The Relation Between the Three Dimensions of the Community of Inquiry and the Learning Styles of Students in a Distance Education Programme

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Abstract—The aim of this work is to investigate the relation between the dimensions of the Community of Inquiry (COI) model, i.e. teaching, social and cognitive presence, and the students' learning styles according to the model of Felder and Silverman, 1988 [1]. A quantitative research was carried out involving 125 postgraduate students of the Hellenic Open University. The teaching presence was observed at a higher degree; in terms of the students' learning styles the most prevalent were the sensing, visual and active styles. There was a significant positive correlation between the teaching and the cognitive presence as well as between the social and the cognitive presence. Finally, with regard to the correlation between the dimensions of the COI framework and the learning styles, the most significant correlations were observed between (a) the cognitive presence and the understanding of information and (b) the cognitive presence and the full set of learning styles.

1　　Introduction

In recent years, an increased research interest has been developed for theoretical and practical frameworks in order to ensure the effectiveness of learning in distance education programmes using the Information and Communication Technologies. Among these, the Community of Inquiry (COI) framework [2] stands out. The COI framework is a dynamic model, based on constructivist learning processes, in which the members of the community are active creators of their knowledge. Learners consider that learning arises through reflection and critical dialogue and they have common goals and a strong commitment to them [3].

Furthermore, the effective planning and development of distance education programmes depends on a combination of parameters, one of them being the satisfaction of the students' particular learning needs. To this end, many researchers have focused on students' learning styles. The learning style is a multidimensional concept, which determines the ways in which a person learns more effectively. Each person understands the learning process in a different way and adopts a different style to process new information. Moreover, adult students constitute a special category in the way they learn [4]. They have already a wide range of experiences, values and knowledge and they start training with specific goals and preferred ways of learning.

In order to support adult students to learn effectively, their special educational needs should be taken into account, as the personal learning style of each student influences the educational outcome [5].

Taking into account the important role of the learning styles and the insight that the COI framework offers to the learning process in distance education, the current study focuses in the examination of the three dimensions of the COI framework and of the learning styles of students. Furthermore, it aims to explore the relation of these two parameters and to provide insight on how to better design the learning process to fit the learning needs of all students.

2 Theoretical background

2.1 The Community of Inquiry framework

The COI framework is a model that tries to define the specifications of a deep and meaningful learning experience. It is determined by three basic interrelated and overlapping elements/dimensions: the teaching, the social and the cognitive presence. According to many surveys, these three dimensions are interdependent and complementary; they are also necessary to make the COI framework work effectively [6, 7]. The function of the COI model is illustrated in the Figure 1.
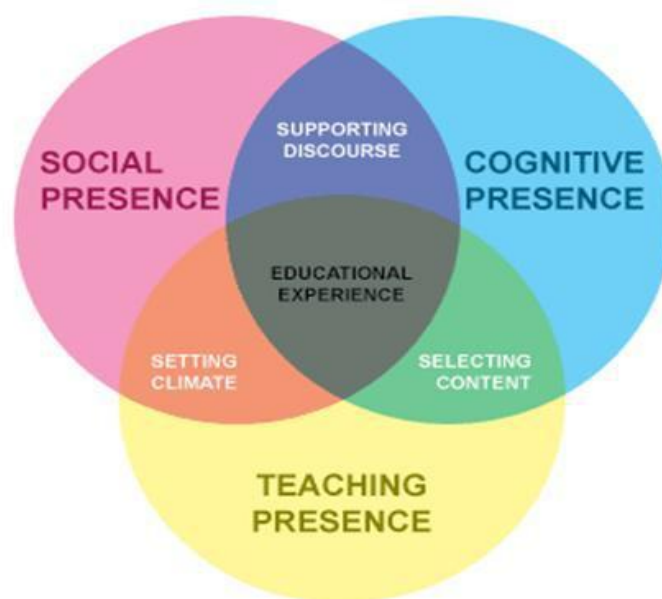

Fig. 1. The community of Inquiry model [2]

The categories and the indicators for each of the dimensions that form the context of the COI framework are presented in detail in Table 1.

