Tools and Methods for Supporting E-Learning Communities and their Evaluation

Chapter X

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ABSTRACT

The goal of this chapter is to introduce the reader to online learning communities, to define and categorize online communities, as well as to present the process, functionality and rules of online learning communities. It also discusses the particular characteristics of the tools and methods that are currently used for supporting online learning communities. It presents a twofold classification of these methods and tools, and discusses the usage of these tools by online learning communities. Furthermore, it proposes tools and methods that could be used in the near future. Finally, this chapter aims at presenting methods and tools used for the evaluation of online learning communities, including classification of these methods and practical examples from their use.

Keywords: Online Learning Communities, Community Tools, Community Platforms, Evaluation Methods, Software Quality, Usability

INTRODUCTION

Online learning communities (OLCs) have been studied under a number of scientific domains including communication studies, sociology, psychology, information systems, business studies, computing, information science and newly formed departments of cyber or Internet studies (Preece, Maloney-Krichmar and Abras, 2003). Their evolution depended primarily on the evolution of the supportive technology that provided the communicational infrastructure necessary to bring community members together. The first medium deployed for community support was e-mail, which was developed in 1972 and, in its primitive form, allowed only point-to-point communication. One-to-many postings were enabled by the listservers technology that became available after 1975. Their basic form has not changed much until today and they are still used in some OLC. In the 1980s appeared the bulletin boards that allowed the threading of postings on the same topic. Similar functionalities were also provided by Usenet News that, along with the rest of the technologies mentioned so far, comprise the set of asynchronous communication technologies. Chat systems on the other hand (like IRC and AOL Instant Messenger) belong to the set of synchronous communication technologies used for supporting OLCs.

The advent of the World Wide Web in 1992 led to the widespread use of websites and the formation of OLC groups that are supported by integrated communication infrastructures and graphical environments in 2 or 3 dimensions started to appear (such as Palace www.palace.com and Activeworlds www.activeworlds.com later). The next step was to move to more sophisticated interfaces and interaction modes like the ones used in gaming worlds (such as Doom and Quake), where users are represented as avatars and interact through text, sound and streaming video. In recent years there have been strong and highly populated communities gathered around a certain technology such as MP3, or open source. Today, with the wide availability of Internet telephone, streaming video, photographs, sound, voice web cams, blogs and wikis, the technological alternatives for building and maintaining an OLC are numerous (Preece, Maloney-Krichmar and Abras, 2003).

The notion of setting up communities of users is of vital importance in the framework of e-learning. Learning is a process closely connected to sociability (Hiltz, 1998; Vygotsky, 1986) and in the majority of cases traditional learning implies the formation and operation of a community. Scientific observation during the last years has indicated that learning on the web in many cases is also accompanied and promoted by the creation and maintenance of OLCs. Research provides evidence that *"strong feelings of community may not only increase persistence in courses but may also increase the commitment to group goals, cooperation among members, satisfaction with group efforts, and motivation to learn"* (Rovai, 2002). Thus, if the strong sense of community is related to

increased persistence, as well as to increased learning, then the sense of community becomes a foundation upon which to design and facilitate online teaching. And though in real life most communities are formed through geographical proximity, OLCs are mostly formed around a shared interest or need, and are a powerful tool for building trust and relationships, knowledge acquisition and exchange, leading to more 'human' web environments.

This chapter begins with defining OLCs, their types and basic functionalities, before focusing on the specific domain of OLCs. Next, it provides an overview of technological tools and methods used for supporting OLCs, proposes an overall categorization and suggests a set of evaluation methods. The chapter concludes with a discussion on the foreseen future directions concerning methods that can be used to enhance the everyday life of OLC inhabitants and upgrade the effect of online teaching and learning.

ONLINE LEARNING COMMUNITIES: A FIELD BACKGROUND

Defining OLCs is not a trivial task. A search in the related bibliography (in both the sociology and the IT domains) results in a variety of definitions with different focus and prerequisites as to what constitutes an OLC. Probably the best known definition of OLCs comes from Howard Rheingold (1994) who described them as *"cultural aggregations that emerge when enough people bump into each other often enough in cyberspace"* (p. 57). Schmid (2000) pursues a more agent-based approach (that does not solely take into account real people), in which, communities are put together through agents – these can be human or software – which are linked by a common language and set of values and pursue common interests. These agents are tied together through a medium in which their roles interact with each other accordingly. Another approach from the IT domain comes from Preece (2000), who identifies four ingredients in OLCs (p.10):

- *People*, who interact socially as they strive to satisfy their own needs or perform special roles, such as leading or moderating.
- A *shared purpose*, such as an interest, need, information exchange, or service that provides a reason for the community.
- *Policies*, in the form of tacit assumptions, rituals, protocols, rules, and laws that guide people's interactions.
- *Computer systems*, to support and mediate social interaction and facilitate a sense of togetherness.

