teaching in the school environment. Also, it provided opportunities for PE who would like to exchange their personal opinions and experiences with other colleagues who teach in remote, different schools. All participants had access to same blog using their personal codes -like a virtual classroom- (figure 1), where the educational material was uploaded and were able to participate in group threaded discussions with their mates and others' group members, using the "replay" or "comment" options to post their messages (figure 2).

The training course was designed in Democritus University of Thrace, by an especially formed scientific team of the Department of Physical Education and Sports. The course's duration was eight weeks, and in the beginning of every week a new thematic unit was released by the appointive instructor. The educational material was designed based on the Teacher's performance assessment instrument-revised (TPAI-R) thematic units (Flowers, Testerman, Hancock & Algozzine, 2002). It was presented using PowerPoint slides (included plain text, drawings, pictures), printable scripts (.pdf), videos, references to literature for further information and hyperlinks to relevant websites (in accordance with the possibilities offered by the Wordpress blog-provider).

Figure 1. Blogs' user interface

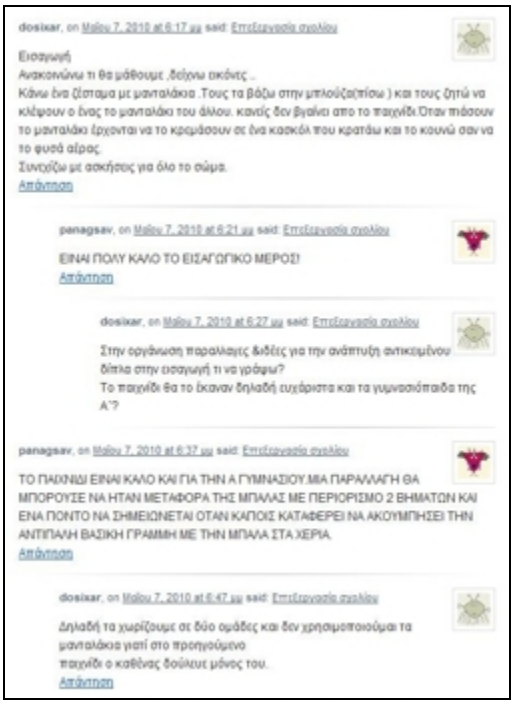

Figure 2. Threaded group-discussion

The Student teams' achievement divisions (STAND) cooperative strategy was applied during the course (Streeter, 1999). In respect to STANDs' cooperative procedures, participants were randomly divided into long-term heterogeneous groups of five, in order to conduct weekly cooperative assignments; a project drafting cooperative work was at the end of every week announced to all the blog members by the leader of each subgroup. Also, they had the opportunity to discuss on weekly announced topics with the entire networks' members. The instructor had only a moderator role (i.e. uploading the educational material, announcing group assignments and leaders, on a weekly basis). Learners' personal progress was followed through scheduled self evaluation quizzes and team recognition voting, that were regularly provided by the instructor to the blog area.

Data Collection and Analysis

Data for this study were transcripts of participants' discussion, using the "replay" or "comment" discussion tools in regard to blog technology. During the eight-week period (May-June 2010) learners posted 287 messages (M=14.45, SD=26.45, MIN=0, MAX=88) in the blog area (instructors' posts were excluded). In some cases, a learner's message was directed to more than one people (i.e. to subgroup members or the entire network). These messages were counted as a sent or a received message as well. The retrieved data stored away in matrix. SNT software was used to conduct the SNA and represent these online interactions in visual object.

Social Network Analysis

Adjacency matrix, graph theory and network analysis technique were applied to analyze the social structure of the blog training course and to quantitatively define the network interaction patterns among learners. For the purposes of the present study, the analysis was focused on the cohesion of the network (Scott, 2001; Wasserman & Faust, 1997).

Centrality measures were conducted to indicate the network activity of individual members. Degree centrality is a method of evaluating centrality on the basis of a member's direct linkage to other members.

In a directed network that considers the direction of the link, two degree centrality is presented by in-degree centrality and out-degree centrality. In the present study, in-degree provided information about the amount of messages a certain learner received, and out-degree about the amount of messages sent to another individual, subgroup or to the entire network (Scott, 2001).

Secondly, a density and reciprocity analysis were conducted as measures of the overall and/or reciprocated connections between the learners. This gives an indication of the level of engagement in the network; thus on how active the learners are involved in the discourse. The density of a network is defined as the number of communicative links observed in it divided by the maximum number of possible links (de Laat, 2002). Reciprocity analysis gives an indication of reciprocated relations between network members; it's a behavioral indicator for the emergence of a community. Reciprocity index represents the ratio of the number of links which are the part of reciprocated relations to the total number of links. Both these values vary between 0 and 1. For example, when density is 0, the network is without any connection; and when density is 1, all the members of a network are connected to one another (Avin & Ravid, 2005).