Table 1. Categories and indicators of the COI dimensions [2]

Presence	Categories	Indicators
Cognitive presence	Triggering events Exploration Integration Resolution	Sense of puzzlement Information exchange Connecting ideas Apply new ideas
Teaching presence	Design and organization Facilitating discourse Direct instruction	Setting curriculum and methods Sharing personal meaning Focusing discussion
Social presence	Affective Open communication Group cohesion	Expressing emotions Risk-free expression Encouraging collaboration

Teaching presence refers to the actions of the teacher concerning the design and organization of the learning process. The facilitation of the discussion among students can form the appropriate conditions for effective collaboration and critical investigation. With the right actions the teacher is able to link the social and the cognitive presence to a functional and balanced relationship to facilitate a meaningful learning outcome [8, 9].

Social presence describes the extent to which students feel socially and emotionally connected to others. It creates conditions for a free exchange of views and for a qualitative interaction among members of the community, offering the sense of belonging. In distance learning, where students are physically distant from each other and from their tutor, social presence is particularly important since it reduces negative emotions such as insecurity, isolation and discouragement [10, 11].

Cognitive presence describes the extent to which students are able to build and confirm a concept through continuous reflection and dialogue. It is a process of constructing knowledge based on collaboration, communication and the creation of personal meaning. It is a holistic process of four phases: the event, the exploration, the integration and the resolution [12].

2.2 The learning styles model of Felder and Silverman

There are several models on learning styles presented in the literature. The present study uses the Felder & Silverman [1] learning styles model, because of its popularity and its high applicability in distance learning. According to this model, persons learn in many different ways. Some prefer to learn facts, while others prefer to discover odds and relationships. Some people understand more effectively by following linear steps, while others function more globally, receiving different information together. Some tend to actively keep and process information by discussing, while others prefer to process it individually through introspection. Finally, some people prefer the visual presentation of information, while others prefer the oral [13].

According to the above, Felder & Silverman [1] proposed a four domain model, which covers the preferences of each student in relation to the learning aspects and which explains how information is received, how it is perceived, how it is processed and how it is understood.

The first dimension concerns the introduction of information (input) and is divided into visual and verbal learning types of students. Visual students have a better ability to remember pictures, while verbal students prefer getting information through written and spoken language. The dimension of perception relates to the way students tend to take up information; it is divided into sensory and instinctive learning types of students. The sensory students work slowly and notice even the smallest detail. They work based on events and they solve problems by following predefined procedures. Unlike the sensory, intuitive students prefer variety and complexity. They avoid details and they work fast and not very carefully. The dimension of information processing relates to the way information is analyzed; it is divided into the active and stochastic learning types of students. Active students prefer teaching methods such as discussion, practical application and problem solving, whereas stochastic students prefer passive methods such as lecturing. Finally, the dimension of understanding is divided into the successive and global learning types of students. Successive students understand information step by step, as they follow a serial course of learning with specific stages, which they can explain at any time. Instead, global students perceive new information in a holistic way. They solve problems in a random way, but they are not always able to explain how they did it [1]. Table 2 presents the four dimensions of the Felder & Silverman learning styles model.

Table 2. Dimensions of the Felder & Silverman learning styles model

Types of students Dimension	
Visual (seeing)/Verbal (listening, reading)	Input
Sensing (facts, processes) /Instinctive (concepts, relationships)	Perception
Active (doing) / Reflective (thinking)	Processing
Sequential (step-wise) /Global (leaps, random)	Understanding

Each dimension of the Felder & Silverman model includes learning styles with different possibilities and weaknesses, as each person approaches the learning process in a different way. No learning style is superior to another. People use several learning styles, but they tend to favor one over the others [14]. The understanding of different learning styles can help teachers in the design of instruction and in the adjustment of the learning process [15, 16].

3 Research Questions

The relation between the three dimensions of the COI framework and the learning styles of students has not been adequately investigated. Since these two parameters are very important for the effectiveness of distance education programmes, the aim of this work is to investigate how students of the Hellenic Open University (HOU)

perceive the three dimensions of the COI framework (teaching, social and cognitive presence) and whether there is a relation between these dimensions and the students' learning styles.

Based on the above, the research questions are defined as follows:

- How do the students perceive the three dimensions of the COI model?
- Which learning styles prevail between the students?
- What is the relation between each of the three dimensions of the COI model and the learning styles of the students?

The above research questions were examined within the context of the HOU, which is the unique Hellenic University offering exclusively distance learning courses to students throughout Greece, as well as abroad since 1998. More detailed information about the studies in HOU can be found in Angelaki and Mavroidis [17]. Currently, the use of online tools has been increasing in the HOU, including a web-based instructional environment / portal, where there is a dedicated website for each course module. The portal simplifies organizational and instructional procedures and provides forums for asynchronous tutor-student as well as student-student interaction.