Core attributes of an OLC (in the sense that communities with more such attributes are clearer examples of communities than those that have fewer) comprise (Whittaker, Isaacs and O'Day, 1997, p. 137):

- A shared goal, interest, need or activity
- Repeated, active participation, with intense interactions and strong emotional ties between participants
- Access to shared resources with policies to determine access
- Reciprocity of information, support and services between members
- Shared context (social conventions, language, protocols)

According to the same source, less central OLC attributes comprise: (1) differentiated roles and reputations, (2) awareness of membership boundaries and group identity, (3) initiation criteria, (4) history and long duration, (5) events or rituals, (6) shared physical environment, and (7) voluntary membership.

A multitude of categorizations for OLCs can be found in the relevant literature. The following classifications should help to clarify the many facets of OLCs. Based on the purpose and the shared characteristics of their members,OLCs can be categorized as *communities of practice* (where individuals share the same profession), *communities of*

circumstance (where individuals share a personal situation), *communities of purpose* (where individuals share a common objective or purpose) and *communities of interest* (where individuals share an interest). In some cases, a community may fall into more than one definition, and over time a community may develop sub-communities formed around special interest groups.

Another interesting categorization distinguishes OLCs by the technological platforms they deploy as:

- *Web-based communities* based on Internet or Intranet technologies
- *Peer communities*, which are based on peer-to-peer technologies, involve network structures where each connected computer can put its hardware or software at the disposal of other computers or use that of others.
- Communities which use *mobile technologies*, which can also provide new forms of media-supported learning (mobile learning).
- Communities which occur in *virtual worlds* (such as Multi User Dungeons), which have so far spread mainly in the field of 'edutainment'.

Regardless of the specific platform, the list of typical functionalities that should be supported for maintaining an OLC comprise (Seufert, 2002):

- Mailing lists
- E-Polls for the collection of opinion polls (e.g. from e-groups)
- Web blackboards
- Visualization of sub-groups
- Community chronicle
- Expert index: who's who, yellow pages
- Document management switching on of content, exchange of documents, etc.
- Photo album, member guestbook
- Audio and video conferences, chat and discussion forums, buddy lists
- Team workspaces, group calendar, work-flow based task administration
- Feedback mechanism: rating functionalities, scoring models for the grading of content, discussion contributions, combined with incentive mechanisms (e.g.. Top lists, point allocation).

Table 1 lists a number of widely used platforms for building and supporting electronic communities (Seufert, 2002).

Platform	*Desciption/Features*	*Application Domain*
Cassiopeia www.cassiopeia.com	Community platform with personalization, functionalities for the organization of teams, integrated incentive system for active participation in the community	Knowledge Communities, Communities of Practice (on the Intranet) B2B Communities (Internet)
Vignette www.vignette.com	Community platform for the lasting formation of customer relations, personalized information for customers, analysis of customer profile (e.g. visitor activities, activities regarding campaigns, through content, advice, feedback, etc.).	Specialization in customer-related communities, (Internet).

WebFair www.webfair.com	Community platform with personalization, integrated feedback mechanism, feedback recorded in a database, integrated scoring model as the basis of an incentive system.	Knowledge Communities in the broadest sense, business communities.
Arsdigida www.arsdigida.com	Community platform with personalization, functionalities for the organization of teams. Open source methodology: developers can develop the tool further according to their own needs.	Knowledge Communities in the broadest sense, Business Communities (Internet/Intranet).
e-groups groups.yahoo.com	Communities can be set up on the prevailing server, simple functionalities such as synchronous or asynchronous communication possibilities, group calendar functionalities for peer-facilitated communities.	Interest/free time communities (Internet), more for private use.
Groove www.grovenetworks.com	Community platform with personalization, functionalities for the organization of teams, document and workflow management functionalities for peer-facilitated communities.	Peer-to-Peer Knowledge Communities (Internet, Peer-to-Peer Technology).

