A School-Teacher's Learning Community: matters of communication analysis

Giorgos Hlapanis[1] and Angelique Dimitrakopoulou[2]

Abstract

This paper presents findings regarding a *'School-Teacher's Learning Community'* that was created around a Distance Learning Educational program. This *Community* could be described as a collaborative environment within which in-service school teachers from Greece participated. Significant learning results could be derived in an informal manner through the interaction of the Community members within a collaborative context; yet, members could also participate as *Students* in a number of different electronically supported courses that were implemented in a formal manner. The basic goal of the project was to boost the educational use of Information and Communication Technologies in school. The creation and evolution of the *Community of Learners* is presented in the case study through the analysis of several factors, such as communication parameters and the involved 'e-moderation'. Special tools were created and used so as to detect 'Social Network Analysis' parameters such as 'network density' and 'centralization'. Especially the qualitative analysis of 'communication graphs' produced some interesting results concerning the deciphering of the different stages the Community passes through, during its evolution.

Keywords: Creation of Learner Community; E-moderation; Phases of Community Evolution

Introduction

This paper refers to the so-called *'School-Teacher's Learning Community'* (STLC) which was created around a Distance Learning Educational program. The program was implemented at the University of the Aegean in Greece. *STLC* could be described as a collaborative environment within which in-service teachers from the Dodecanese Islands participated. This program was designed in such a way that positive learning results could be derived in an informal manner through the interaction of the community members within a collaborative context. Yet, community members could also participate as students in a number of different electronically supported courses that were implemented in a formal manner, in parallel to and at the same time with the *learning* community functioning.

The ultimate goal of the learning project was the improvement of the educational use of Information and Communication Technologies (ICT) by those who participated, by using formal as well as informal ways of learning. Moreover, during the learning project, a research study took place. Research questions examined in this study that are related to *learning community* issues are looked into in this paper.

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[1]   Corresponding author. LTEE Laboratory, University of the Aegean, hlapanis@aegean.gr
[2]   LTEE Laboratory, University of the Aegean, adimitr@rhodes.aegean.gr

Many researchers have shown concern about *Learning Communities* or *Communities of Practice* (McMillan & Chavis 1986, Lave & Wenger 1990, Wenger 1998, Palloff & Pratt 1999, Murphy, Mahoney & Harvell 2000, Rovai 2000, Rogers 2000, Ferry, Kiggins, Hoban & Lockyer 2000, Bradshaw, Powell & Terrell 2002, Barab & Schatz 2001, Barab, Baek, Schatz, Moore, Sluder & Scheckler 2002, Barrett 2003, Gaskell & Riding 2003, Tisdell, Strohschen, Carver, Corrigan, Nash, Nelson, Royer, Strom-Mackey, & O'Connor 2004, etc.), but although definitions of such communities, even rules and guidelines concerning their appropriate functioning have been given, it is not quite obvious when a *learning community* is actually created and in what way this could be noticed. This, along with which factors can influence a *learning community's* creation and evolution are dealt with in this paper. One widely accepted definition of an online *learning community* that is taken into account in this paper has been given by Barab et al. (2002) as: '*a persistent, sustained socio-technical network of individuals who share and develop an overlapping knowledgebase, set of beliefs, values, history and experiences focused on a common practice and/or mutual enterprise*'.

Other research questions that have been partially dealt with are '*How can communication parameters be used for the analysis of such complex systems?*' (Tanner & Jones 2000, Riding 2001, Guimera, Danon, Diaz-Guilera, Giralt & Arenas 2002, McDonald 2002, Tyler, Wilkinson & Huberman 2003, McArthur & Bruza 2003, Groth 2003, McDonald 2003, DePaula 2003, Reffay & Chanier 2003) and '*Does the presentation of communication analysis results influence the way Community members participate?*' (Wertsch 1979, Martýnez, Dimitriadis, Tardajos, Velloso & Villacorta 2003, Nurmela, Palonen, Lehtinen & Hakkarainen 2003, Taurisson & Tchounikine 2004). These two issues as well as matters related to e-moderation policy applied in *Learning Communities* (Barab et al. 2002, MaKinster et al. 2001, Vlachopoulos & McAleese 2004, Friel 2000, Rogers 2000, Vonderwell 2003), were also explored during the study and are presented in this paper.

The distance learning educational program is presented at first in the paper, along with elements of the case study that took place during the program implementation. The importance of Activity Theory during the analysis is mentioned and the basic *Activity of the Creation of the Community of Learners* is also presented. Research questions, analysis methods, communication parameters and other useful data and metadata such as the communication graphs that were used in the analysis are described. Moreover several analysis results are presented in this paper, mostly those related to the way and the moment a community of learners is created, as well as results related to ways of deciphering the different phases a learner community passes through. The paper also focuses on special tools that were designed for the self-regulation of the community members' behavior; the importance, the effectiveness as well as problems related to these tools that were identified during the analysis is presented.

The distance learning educational program and the case study

The distance educational program was designed in such a way that significant learning results could be derived in an informal manner through the interaction of several *community* members within a collaborative context. A total of 85 members constituted the community. Fifty nine in-service teachers, working in a dispersed area (different islands) of the Aegean Sea in Greece participated in the program as members of the learning community. At the same time these members could participate as *Students* in a number of different electronically supported courses that were conducted in a formal manner. The content concentrated on aspects mainly concerning the use of ICT in teaching practices. The *Students* were allowed to participate in several different courses, up to 5. There were eighteen different electronically supported courses that were moderated by twenty three *Instructors*, who were also considered members of the learning community and could participate in every community activity. Finally, the overall learning community was moderated and supervised by two e-moderators.

In order to create and sustain the learning community, independently of the specific courses, the following principles were applied: (a) an hybrid virtual and face to face mode was implemented, (b) *Students* were constantly encouraged to be involved in different groups and shift their participation from small groups (e.g. groups working on a specific learning activity) to wider groups (the members of a specific course) or sub-communities (e.g. all Mathematics' teachers), or to the whole community (all the members of STLC), (c) Fellow members were encouraged in assisting new coming members (in technical matters or even in more 'theoretical ones', (d) Discussions concerning the whole community (and sub-communities) where permanently sustained by the e-moderators, so as to continuously support the sense of the community. All members of the community were needed to work for the support of the learning community while at the same time they had to work independently for the specific courses they participated in. (e) Each *Instructor* was involved in the permanent effort to create a cooperative and collaborative work mode, etc.