Finally, multi dimensional scaling (MDS) has been used to visualize the interaction between the network members. In the MDS map the concepts of space and distance are used to map relational data, based on the intensity of the engagement in the network as a measurement of closeness. The more network members interact with each other, the closer they appear on the MDS map (de Laat, 2002). Although there isn't a stress value recommended to be reliable for all kind of data, and applicable in all situations, according to a wildly adapted criterion: the less MDS stress value is, the more adaptable is data representation (Heady & Lucas, 2010).

Content Analysis

The qualitative data were analyzed using CA, in regard to Gunawardenas' et al. (1997) coding scheme. This model is designed to examine the negotiation of meaning and social construction of knowledge in CSCL environments. In the present study, the message as a whole was the unit of analysis, because this way the process of social knowledge construction was efficiently accessed (Gunawardena et al., 1997).

In order to calculate reliability of coding categories, messages were coded and validated by two coders. The coding categories, based on Gunawardenas' et al. (1997) coding scheme and Garrisons' et al. (1999) social presence dimension are shown in tables 1 and 2, respectively. The coders did a sample exercise on other messages to familiarize themselves with the models, and then they independently proceeded with the analysis. The results were cross examined by one another and Cohens' Kappa (κ) value of reliability was calculated.

Table 1. Coding categories (Gunawardena et al., 1997)

Code*	Category
Phase I: Sharing/comparing of information	
I1	A statement of observation or opinion
I2	A statement of agreement from one or more other participants
I3	Corroborating examples provided by one or more participants
I4	Asking and answering questions to clarify details of statements
I5	Definition, description, or identification of a problem
Phase II: The discovery and exploration of dissonance or inconsistency among ideas, concepts or statements	
II1	Identifying and stating areas of disagreement
II2	Asking and answering questions to clarify the source and extent of disagreement
II3	Restating the participant's position, and possibly advancing arguments or considerations in its support by references to the participant's experience, literature, formal data collected, or

	proposal of relevant metaphor or analogy to illustrate point of view
Phase III: Negotiation of meaning/co-construction of knowledge	
III1	Negotiation or clarification of the meaning of terms
III2	Negotiation of the relative weight to be assigned to types of argument
III3	Identification of areas of agreement or overlap among conflicting concepts
III4	Proposal and negotiation of new statements embodying compromise, co-construction
III5	Proposal of integrating or accommodating metaphors or analogies
Phase IV: Testing and modification of proposed synthesis or co-construction	
IV1	Testing the proposed synthesis against "received fact" as shared by the participants and/or their culture.
IV2	Testing against existing cognitive schema
IV3	Testing against personal experience
IV4	Testing against formal data collected
IV5	Testing against contradictory testimony in the literature
Phase V: Agreement statements (s)/applications of new constructed meaning	
V1	Summarization of agreement (s)
V2	Applications of new knowledge
V3	Metacognitive statements by the participants illustrating their understanding that their knowledge or ways of thinking (cognitive schema) have changed as a result of the conference interaction

**Subcategory code*

Table 2. The social presence dimension (Garrison et al, 1999)

Code	**Categories**	**Indicators** (examples only)
C1	Emotional expression	Emotions
C2	Open communication	Risk-free expression
C3	Group cohesion	Encouraging collaboration

3. Results and Discussion

Social Network Analysis

Centrality measures were conducted to indicate the network activity of individual members. The results show (table 3) that seven learners (L4, L6, L7, L8, L13, L15, L19) had rather high scores on betweenness, thus they were central members of the network in terms of controlling the information. Twelve learners had a medium or low impact in regulating the flow of information. One learner (L16) that did not write any messages, although did receive, can be seen as an outsider, although not an isolate, in controlling the discourse within this network.

Table 3. Engagement of members in the network

Members	**In-degree**	**Out-degree**	**Betweenness**
	M=0.439	M=0.439	M=111.5
	SD=0.063	SD=0.37	SD=100.022
L1	0.526	0.210	28.000
L2	0.578	0.210	18.000
L3	0.526	0.210	18.000
L4	0.368	1.000	288.000
L5	0.421	0.210	41.000

L6	0.421	1.000	332.000
L7	0.368	1.000	338.000
L8	0.368	1.000	206.000
L9	0.526	0.210	11.000
L10	0.421	0.210	92.000
L11	0.526	0.210	11.000
L12	0.421	0.210	87.000
L13	0.421	1.000	193.000
L14	0.368	0.210	48.000
L15	0.421	0.210	120.000
L16	0.473	0.000	0.000
L17	0.368	0.210	42.000
L18	0.421	0.263	68.000
L19	0.421	1.000	243.000
L20	0.421	0.210	46.000

To get an indication of the overall and reciprocity linkage of members in the network, we conducted density and reciprocity calculations that indicated how active learners were involved in the discussion and showed how dense was the participation within it. In this case of exchanging messages through online discussion, although the network demonstrated only a relatively satisfied density of 43.9%, its reciprocity was rather high (56.3%) within 167 messages. Student in-degree varied between 7 and 11 and out-degree varied between 0 and 19 (table 4). This was expected as in a CSCL environment reflects the completion of the team projects and the assessment tasks, due to the fact that learners are mainly willing to change information with their mates, rather to participate in discussion-topics with the overall networks' members.