Table 1. Platforms for building and maintaining OLCs.

Moving to the e-learning domain, a real-world OLC is a group of people who are dedicated to learning together in a safe environment that encourages dialogue, feedback, reflection and empowerment**.** In addition, learning communities: (1) work in teams (2) have agreed upon aspirations that develop personal goals, (3) create a learning community vision for what is possible, (4) engage in meaningful conversations and (5) are respectful, encouraging and forgiving. Technology can be used to create learning (or educational) communities that foster collaborative learning so that students can learn together and benefit from sharing ideas and resources supported by skilful moderators and mentors (Hiltz, 1998; Salmon, 2000). The introduction of OLCs to the typical web-based learning scenario has proved to be a quite promising concept, allowing the improvement of both the quality of online courses and the objective satisfaction of users in web-based learning environments. According to Reinmann-Rothmeier, Mandl and Prenzel (2000) a learning community is a community in which people are joined together by a mutual interest to intensively examine a particular theme, and in so doing are able to learn together, exchange existing knowledge and jointly work on aspects of problem solving. Ideally, within the context of a learning community, knowledge and meaning are actively constructed, and the community enhances the acquisition of knowledge and understanding, and satisfies the learning needs of its members. Moreover, communities can counteract the isolation of the independent learner and the associated dropout quota (Seufert, 2002). Members of a learning community may be students, lecturers, tutors, researchers, practitioners and domain experts.

The following table presents indicative examples of some widely used tools for supporting OLCs. These tools provide more sophisticated and integrated solutions and are classified as either Learning Management Systems (VCampus, Centra and iCohere) or collaborative annotation systems (Case and Mole). More details on tools and methods used for supporting OLCs are available in the third section.

Tool	*Description/Features*
VCampus Corporation www.vcampus.com	Utilizes the "PowerBlend Blended Learning" concept which provides various communication and collaboration options to its users (discussion boards, live chat, shared whiteboards).
Centra www.centra.com	Enables online business collaboration, communication and learning. More specifically, Centra provides support for synchronous web conferencing, including chats, whiteboards and video teleconferencing.
iCohere http://www.icohere.com	Supports relationship building and collaboration, and allows easy integration of existing learning content. Provides streaming presentations, custom e-learning modules and other content, as well as online meetings and discussion areas with group process tools, fostering collaboration in service of learning.
Case (Glover, Hardaker, & Xu, 2004)	Allow users to add an additional layer of information to the Web learning content in the form of collaborative annotations. The developers of this system expect that by allowing the community members to collaborate on the learning material, the quality of learners' online discussion will be improved through the integration of the learning context directly into the content design.
Mole (Whittington, 1996)	Combines exploratory learning with hypertext based material and collaborative learning through the use of annotations. Mole was designed to enable learners to take an active role in their learning by facilitating online annotation of the hypertext notes.

Table 2. Tools for supporting OLCs.

Despite the increasing interest in OLC design and the increasing number of newly built communities, the issue of identifying criteria for evaluating their success remains open. Designing and implementing an online environment for supporting a community requires much more that merely providing for the communication and resource sharing capabilities. OLC designers are people who must combine *"… the world of technology and the world of people, and try to bring the two together"* (Kapor, 1996). In attempting to set up a successful learning community on the web many things can go wrong and the road from assuring all technical prerequisites to having people participating and keeping the community alive, is long and winding.

Since the domain of OLCs is multidisciplinary, the evaluation of what constitutes a success OLC should be based on more than one parameters and most scientists measure success in terms of sociability (i.e. the social interactions between community members and the policies that guide them) and usability (i.e. the use with which the software can be used) within the virtual community boundaries. Potential determinants of success in OLCs in terms of sociability comprise the number of participants in the community, the number of lurkers (Nonnecke, 2000; Nonnecke and Preece, 2000), the number of posted messages; the number of messages per participant, the degree of reciprocity, as indicated by e.g. the number of responses per participant, the amount of on-topic discussion, the degree of

empathy in interactions, the level of trust, the frequency of uncivil behavior incidences, average duration of membership, percentage of people that are still members after a certain period of time (Preece, 2001). On the usability dimension, potential determinants of success may include speed of getting to know how to use the interface, productivity (how long it takes to perform trivial tasks in the community), frequency of errors in using the community infrastructure and subjective satisfaction of community members (Preece, 2001).