4 Method

The present research was conducted in February 2017, within the HOU and involved 125 postgraduate students of the Postgraduate Course on "Education". A quantitative research was carried out. For this purpose, the tools created by Swan, Shea, Richardson, Ice, Garrison, Cleveland-Innes, & Arbaugh [18] on the three dimensions of the COI framework and by Felder & Soloman [19] on the learning styles were used. These are two tools with a high level of internal consistency and reliability. Both data collection tools have been translated and adjusted in the Greek language in order to serve the purpose of the study.

To this end, and to ensure the validity of the survey tool, a pilot test was carried out before the dissemination of the questionnaire to the students. This involved 5 students of the Postgraduate Course on "Education", who were not included in the final sample. Particular emphasis was placed on the tool's proper configuration and the availability of sufficient questions for each variable. Thus, the final survey included 44 closed-ended questions, which were grouped into sub-sections and followed a logical sequence in order not to confuse the respondents. More specifically, 11 items were related to the teaching presence perception, 9 items to the social presence perception, 7 items to the cognitive presence perception, while 17 items were related to the participants' preferred learning styles.

Questions corresponded to a 4-point Likert scale. Their completion was anonymous, and each participant had the right to respond only once. The questionnaire was distributed online, through purposive sampling. The online distribution prevented a potential influence from the researcher and allowed students from different geographical areas of the country to be included in the sample of the

research. Carrying out the quantitative research has allowed the researcher to remain impartial, ensuring to a high degree the objectivity and impartiality of the results.

5 Data Analysis

The analysis of results of this quantitative research was conducted using the statistical software SPSS Statistics 23. Descriptive statistics, such as standard deviation and mean score, were used to summarize the sets of information and to show the extent to which the survey participants perceive, in the particular learning environment, the existence of the dimensions of the COI framework and their preferable learning styles. Also, the non-parametric Spearman statistical index was used to investigate the correlation between the dimensions of the COI framework and the students' learning styles.

For this reason, the variables defined were the three dimensions of the COI framework (teaching, social and cognitive presence) and the four dimensions of the Felder & Silverman learning styles model (input, perception, processing, understanding). A database was created, which included the responses of the 125 respondents to the 44 questionnaire questions, as well as eight additional fields, showing the averages of the answers of each student in the individual categories of questions. The highest possible average was the value of 4, which represented the response "very much".

6 Results

6.1 Reliability

The reliability of the scales was estimated using Cronbach's alpha coefficient of internal consistency. Considering that Cronbach's alpha coefficient should be above 0.70 for a measurement value to be acceptable [20, 21] all the variables presented high reliability and therefore the data can provide consistent results. The values of Cronbach's alpha for each parameter were: (a) teaching presence Cronbach's a = 0.92, (b) social presence Cronbach's a = 0.90, (c) cognitive presence Cronbach's a = 0.83 and (d) learning styles Cronbach's a = 0.71.

6.2 Dimensions of the COI framework and learning styles

The mean (M) observed for the teaching presence in the four-point scale was 2.881 (Standard Deviation (SD) = .7437), which shows that students were sufficiently satisfied with the teachers' actions. Regarding the cognitive presence, the mean was 2.673 (SD= .7040), while the lowest score was observed social presence (M=2.079, SD= .7775).

Regarding the learning styles, the overall score was 2.891 (SD= .7306). More specifically, regarding the introduction of information, it was found that students

accept easier written information (M=2.962, SD= .3988). As to the perception of information it was found that students prefer the sensory way to solve new problems (M=2.576, SD= .4595). Regarding the processing of information, the majority of students seemed to prefer active learning styles (M=3.105, SD= .3205) and in relation to the understanding of information, it was found that the successive learning style is more preferred than the global one (M=3.044, SD= .0409).

Overall, table 3 shows that the students' perception of the COI dimensions and learning styles were above average. In particular, concerning the learning styles, the dimensions related to information input, processing and understanding, presented the highest score, while in relation to the dimensions of the COI framework, the perception of social presence had the lowest score.