Table 4. Network density and reciprocity

Measures	**Value**	
	In-degree	**Out-degree**
Sum	167	167
Mean	8.35	8.35
Std.Dev.	1.195	7.03
Min	7	0
Max	11	19
# of isolate	0	
Density	0.439	
Reciprocity	0.563	

An MDS (figure 3) was calculated to visualize the patterns of interaction between the learners. The amount of messages the members of this network have sent and received indicated how close they are

situated on the MDS map, thus the level of their engagement. The stress value that indicated the quality of the MDS map was 0.296.

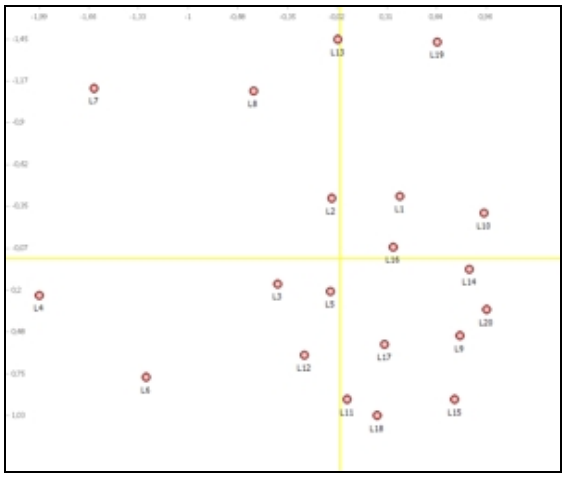

Figure 3. Interaction pattern within the network

Finally, the sociogram (figure 4) shows the structure and patterns of network member interactions, based on both (sending and receiving messages) links of communication.

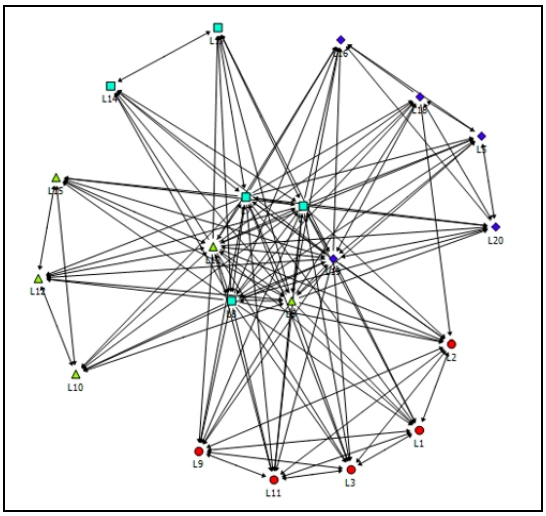

Figure 4. Communication pattern within the network

Content Analysis

A total of 287 learners' posted messages were coded in regard to Gunawardenas' et al. (1997) scheme to analyze the social construction of knowledge. Ninety seven of the messages (33.79%) could not be assigned to any of Gunawardenas' et al. (1997) scheme categories. The content of these messages were social talks and did not contribute to the discourse as such. The results of the 190 coded messages are shown in table 5. The Cohens' Kappa (κ) inter-rater value of reliability indicated that coding categories could be acceptable for drawing conclusions (κ=0.71).

Most of the communication (44,5%) among the learners, remained in the phase of sharing, or comparing information (phase I). This was somewhat expected, because such a phase of learning would provide the foundation for further exploration. Therefore, a lot of PE expressed opinions and exchanged information, related to each thematic unit's context, were shared between networks' members. Although, the exchanging of descriptions and opinions sometimes was being supported by other learners' examples or questions about clarification of the written statements, dissonance (or inconsistency) among their ideas were expressed in low level.

Table 5. Social construction of knowledge (Gunawardena et al., 1997)

Category	**Phase I**					**Phase II**			**Phase III**					**Phase IV**					**Phase V**		
Percentage	44.5%					7.8%			38.2%					5.8%					3.7%		
Code*	**I1**	**I2**	**I3**	**I4**	**I5**	**II1**	**II2**	**II3**	**III1**	**III2**	**III3**	**III4**	**III5**	**IV1**	**IV2**	**IV3**	**IV4**	**IV5**	**V1**	**V2**	**V3**
Messages	57	6	2	1	4	10	6	6	18	13	10	19	13	4	2	4	1	0	1	3	3

**Subcategory code*

Thus, only 7.8% of the messages were coded as phase II. A high percentage (38,2%) of the messages were categorized as phase III, which showed evidence of a considerable amount of co-constructed knowledge, critical analysis of peer ideas, or of the negotiation taking place during the discourse. Finally, 5.8% and 3.7% of the messages were coded as phase IV and V respectively, since testing and application of learners' new ideas (thus, the demonstration of higher order thinking skills) were reflected mainly through their weekly announced team projects.