During the implementation of the distance learning educational program, a case study research took place. Activity Theory was used in order to break down the complex learning system into several different *Activities* and *Actions* and finally thoroughly analyze it.

Human *"Activity",* according to "Activity Theory" (Leont'ev 1974, Engestrom 1987, Nardi 1996, Kuutti 1996), constituted the basic unit of analysis. An important issue that was taken into consideration was the '*studying of all the different human activities that constitute a learning community*'; a learning community such as the one of the case study. Two basic "*Activities*" that were studied in detail were the "*Organising of a teacher education program*" (Hlapanis & Dimitrakopoulou 2006)*,* as well as the *Activity* of "*Creation and sustenance of the community of learners"*. This paper mostly focuses on research results related to this latter basic *Activity*.

The Activity of Creation of the Learners' Community

In the Figure 1, basic elements of the Activity of the "*Creation of the community of learners*", and their correlations according to Activity Theory (Engestrom 1987, Kuutti 1996*,* Hlapanis & Dimitrakopoulou 2004), are presented. Each human Activity is inspired by certain motives. The basic Motive for the existence of the specific Activity was the creation of an alternative and effective environment for in-service training and further education of school teachers. The desired outcome of the Activity was the change of belief, practice and behaviour of the participants in the community, relatively to the use of ICT, as a result derived by their participation and the acquired experience. Ultimately, a most desired outcome would be the change of practices applied in school.

The *Subjects* of the *Activity* were the participants and community members, i.e. the *Students*, the *Instructors* and the e-moderators. As previously mentioned fifty nine (59) in-service teachers participated in the program as members of the learning community and at the same time they were *Students* in a number of different electronically supported courses that were conducted in a formal manner. The eighteen (18) different electronically supported courses were moderated by the twenty three (23) Instructors, who were also considered members of the learning community. Finally, the overall learning community was moderated and supervised by the two (2) e-moderators. This different role of each subject describes the Division of Labor for the overall Activity.

The *Community* during this *Activity* consists of the *subjects* (*Students*, *Instructors* and *E-moderators*), as well as people concerned about the outcome or affected by it, such as pupils from the schools of the participants, other fellow teachers and the broader educational community.

The *Object* of the *Activity* of *Creation of the learners' community* is related to the creation of the appropriate environment for collaboration among the participants, as well as the successful materialization of electronically supported lessons. For each *subject* participating in this *Activity* the *Object* had variations, for

example for the E-moderators it was related to the creation and moreover for the sustenance of the community, for the *Instructors* the *Object* was more related to the materialization of the goals of their course through the participation in the overall *community of learners* and for the *Students* it was related to specific benefits derived from their participation in such a community and the collaboration and support provided by fellow members.
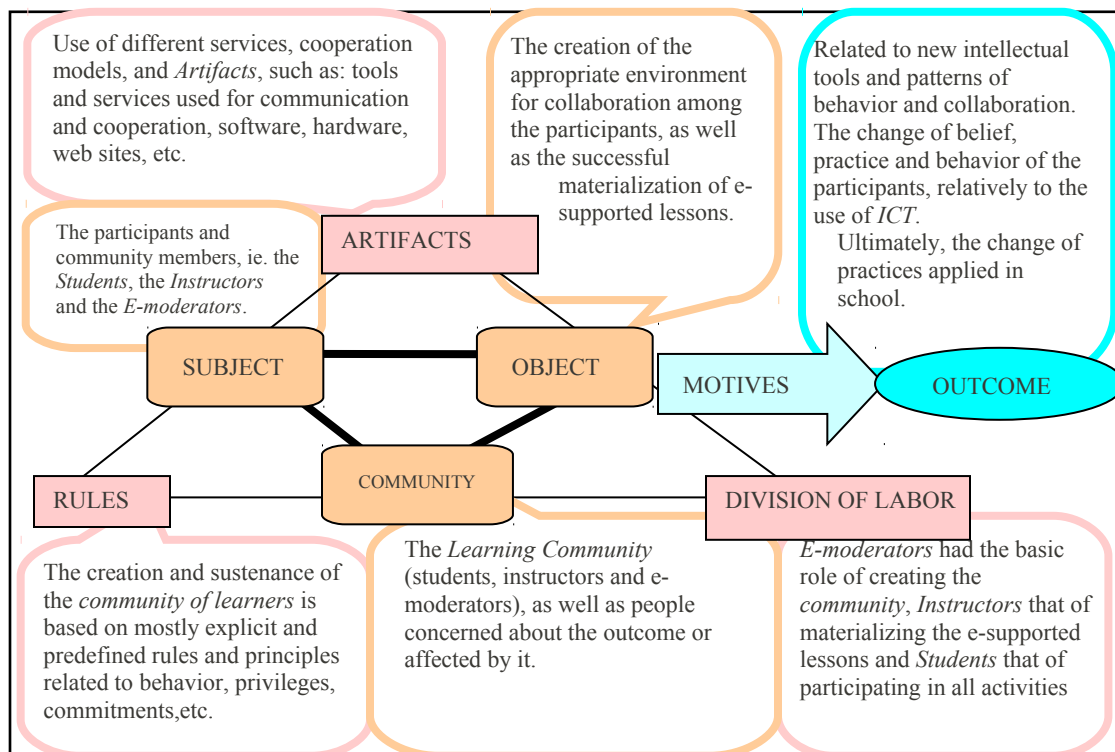

Figure 1. Basic elements of the Activity of Creation of the *Community of Learners*, according to Activity Theory
(Engestrom 1987, Hlapanis 2006, Hlapanis & Dimitrakopoulou 2004)

In order to implement the specific *Activity*, the creation and use of several *Artifacts* was needed. Such *Artifacts* were different tools and services used for communication and cooperation, software, hardware, web sites, etc. Even models outlining ways of collaboration and of course conduction could also be considered as *Artifacts*.