Table 3. Mean values and Std. Deviation of variables

Dimension	Mean value	Std. Deviation	N
Teaching presence	2.881	.7437	125
Social presence	2.079	.7775	125
Cognitive presence	2.673	.7040	125
Learning styles-overall	2.891	.7306	125
Input	2.962	.3988	125
Perception	2.576	.4595	125
Processing	3.105	.3205	125
Understanding	3.044	.0409	125

6.3 Correlations between the COI framework dimensions

The results showed an average positive and statistically significant correlation between the teaching and cognitive presence (Spearman's rho= 0.454, Sig. 2-tailed= 0.000<0.01) and between social and cognitive presence (Spearman's rho= 0.386, Sig. 2-tailed= .000<0.01). In addition, there was a statistically significant, weak, positive correlation (Spearman's rho= 0.232, Sig. 2-tailed= 0.009<0.05) between teaching and social presence.

Table 4. Correlations between the COI framework dimensions

		Teaching Presence	Social Presence	Cognitive Presence
Teaching presence	Spearman Correlation	1	.232[*]	.454[**]
	Sig. (2-tailed)		.009	.000
	N	125	125	125
Social presence	Spearman Correlation	.232[*]	1	.386[**]
	Sig. (2-tailed)	.009		.000
	N	125	125	125
Cognitive presence	Spearman Correlation	.454[**]	.386[**]	1
	Sig. (2-tailed)	.000	.000	
	N	125	125	125

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

6.4 Correlations between the COI framework dimensions and the learning styles

Statistically significant correlations exist between teaching presence and the dimension related to information understanding (Spearman's rho= .280, Sig. 2-tailed = 0.002<0.05) as well as between social presence and the dimension related to information understanding (Spearman's rho= .258, Sig. 2-tailed= 0.004<0.05). This indicates that an increase in the perception of the teaching and social presence is accompanied with a moderate increase in the ability of understanding information.

In addition, there is a statistically significant, positive correlation between cognitive presence and the overall parameter of learning styles (Spearman's rho= .339, Sig. 2-tailed= 0.000<0.05) as well as between cognitive presence and the dimensions related (a) to information perception (Spearman's rho= .271, Sig. 2-tailed= 0.002<0.05), and (b) to information understanding (Spearman's rho= .316, Sig. 2-tailed =0.000<0.05), which indicates that an increase in the perception of the cognitive presence is accompanied by an increase in perceiving and understanding information which impacts overall learning.

Table 5. Correlations between the COI framework dimensions and the learning styles

		Overall Learning styles	Input	Perception	Processing	Understanding
Teaching presence	Spearman Correlation	.,204	.065	.110	.067	.280**
	Sig. (2-tailed)	.023	.472	.221	.460	.002
	N	125	125	125	125	125
Social presence	Spearman Correlation	.215**	.166	.106	.008	.258**
	Sig. (2-tailed)	.016	.064	.240	.929	.004
	N	125	125	125	125	125
Cognitive presence	Spearman Correlation	.339**	.101	.271**	.146	.316**
	Sig. (2-tailed)	.000	.264	.002	.105	.000
	N	125	125	125	125	125

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

7 Discussion

The results of the present study suggest, that students consider more positively the teaching presence, since they perceive as very important that the teacher designs the educational process in a way that helps them develop a productive dialogue with each other and discover new knowledge. It can be argued that the focused discussion, with their active involvement, and the adequate feedback provided helps them understand the module content and improve their strengths without losing valuable time [22]. Furthermore, the previous experience of students - which is almost entirely based on

traditional education methods - may influence them in adopting a more positive attitude towards the teaching dimension of the COI framework [23].

Regarding the dimension of cognitive presence, students were partly satisfied; the results suggested that, there are margins for further improvement both in the introductory and in the exploration phase. The integration phase is often more difficult to be successfully achieved than the initial two phases [24]. However, in the present study the students showed that they felt able enough to use the knowledge that they acquired and to apply it in other educational environments. It is worth noting that the success of the evolution of the cognitive presence also highlights the effectiveness of the teaching presence, which, as mentioned above, was perceived to be achieved to a satisfactory level [25].

In relation to the social presence, it was found, on the contrary, that it was not achieved to the same extent. In a distance education environment like the one examined here, it is difficult to develop the sense of belonging; however, the feeling of a secure environment can strengthen personal relationships and provide significant benefits to the students' group [26]. This is enhanced by the lack of experience of the students in working in such an environment. Therefore, there is an increased need to develop a sense of familiarity and security which can strengthen interpersonal relations and provide increased benefits in the team of learners [3].