The following learners' coded messages are presented as an example of PEs' collaborative knowledge construction activity in the CSCL environment, illustrating all five phases of knowledge construction activity.

Phase I: Sharing/comparing of information

> *"This was my next question, because children's' reaction -for certain- varies from one to another. Should we include both those versions?"* (L8-148/I4)

Phase II: The discovery and exploration of dissonance or inconsistency among ideas, concepts or statements

> *"I think we don't need so many of them"* (L8-163/II1)

Phase III: Negotiation of meaning/co-construction of knowledge

> *"Shall we remind them that in some cases they aren't so skillful too, so they could also come at the same difficult position?"* (L8-155/III4)

Phase IV: Testing and modification of proposed synthesis or co-construction

> *"Also, we can use two games or skills, in which some groups could be skillful at and others not (or the opposite) in order to demonstrate that everyone has abilities and disabilities too; with cooperation everyone can succeed"* (L8-166/IV1)

Phase V: Agreement statements (s)/applications of new constructed meaning

> *"Eventually, the first lessons, during which children are testing their limits, are extremely important. Direct and brief rules, knowledge about their family situation, reinforcement of their positives, being close to make them feel important, along with parental positive involvement -if they are willing and available- are the best practices"* (L8-158/V1)

The 97 messages that were identified as learners' social talks were further coded and assigned to Garrisons' et al. (1999) social presence categories (κ=0.82) (table 6).

Table 6. Learners' social presence (Garrison et al., 1999)

Category	**1. Emotional expression**	**2. Open communication**	**3. Group cohesion**
Percentage	34.02%	50.51%	15.46%
Code	**C1**	**C2**	**C3**
Messages	33	49	15

Most of the 97 social messages (50.51%) were coded in the "open communication" category, since learners' tended to communicate asking questions about technical issues, presenting themselves to their group-mates, and exchanging information about their personal preferences in their every-day life. 33 messages (34.02%) were coded in the "emotional expression" category, which indicates that PE felt relatively comfortable to express their feelings within the social network, and in some cases trying to encourage group collaboration or facilitating the cooperative activities (15.46%).

The following coded messages are presented as an example of PEs'social activity in the CSCL environment, and illustrate the three categories of social presence dimension, according to Garrisons' et al. (2000) coding scheme.

Category 1: Emotional expression

> *"Congratulations guys! Well done!"* (L6-314/C1)

Category 2: Open communication

> *"I will be out of town in order to participate to an athletic event. Sunday evening suits me better"* (L8-351/C2)

Category 3: Group cohesion

> *"Good evening to all of you! We should start working; otherwise it will not be ready till Monday!"* (L2-299/C2)

4. Conclusion

This study indicated that interaction patterns between the members of this network were rather centralized, and its density was relatively satisfactory. Although some of the learners were more actively engaged, most of them were somehow involved within the discourse. Many strong links between the members were found, but there were also a considerably amount of weak links between the less active. Still, person to person communication was rather high. These findings might be attributed to the formed

subgroups within the network, since learners tended to share information mainly with their mates, rather than participate in the discussion topics with the overall networks' members.

The content of the discourse was mainly focused on sharing and comparing information, mainly leading to the negotiation or construction of knowledge through identifying areas of agreement or making new proposals. Only few instances of dissonance or inconsistency took place during the discussion topics. Similarly, testing and application of learners' new ideas were reflected mainly through their team projects, thus only a few messages were categorized to the high order thinking skills phases (phase IV and phase V).

There was a considerable amount of learners' social messages, so a significant degree of their social presence was established, which indicates that socio-emotional interaction and support between PE were important and sometimes essential in realizing meaningful and worthwhile educational outcomes. The ability of participants to project themselves socially and emotionally, as "real" people, through the blog environment, in the present study seemed to be crucial in establishing a critical community of learners.

These analyses have added to our understanding of in-service PE learning processes in CSCL environment within a blog learning environment. They show, for instance, how co-learners may operate quite differently and yet within discernible patterns, some being strong facilitators, while others offer little -and in one case no- support to their collaborators. But, there are clearly many steps to be taken in terms of differentiated patterns of cooperation and its relation to the co-construction of knowledge. It would be interesting to conduct further research concerning how strong and weak links in a learner's blog-network might affect the process of knowledge construction, when different cooperative strategies are applied. Finally, due to the limitations of the present study, further research is needed with a larger number of participants, during longer course duration.

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