OLCs (which are typically categorized as communities of purpose) should also be evaluated based on the degree they serve learning and teaching in a remote collaborative scenario and the degree they satisfy the needs of all community members (i.e. students, lecturers, tutors, researchers, domain experts moderators, etc.). These factors though depend on the specific domain each OLC is gathered around, as well as the learning scenarios employed and thus it cannot fit in a generalized evaluation framework as the ones described in the fourth section. Another consideration is whether the community is a closed, class-based community or an open one, as the criteria must conform to the different objectives and priorities. Nevertheless, support for communication, access to resources and collaborative work must be provided, as well as sufficient moderation to protect students against inappropriate behaviour and to guide interactions.

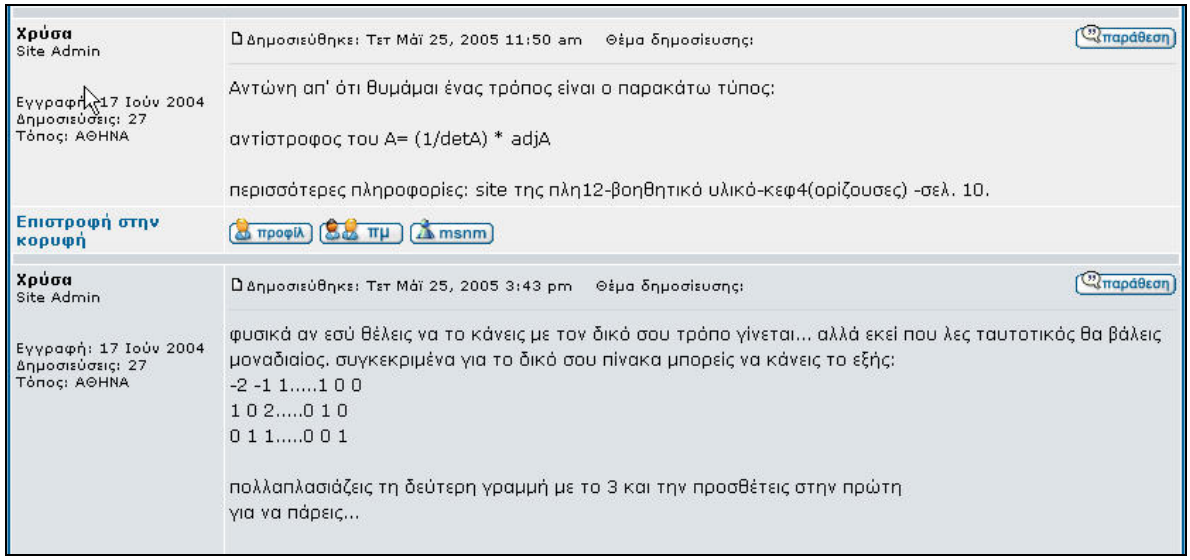

Figure 1. Discussion among the members of an OLC in the Hellenic Open University Basic communication tools

TOOLS AND METHODS SUPPORTING ONLINE LEARNING COMMUNITIES

This section discusses the particular characteristics of the tools and methods used for supporting OLC. It begins with a categorization of the tools and methods currently used for building and supporting OLC. The categorization is twofold: on the one hand it is based on the learner and the learning process, and on the other hand it is based on the technological complexity of the solutions offered.

As regards technological complexity, both *basic* and *advanced* tools and methods are included in this presentation, enhanced with experiences from their use. It must be noted that most of the presented technologies were not initially developed for OLCs; consequently their scope and users are quite broader. However, once introduced in the OLCs they have been easily adopted, since it was obvious that they improved the educational procedure.

As regards learner based classification, it must be noted that the related bibliography includes numerous studies classifying web-based education systems

supporting OLCs. For example (Oliver et al., 1998) are using the place and time parameters to classify learning communities into traditional vs. distance and synchronous vs. asynchronous. Most related studies, such as (Crossman, 1997; Stenerson, 1998; McCormack & Jones, 1998), are focusing on the use of the World Wide Web as a combining medium that facilitates the work of OLCs. This chapter classifies the systems that support OLCs as: *synchronous* or *asynchronous* and *single-user* or *collaborative*. Synchronous refers to systems enabling more than one OLCs members to work simultaneously and asynchronous to systems not providing this possibility. Collaborative refers to systems enabling the collaboration of many learners within an OLC to complete a task that cannot be completed by a single learner.