According to Wenger (1998), in order to create a *community*, rules that determine the way participants interact are needed. Such methods and rules of interaction that should be applied to the *learning community* are the responsibility of *e-moderators*. These mostly explicit and predefined *Rules* and principles related to behavior, privileges, commitments and ways of doing for all participants can be considered the last, but not least, element of the creation and sustenance of the *community of learners*.

Research questions and analysis methods

As previously mentioned, an important issue that was taken into consideration during the case study was the 'studying of all the different human activities that constitute the learning community in STLC'. This paper mostly focuses on research results related to the basic *Activity* of "*Creation and sustenance of the community of learners"* and therefore the basic research question dealt with is that of the creation and evolution of a learning community ('*when is a learning community created and how does it evolve*?'). Within this paper, tools and methods of analysis appropriate for the studying of learning communities are presented.

Interpretations were based on quantitative as well as qualitative data. Mixed methods of analysis were also used in the evaluation, because they provided flexibility and increased reliability by triangulation of results obtained from the different sources of data (Hlapanis & Dimitrakopoulou 2006).

(I) First of all, during the analysis, data were derived from:
  (a) **Communication services** such as: e-mail, forum, chat, system log files, actions in the platform that were recorded (for example reading existing documents or inserting new documents).

  (b) **Questionnaires and interviews.** Questionnaires were being answered by all participants in the *learning community* (*Instructors* and *Students*), mostly via the completion of web-based forms or by sending email messages. Semi-structured interviews were conducted during different phases of the program implementation, involving both *Instructors* and *Students* and were audio-taped. The interviews typically lasted 40 to 60 minutes. Quantitative-statistics analysis was based on data derived from questionnaires that were completed by the *Subjects*; qualitative analysis of the interviews of participants was also performed.

(II) Moreover, during the case study the process of the creation and evolution of the *community of learners* in *STLC* was depicted through the analysis of several key factors, such as the involved *e-moderation* and certain communication parameters of the *community*.
  (c) **The e-moderation of a learning community** As previously mentioned, e-moderators are responsible for the determination and application of rules that determine the way participants interact and govern the learning community. Moreover e-moderation can also include management, direction and facilitation of the community members. According to Garrison & Anderson (2003), e-moderators are considered: "…teachers who design, facilitate and direct the cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes." According to Vlachopoulos & McAleese (2004), two distinct approaches for e-moderation are defined: Low or non directive moderation style, when instructors intervene with students in order to help them 'reflect' while progressing their discussions and High or directive moderation style, when instructors intervene in both the process of the on-line course and the in the content as well. The analysis of the applied e-moderation in *STLC* was mostly qualitative and was proved useful when mixed methods of analysis were also used. During the analysis the impact of e-moderation to the overall *Community* communication was examined, as explained later on.
  (d) **Communication *graphs*.** In addition to typical quantitative and qualitative data sources, interpretations were triangulated using measurements concerning each member's participation and the overall community communication structure. Data relevant to these measurements were derived by using Social Network Analysis (SNA) methods (Nurmela et al. 2003, Martinez et al. 2003, etc.); communication parameters such as network "*density*" and "*centralization*" were calculated and *"communication graphs"* presenting the communication morphology were produced and analyzed (Hlapanis 2006). These mixed methods of analysis that were used, provided flexibility and increased reliability. The communication parameters and especially the graphs could be considered as metadata representing the evolution of the community. In STLC these metadata primarily served as tools for e-moderators and researchers in order to monitor the evolution of the community; moreover their use extended to community regulation, as a tool of awareness for the community members and selfregulation, as described later on in this paper. In order to create the communication graphs special calculations and software tools are needed. These calculations were done in STLC by the creation and use of special artifacts (software tools) that derived data from system files. These software tools produced dot

language files that when driven to Graphviz (www.graphviz.org) which finally produced the communication graphs. Such a communication graph appears in figure 2, presenting all email activity that was accomplished by members of STLC during the first week of the project functioning. In the graph the subjects (*Students*, *Instructors* and *e-moderators*) are presented as oval nodes, with a specific color indicating the division of labor (white for *Students*, blue for *Instructors* and green for *e-moderators*). Associations or joins between nodes indicate interaction/communication between the corresponding members of the community and moreover the distance between two nodes indicated the degree of interaction/communication between them; thus, the closer two nodes are in the graph the greater the degree of communication between the corresponding community members, within the time period the graph represents.
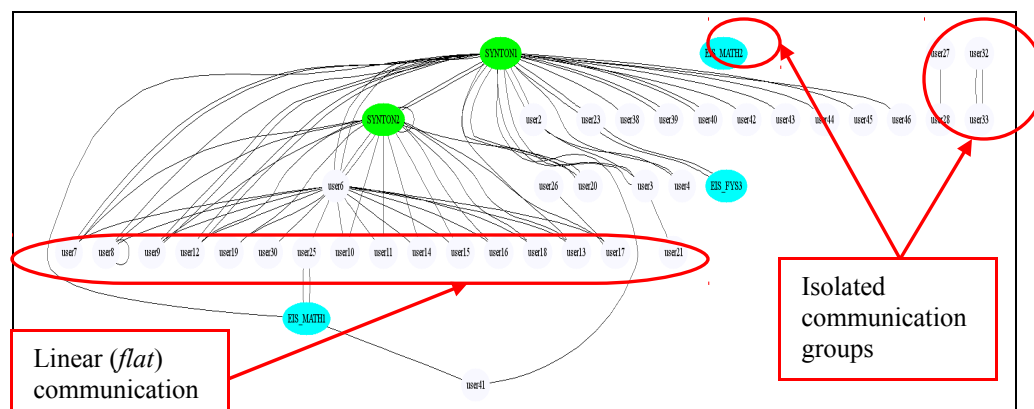

Figure 2 Email Communication *Graph* of the *Community of Learners* (1st week)

The Creation and Evolution of the community of learners in STLC

In this section, it is shown how some basic elements of the creation and evolution of the community of learners in STLC are detected through the analysis of the communication graphs, the examination of the impact of e-moderation in the community functioning and the statistical analysis about the members' *community* feeling. The second level use of the communication graphs and the activity reports as tools for community members' self-regulation is examined separately, later on in this paper due to its importance and its less direct connection to the learner community creation.