The complementary and mediatory relation that the three dimensions of the COI framework have between them makes clear the necessary coexistence of all three dimensions in developing an effective learning community. The literature makes reference to the complementary relationship of teaching and cognitive presence; as far as the present research is concerned, the results suggest that there is indeed a strong correlation between them. The effective implementation of the teaching presence is able to create a suitable ground for the development of the cognitive presence [27, 28]. In this study, the effectiveness of the teaching presence was adequately supportive. In addition, it is noted in the literature that social presence has a mediating role in the development of cognitive presence: social presence can greatly influence learning outcomes as it can strengthen the emotional interaction [29]. This is also indicated in the present study, through the positive correlation between the social and the cognitive presence. Finally, there was a moderate positive correlation between the teaching and the social presence; the role of the teacher in increasing social presence seems to be positive, but not decisive [2].

In relation to the learning styles, the results of the present study revealed that the prevailing learning styles were the sensory, the visual, the active and the successive. Still, a large percentage of participants seemed to prefer stochastic, verbal and global learning styles. What seems to be less preferred is the instinctive style. These findings are in agreement with findings from similar studies, [30, 31, 32, 33] in which the most preferred learning styles were successive, visual, active and sensory. The majority of students seem to prefer the virtual and serial presentation of specific information and their active involvement in the process of learning. However, students tend to shape their learning preferences continuously, so the alternate application of different teaching methods could offer a more complete result, covering the individual needs of each student separately [34, 35].

Concerning the correlations between the dimensions of the COI framework and the learning styles, the most important were observed between the cognitive presence and the overall parameter of learning styles as well as between the cognitive presence and the understanding of information. This seems reasonable, as cognitive presence is the process of constructing knowledge by connecting new and already existing information and is directly related to the ways that students choose to reach and understand new information and therefore to the process of learning. As Fahy and Ally [36] have noted, even in an educational environment where all parameters have been adequately considered, it is expected that there will exist individual, different ways of learning and different types of educational interactions. The above findings support the importance of the role of the COI framework and of the learning styles of students for improving the effectiveness of the learning process [34, 37]. The development of a framework within which the three dimensions of the COI model will be developed in a way that each learner would be supported individually, taking into account all the above parameters, will further increase the effectiveness of the learning process.

8   Conclusion

The purpose of this study was to investigate, in the context of the Hellenic Open University, the three dimensions of the COI framework and the students' learning styles, and especially to examine whether a relationship exists between these parameters. As regards the way that students perceive the three dimensions of the COI framework, it was found that teaching presence was achieved at a higher level than social and cognitive presence. This is possibly attributed to the adequate design of the lectures as well as to the long-lasting existing experience of students on traditional education methods, and therefore, on the way students have learnt to perceive the educational processes. It also indicates that further efforts should be resumed to increase the development of the cognitive process and to create a feeling of community and belonging.

Concerning the correlation between the three dimensions of the COI framework, quite strong, statistically significant, positive correlation has been observed between teaching and cognitive presence as well as between social and cognitive presence, highlighting the pivotal role of students constructing knowledge based on collaboration, communication and the creation of personal meaning.

The most prevalent learning styles were the sensory, the visual, the energetic and the sequential, while the learning style that seemed to be less preferred was the instinctive. Students with not much experience in distance education and in organizing their own learning processes do not appear to prefer variety and complexity; they are more inclined to work following predefined procedures.

Regarding the correlation between the three dimensions of the COI framework and the learning styles of students, significant relationships were found between the cognitive presence and the overall parameter of learning styles, as well as between the cognitive presence and the understanding of information. Cognitive presence is

closely linked to the process of learning and to the learning styles, since through the cognitive dimension students are constructing knowledge based on collaboration, communication and the creation of personal meaning. The cognitive presence is also most relevant to the last, crucial, step of Felder & Silverman's model, which is related to how students understand new information.

It is clear, therefore, that understanding the links between the dimensions of the COI framework and the learning styles of students can support and increase the efficiency and effectiveness of the learning process, in the context of distance education. The present study constitutes a first step in the investigation of the relationship between these two concepts/frameworks. It was conducted in the framework of HOU, a fact that poses limitations in the generalization of the findings regarding other distance learning environments. Furthermore, the present study focused on a limited number of postgraduate students selected via purposive sampling in a course on "Education". The conduct of a survey in a larger, more diverse sample, including students from different schools/disciplines, as well as postgraduate and undergraduate students, would increase the validity of results. Finally, the conduct of the survey by using additional methods and tools, combining quantitative and qualitative methods, could provide further insight in the learning process, contributing further to the effectiveness of distance learning programmes.

9   References

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