(a) The analysis of STLC communication graphs and elements for the Community Creation. In order to analyze the *Activity* of "*Creation and sustenance of the community of learners*", great emphasis was given to data derived from the use of email during community member communication. This was done due to the repeated use of email as a mean for implementation of e-moderation by the two e-moderators. Moreover in STLC, because of the way it was organized, email was considered the basic communication service that was frequently/regularly used by all (or most) members of the community, and thus reflected learning activity and interaction. In order to analyze the community evolution and determine the moment it would be created, communication parameter measurements were done every week. Therefore a different graph representing STLC communication was produced approximately every week, for nearly all 14 weeks of the community functioning.

In the previous figure (figure 2) the communication graph presented STLC member communication via email during the 1st week of the community functioning. In figure 3, another graph appears, presenting member

communication via email during the 6th week of STLC. During the analysis, by triangulating results, it was shown that this 6th week was an important milestone for the Activity of creation of the community of learners. By comparing the two representative samples of communication graphs, which are shown in figures 2 and 3 and are corresponding to the email communication of the 1st and 6th week of the community functioning respectively, several observations can be made, such as:

- In figure 3 communication among fellow members of the community can be described as more dense and more complicated (or less *flat*) than the communication of the overall community during the 1st week, as shown in figure 2.
- During the 6th week of the community functioning, many different communication cells or groups have been created, as shown by the red circles of figure 3. In figure 2, no such cells or groups can be identified.
- Although during the 6th week of the community functioning more members than the 1st week have become *active* (have started to communicate) and have entered the corresponding communication graph as new nodes (thus the number of nodes has increased in figure 3), no isolated groups of community members or nodes exist in figure 3. This is not the case in figure 2, were such isolated groups exist, although the total number of nodes in much less.
- The graph in figure 3 can be considered as a typical communication graph of a group of people that are members of a community, with frequent interaction and communication. This is justified by the existence of a large communication cell that embodies nearly all members of the community and by other research results. *STLC* participants already definitely shared common goals, practices and had a mutual enterprise. Through this analysis it was shown that they were also members of a *persistent, sustained socio-technical network of individuals* and therefore members of a community according to the previously mentioned definition (Barab et al. 2002).
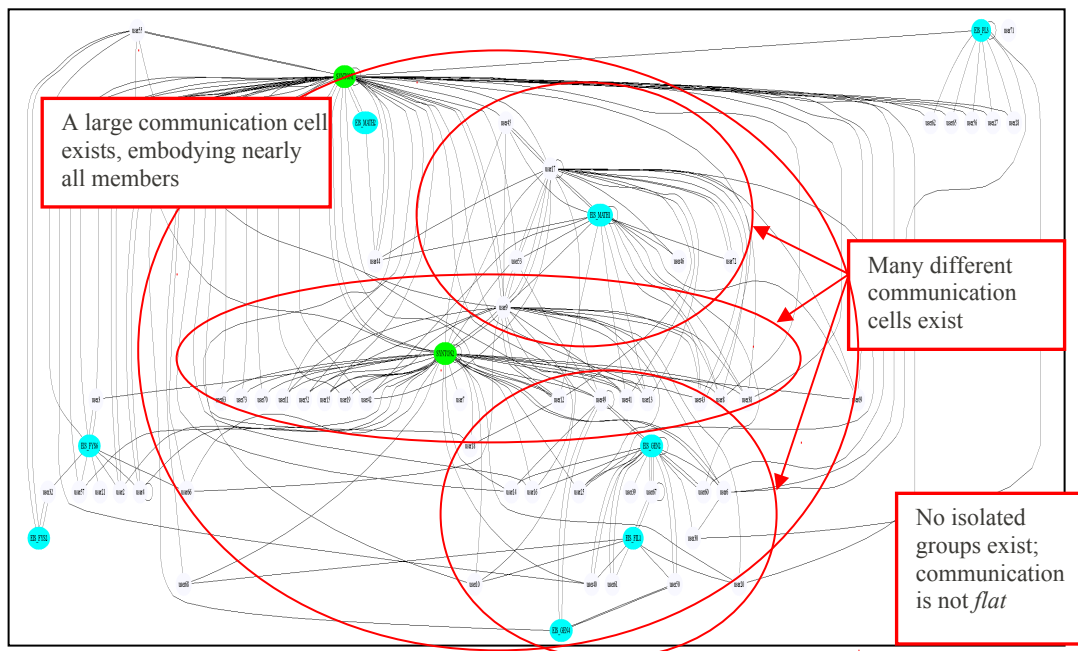

Figure 3 Email communication graph of the *community of learners* (6th week of STLC functioning)

By the previous analysis it can be concluded that a graph presenting the communication pattern of learners can be considered as one representing a typical community of learners, when:

  (a) Most members of the community participate.

(b) No isolated communication groups exist (or at least only a few).

(c) Communication is not flat, most members interact with many different fellow members and not just one (for example the e-moderator).

(d) Many different communication cells exist, representing interactivity and even better, a large communication cell should embody all (or nearly all) community members.

On the other hand, such a communication graph can be considered as one not representing a community of learners, when:

(a) Only few members participate.

(b) Many isolated groups or members exist.

(c) Communication is mostly flat, i.e. most members communicate with few (or just one) fellow members.

(d) Few or none at all communication cells exist.

Such conclusions derived by the analysis of communication graphs should of course be validated and confirmed by other research data as well, for example by examining the e-moderation that is applied in such a community and the members' opinion (feeling/sense) about the community's existence.

(b) The impact of e-moderation in the Evolution of the community, and the integrated presentation of all communication elements in STLC. The methods and rules of interaction that should be applied in STLC was the e-moderators' responsibility, according to the previously mentioned division of labor. Moreover e-moderation in STLC included management, direction and facilitation of all members of the community, in order to achieve their goals. High and low e-moderation was used in turns in STLC because it was considered that the exclusive use of directive moderation style could bring on many long and analytical messages containing the moderator's and instructor's point of view and could generate inactivity among the students and therefore was avoided. Low e-moderation was used regularly, more often than high e-moderation, mostly as a mean of encouragement and facilitation. Non-directive moderation could make inactive students engage in conversations, participate, become more active. The Instructor could of course use directive moderation style in order to drive conversations towards the desired results, yet without intervening too much because that could turn students into passive participants and therefore passive learners which was not desired.

E-moderators, by using directive moderation style, mostly via email messages every week or so, produced reports concerning the overall functioning of the community and the definition of new goals to be achieved by the community members. High e-moderation was also used when new discussions were evoked by e-moderators, in order to boost community member interaction.

In *STLC* both styles of e-moderation were materialized through the use of communication artifacts. Such artifacts were mostly email messages due to their foolproof destination arrival and feedback for their reading. Other means of communication, such as bulletin boards, fora and chat sessions were also used by the e-moderators, yet in a more auxiliary manner. During the qualitative analysis of all e-moderation messages, the effect of each message in the overall communication of the community was looked into. In order to do so, an integrated presentation of all elements (artifacts) of communication was done, as shown in Figure 4. In an appropriate scale, the number of email messages per week (blue colored lines), the number of messages posted in the main community Forum (pink colored lines) and the degree of participation in the chat sessions (green colored lines) are all presented in the same figure. In this Figure 4 milestones represented by high and low e-moderation email messages are also identified (light blue colored and orange colored milestones respectively). A careful qualitative analysis of the e-moderation messages in parallel to the quantitative analysis of the elements of communication reveals some special email messages that had a great impact on the overall community communication. For example, the important high e-moderation message of day 51 is marked by a red circle in Figure 4. The impact on email communication of the community due to this message

was so great that it is by itself a milestone representing a different phase in the community's evolution. The difference in email communication measurements for the whole of the community that was caused by this particular email message is shown by the red crooked line in figure 4 and is quite obvious.
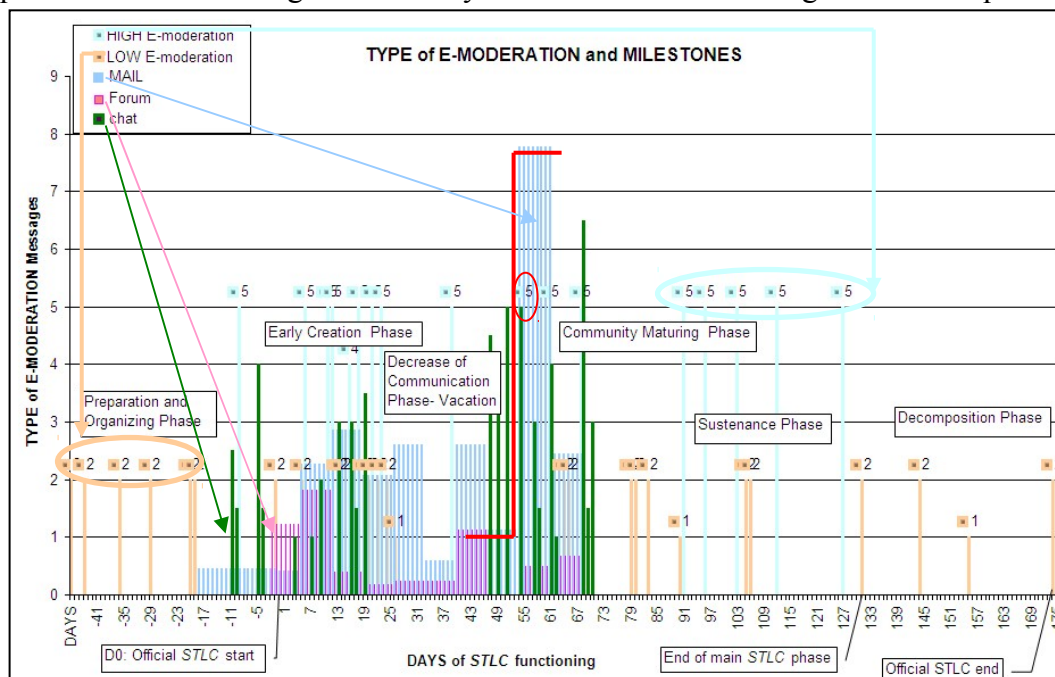

Figure 4 Integrated analysis of all elements of communication

The members' feeling about the sense of the community. During the research, the degree that the *Subjects* felt that they were part of a community of learners was examined through the statistical analysis of their answers to appropriate questions such as the following:

Question: Do you believe that the members of STLC behaved as members of a tightly tied group, as members of a Community of Learners with common goals and expectations? Possible answers (Likert scale) were:

  ☐ *Positively NOT (1): There was **no** indication whatsoever of STLC member behavior that resembled that of a Community of Learners with common goals and expectations.*
  ☐ *Probably NOT (2): STLC member behavior was **probably not** that of a Community of Learners with common goals and expectations.*
  ☐ *Maybe/Not sure (3): I am **not sure** about that, more 'research' should be done in order to answer.*
  ☐ *Probably YES (4): STLC member behavior was **probably** that of a Community of Learners with common goals and expectations (for many members and for a long time period).*
  ☐ *Positively YES (5): STLC member behavior was **positively** that of a Community of Learners with common goals and expectations (for all or at least most members and for the whole time period).*

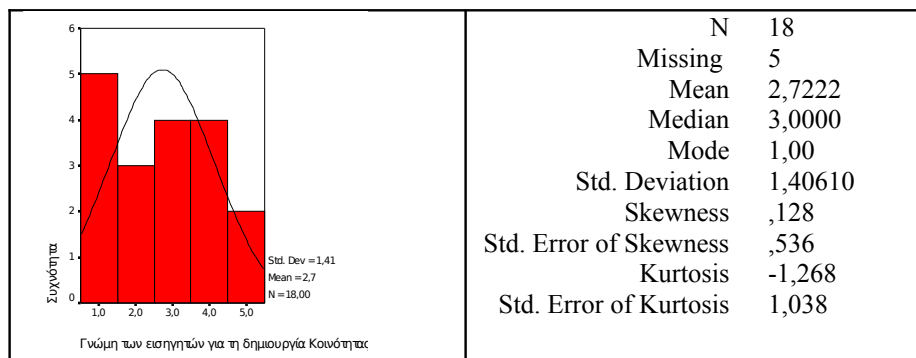|	
N	18
Missing	5
Mean	2,7222
Median	3,0000
Mode	1,00
Std. Deviation	1,40610
Skewness	,128
Std. Error of Skewness	,536
Kurtosis	-1,268
Std. Error of Kurtosis	1,038

Figure 5 Frequency graph presenting the answers of Instructors to the question: «*Do you believe that the members of STLC behaved as members of a tightly tied group, as members of a Community of Learners with common goals and expectations?* »

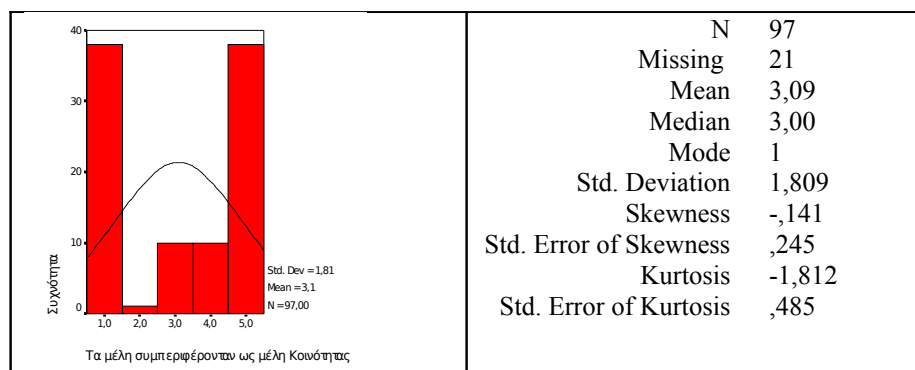| N	97
Missing	21
Mean	3,09
Median	3,00
Mode	1
Std. Deviation	1,809
Skewness	-,141
Std. Error of Skewness	,245
Kurtosis	-1,812
Std. Error of Kurtosis	,485

Figure 6 Frequency graph presenting the answers of Students to the question: «*Do you believe that the members of STLC behaved as members of a tightly tied group, as members of a Community of Learners with common goals and expectations?*»

The above question was answered by 18 *Instructors* and the results of their answers are shown in the above figure 5. The same question was answered by all 59 Students twice, once in the middle and once in the end of the program. Their answers are shown in the above figure 6. During the analysis, the *Students'* and *Instructors'* opinion about the degree of *community* creation/existence was a dependent variable; its association to other, independent variables, such as *E-moderator* or *Instructor* choices or registered objective data concerning the *Students*, was examined. The analysis results relative to this question confirmed certain conclusions derived by some of the mixed methods of analysis that were also used.

Quantitative analysis was also proved useful for the deciphering of the different evolution phases the *Community* in *STLC* passed through. Moreover, many important correlations related to the research questions examined during the case study, were detected. Some important such correlations are mentioned later on in the next paragraphs.

Analysis Results

I.) Creation of a community: A few important analysis results that are relevant to the *Activity of creation of the community of learners* are the following:

1. The moment of creation of the community of learners in STLC was detected through the analysis of the communication graphs, the examination of the impact of e-moderation in the community functioning and the statistical analysis about the members' *community* feeling. These tools of analysis and especially the communication graphs were proven useful for studying cases such as STLC.

2. In order to analyze the impact of the applied e-moderation policy in the evolution of the community of STLC, an integrated analysis of all elements of communication was used. The qualitative analysis of high e-moderation messages was paralleled to quantitative analysis results concerning many communication parameters and many useful conclusions were derived (such as the deciphering of different evolution stages of the community).

3. In STLC the degree of communication and interaction among community members proved to be crucial for the creation of the *learner community*. This is confirmed by correlations that were detected, such as the

following, which moreover validates the choice of email service for the studying of the community creation in STLC.

- The degree of use of email communication in a course by *Instructors* (as a choice made by the responsible for the course *Instructors* and an independent variable), was proven positively related (**Pearson's** $r = +0.742$, $df = 16$, $p=0.001 <0.01$) to the degree that the *Instructors*, were considered (because of their actions) by the *Students* attending the course, that they were trying to make the *Students* feel members of a *learner community* (as the *dependent* variable).

4. No significant relation was found between the *Students'* opinion about the degree of creation of the *learner community* and independent variables such as sex, age or other recorded personal characteristics. Therefore this indicates that *Students* were able to judge matters concerning the community creation without being affected by certain characteristics.

II.) Evolution of a community: The creation of a *community of learners*, like the one that was materialized in STLC, does not arise automatically, nor suddenly, but is rather a result of specific actions and efforts of the *Subjects*, *Students* and *Instructors* alike. In *STLC*, the way *e-moderation* was applied was proven an essential element for the community creation. The gradual generation and evolution of the *community of learners* in STLC was decoded through the analysis by taking into account many different parameters, such as ways and degree of communication, *SNA* parameters, ways and styles of e-moderation, several incidents (for example technical problems), even facts such as a vacation period.

In the end the following six discernible phases for the STLC *community,* as shown in figure 4, were traced:

a. Preparation and organizing phase: duration 3 weeks
During this period, *E-moderators* had in mind to organize the project and to try and solve any initial problem might occur. Face to face seminars were implemented in order to prepare the community members (mostly *Students*) for the project and to make some first acquaintances, thus making later on bonding among members easier. Communication among members was mostly triggered by low e-moderation email messages.

b. Early community creation phase: duration 2 weeks
During this period, the first signs of the *learner community* creation could be seen. Continual encouragement was needed and *E-moderators* were attempting to activate the members of the community by both high and low e-moderation messages. Reports describing and analyzing the way the community was evolving begun during this phase.

c. Decrease of communication phase: duration 2 weeks
This phase was expected due to the vacation period that was scheduled. Yet, it started a little earlier (3 days) due to a technical problem that occurred and was not immediately fixed. The two e-moderators tried to keep the '*spirit*' of the newborn community '*alive*', by sending low e-moderation messages, mostly with an encouraging or wishful content.

d. Community maturing phase: duration 4 weeks
During this phase all technical problems were solved and all community members were refreshed and ready to work. The phase started with a high e-moderation message which triggered a great increase in all means of communication. Community members reacted in a positive manner to every activation message and after a certain point the community functioning was ideal without any need for e-moderation messages. The two E-moderators towards the end of the period were sending only the weekly scheduled high e-moderation messages containing the communication reports. During this phase the community of learners could be considered as *mature*.

e. Community sustenance phase: duration 5 weeks

Due to the gradual ending of certain courses that took place and the corresponding reduction of *active* community members, a slow shrinking of the community started. The community '*spirit*' was very well there, yet a slightly greater effort than before was needed by the two e-moderators in order to sustain the *community*. This effort was expressed with an increase in both high and low e-moderation messages.

f. Community decomposition phase: duration 4 weeks

By the end of the previous period the community had already shrunk. During the next 4 weeks of this phase it started to disintegrate, members were withdrawing continually and those that were still participating cared more about their courses and grades. This was normal because most courses were ending or had just ended. The official end of the *STLC* project also indicated the de facto decomposition of the community of learners because the educational program as a whole came to an end due to lack of funding; the software platform supporting STLC came to an end and all *Instructors* officially ceased their participation.

Tools designed for the self-regulation of the community members' behavior

An important and distinct characteristic of STLC was that the communication graphs and the activity reports were used both as tools of analysis and as tools for community members' self-regulation. Moreover it was supposed that indirectly the reports would influence the members' community feeling. The reports contained communication *graphs* and other *Social Network Analysis* parameters (such as network *density* and *centralization*); they were calculated on a regular basis and presented to all members of *STLC*. The two e-moderators used to send these reports approximately every week, for nearly all 14 weeks of the community functioning. The reports served as a tool for the application of high e-moderation. A basic goal of the overall process was the provocation of self-regulated behavior change of community members whose behavior was indifferent; change leading to increase of communication and interaction with fellow members without having to send a special low e-moderation message to each one of them. These reports, along with the communication *graphs* and the analysis that was presented by the e-moderators can be considered as *Tools* designed for the self-regulation of the *Student* behavior in the community. These tools could also be used by the *Instructors* as well, in order to access their *Students'* behavior in each course, the degree of interaction and assistance that each *Student* showed.

It must be noted that in order to preserve anonymity, the communication reports were coded; thus, a secret number corresponded to each member. Any member that needed to know his/her position in the communication graph could retrieve this information from an *Instructor* or an *e-moderator*.

The following research question that relates to the above mentioned *tools* was examined: "*To what extent does a learner community member's behavior change due to the presentation of reports analyzing and visualizing the communication within the community?*"

During the analysis, the basic independent variable was whether the *Subjects* (*Students* and *Instructors*) did in fact notice the reports presented by the two *e-moderators*. Several dependent variables related to the anticipated member behavior change were examined. Some important correlations that were detected during the analysis are presented in this paper:

- The observation of the *e-moderators'* reports by the *Students* in *STLC* (as a choice made by the *Students* and an independent variable), was proven highly and positively related (**Pearson's r = +0.467, df = 33, p=0.005 <0.01**) to the degree that the *Students* considered themselves to have altered their behavior towards a more active presence in the *community* (as the *dependent* variable).
- The observation of the *e-moderators'* reports by the *Students* in *STLC* (as a choice made by the *Students* and an independent variable), was proven positively related (**Pearson's r = +0.424, df = 33, p=0.010 <0.05**) to the *Students'* final assessment in *STLC* (as the *dependent* variable).

The above two interesting correlations indicate that the *E-moderators'* reports and the *tools* designed for member behavior self-regulation were effective in a high degree, at least regarding the *Students* of *STLC*. Unfortunately these *tools* and reports did not have an accordingly substantial influence to the *Instructors* of the *community;* no influence or behavior change was detected whatsoever for this group of *Subjects*. This fact and the difficulty of triangulating results by using objective communication parameters (such as *density* and *centralization* for each member) leave the above mentioned research question partly open for further examination in the future.

Yet, during the analysis, some other important correlations were also detected, such as:
- The *Students'* degree of participation in *STLC chat* sessions (as an independent variable), was proven negatively related (**Pearson's r = -0.664, df = 11, p=0.026 <0.05**) to the degree that the *Students* considered themselves to have altered their behavior towards a more active presence in the *community* (as the *dependent* variable). The more a *Student* was participating in *STLC chat* sessions, the less he/she believed to have been influenced by the *e-moderators'* reports.
- The number of email messages a *Student* sent *in STLC* (as a choice made by the *Students* and an independent variable), was proven highly and positively related (**Pearson's r = +0.449, df = 35, p=0.007 <0.01**) to the degree that the *Students* considered their fellow members of the *Learner Community* to have altered their behavior towards a more active presence in the *community* (as the *dependent* variable). The more a *Student* was using email in *STLC*, the more he/she believed that the other *community* members had been influenced by the *e-moderators'* reports.

The first of the above correlations can be explained by the incomplete analysis for the communication that was presented in the reports and mostly focused on the email service and not at all to other means of communication, such as forum and chat. *Students* that mostly participated in chat sessions felt less committed by the analysis reports and less involved in the procedure and thus cared less and therefore were influenced less. This conclusion is confirmed by the second of the above correlations that shows that *Students* using more the email service believed that their fellow members were more influenced by the *e-moderators'* reports.

Finally, another interesting correlation that was detected during the analysis was:
- The *Student's sex* (as a *Student characteristic* and an independent variable), was related (**Pearson's r = 0.386, df = 35, p=0.019 <0.05**) to the degree that the *Students* considered their fellow members of the *learner community* to have altered their behavior towards a more active presence in the *community* (as the *dependent* variable). Male *Students* believed in a considerably higher degree than female *Students,* that their fellow community members had been influenced by the *e-moderators'* reports.

The above correlation shows that men are more influenced by such reports than women, or at least they are more interested about such reports. This confirms the belief that men are more effective and respond better in competitive environments and situations than women, who function better in more cooperative environments and situations (Belenky, Clinchy, Goldberger & Tarule 1986, Merryfield 2001, Barret 2003).

The above mentioned correlations that were detected during the analysis and the corresponding conclusions indicate that behavior self-regulation for *learner community* members is possible. Yet some significant problems were discovered during the case study that appointed the corresponding research question still open to further study. These problems were related to information presentation errors, incomplete analysis and the Subjects' lack of interest. In particular:

(*a*) Information presentation errors: Errors were made in the procedure of information presentation. In order to preserve anonymity, deontology dictated that communication reports and communication graphs should be

coded. The coding policy chosen was to assign a secret number corresponding to each member. Any member that needed to know its position in the communication graph could retrieve this information by asking an Instructor or an E-moderator about is/her secret number. This policy proved to be less effective than expected. The procedure was complicated and Community members' interest gradually reduced. A more effective policy might be that of calculating/creating a separate communication graph for each member with his/her position noted, yet the rest of the graph nodes would remain coded or nameless. Unfortunately this enhanced policy, however more effective it could be, was much too time and resource consuming to be applied in the STLC project.

(*b*) Incomplete analysis: all means of interaction and communication services should have been taken into account. The analysis of the Community communication was incomplete in a sense that many means of interaction and communication services were ignored, or at least not taken into account the way they should have been. This was done because of practical and technical reasons in the case study of STLC; according to the available resources, the analysis was already complex enough to broaden it further. Yet this was obvious to members that were already active in their communication and used more than just email or forum postings. This problem caused increasing indifference to a certain group of Subjects and should be avoided in future projects with more available resources than STLC.

(*c*) Instructors' lack of interest: more concrete motives should have been given to *Instructors*. The *Instructors* had a tremendous workload in STLC, much greater than what was anticipated at first. This fact, along with continuous time pressure, made the communication reports seem of lesser importance to most *Instructors*. Either more *Instructors* should have participated, thus decreasing the workload, or more concrete motives (for example payment) should have been given to the ones participating. Again, this problem was related to a certain lack of resources.

Discussion

In regard to the *Creation of the community of learners* as well as its evolution during the STCL project implementation, three basic conclusions can be derived from the analysis:

1. Tools and methods of analysis appropriate for the studying of learning communities evolution were proposed. Especially communication graphs proved useful during the analysis in determining the moment of *Creation of the community* of learners in STLC. It is to be noticed that in the case of SLTC, the communication graphs were based on the e-mail, however in other communities another communication tool could be more representative of members' activities (e.g. the forum). The graphs were also used for the deciphering of the different phases of the evolution. Triangulation of results was obtained from different sources of data, such as data derived from other communication services (forum, chat), system log files, as well as questionnaires answered and interviews given by STLC participants. Another analysis method that was useful was the integrated presentation of all elements of communication in STLC and the parallel study of high e-moderation messages. This study was of a qualitative nature, yet the impact of each e-moderators' message on the overall community communication and interaction was mostly studied in a quantitative manner.

2. During the analysis it was shown that the creation of a *community of learners*, like the one that was materialized in STLC, does not arise automatically, nor suddenly, but is rather a result of specific actions and efforts of all participating members. In STLC, an essential element of the community creation was the way e-moderation was applied. The gradual generation and *Evolution of the Community of Learners* in

STLC was decoded by using many of the above mentioned analysis methods and tools and six discernible phases were traced: (a) The preparation and organizing phase; (b) The early community creation phase; (c) The decrease of communication phase; (d) The community maturing phase; (e) The community sustenance phase; (f) The community decomposition phase.

Analogous phases could be anticipated in cases of community creation and evolution in future educational projects resembling STLC.

3. In STLC the communication graphs and the activity reports produced by the e-moderators were used both as tools of analysis and as tools for community members' self-regulation. These tools could also be used by the *Instructors* as well, in order to access their *Students'* behavior in each course, the degree of interaction and assistance that each *Student* showed. An interesting research question that was examined was "*To what extent does a learner community member's behavior change due to the presentation of reports analyzing and visualizing the communication within the community?*" Some interesting correlations were detected during the analysis indicating that this self-regulation is possible, yet the corresponding research question should be considered still open to further study. This is due to problems related to: (a) Information presentation errors. (b) Incomplete analysis; all means of interaction and communication services should have been taken into account. (c) Instructors' lack of interest; more concrete motives should have been given to Instructors.

The above mentioned main conclusions were the result of the case study and the analysis that took place during research simultaneous to the STLC program implementation. Studying STLC proved worthwhile because a number of features and research questions related to this project were explored (Hlapanis 2006, Hlapanis, Kordaki & Dimitracopoulou 2006, Hlapanis & Dimitracopoulou 2006). Especially certain aspects concerning the complex problem of the *creation and sustenance of a learning community* were presented in this paper. As previously mentioned, although many researchers have dealt with learning communities (McMillan & Chavis 1986, Lave & Wenger 1990, Wenger 1998, Palloff & Pratt 1999, Murphy et al. 2000, Rovai 2000, Rogers 2000, Ferry et al. 2000, Bradshaw et al. 2002, Barab & Schatz 2001, Barab et al. 2002, Barrett 2003, Gaskell & Riding 2003, Tisdell et al. 2004) it was not quite obvious when a *learning community* is actually created and in what way this could be noticed. The above mentioned tools and methods of analysis, proposed in this paper for the studying of learning communities (especially the communication graphs), could be useful in this aspect as well as for the deciphering of the community evolution. This could be considered as a partial answer to research questions like '*How can communication parameters be used for the analysis of such complex systems?*' that have been dealt with by many researchers (Tanner & Jones 2000, Riding 2001, Guimera, Danon, Diaz-Guilera et al. 2002, McDonald 2002, Tyler et al. 2003, McArthur & Bruza 2003, Groth 2003, McDonald 2003, DePaula 2003, Reffay & Chanier 2003). Finally, we think that most of the proposed methods and tools could be applied (in an adapted way) in every kind of community independently of its nature, however this is a claim that needs to be validated.

Another issue dealt with in this paper was that the communication graphs and the activity reports were used in STLC both as tools of researchers' analysis and as tools for community members' self-regulation. This is related to some interesting research questions that concern several researchers (Martýnez et al. 2003, Nurmela et al. 2003, Reffay & Chanier 2003, Taurisson & Tchounikine 2004), such as matters of community member self-regulation caused by communication reports. Although some interesting results were derived by the analysis of STLC these particular research questions should be subject to further studying in order to be widely applicable and efficient in the future. In any case, this aspect of the work is registered in the new field of computer based interaction analysis supporting selfregulation (Dimitracopoulou et al., 2005,

Dimitracopoulou, Dillenbourg, Hoppe, 2004), which is going through a period of intensive evolution, studying similar aspects.

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