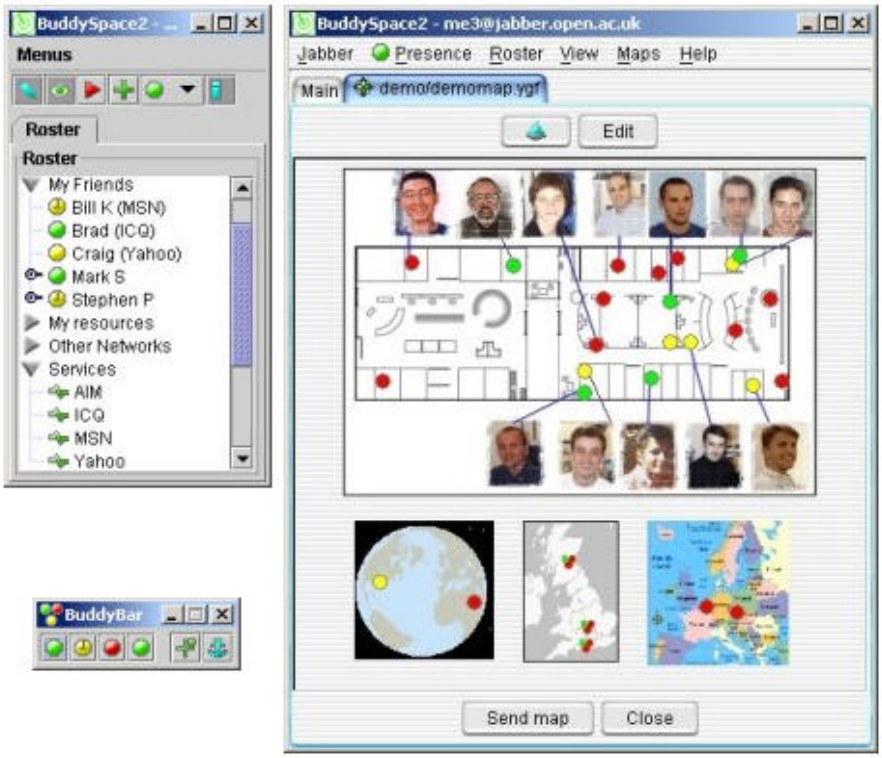

Figure2. Buddy Space allows advanced communication among members of an OLC

Based on the above twofold classification (learner and technology based), the following sections present some of the most commonly used tools and methods. The order in which the tools and methods are discussed below does not imply any type of further classification, although it is partially based on technological complexity.

Current basic communication tools that support OLCs are the e-mail, the fora and the discussion lists. All these tools are text-based, as implied by the characterization 'basic'. Namely, to use these tools require the members of the OLC to type a message that the other members will read. One of the main communication instruments in today's distance education is e-mail. Besides e-mail, the use of fora is also quite common in OLCs, since fora are mainly used for communication and publication. Figure 1 presents part of a tutor-students discussion related to the 'Introduction to Computer Science Module' of the Hellenic Open University. Finally, discussion lists are quite similar to e-mail and fora and are used by OLCs in a similar manner.

All the aforementioned tools are mainly used for asynchronous communication. Since their purpose is communication, they could be also considered as collaborative tools, although they are mainly used to facilitate non-collaborative learner-tutor communication.

Advanced communication tools

Chat (realized, in most cases, with instance messengers) is a well-known communication means for OLCs that is also text-based. The main difference between chat tools and the aforementioned text-based tools is that chat is synchronous. Furthermore, most instance messengers incorporate additional net-phone and net-meeting facilities, allowing faster and technologically advanced communication, and can therefore be used for lecturing purposes as well.

An example of a chat tool is the Buddy Space (see Eisenstadt et al. 2003), used in the British Open University (found at: http://kmi.open.ac.uk/projects/buddyspace/), that allows optional maps for geographical & office-plan visualizations, as well as build-in tools for web casts and video communication (see figure 2). Advanced communication tools are used for the collaboration of the members of an OLC in a synchronous manner.

Tutor lectures

Some universities offer online course lectures to their OLC members. An example is shown in figure 3 illustrating a screenshot from a lecture in the Harvard University. Online lectures resemble traditional university course classes. Usually, online lectures are stored for later review by the members of the OLC.

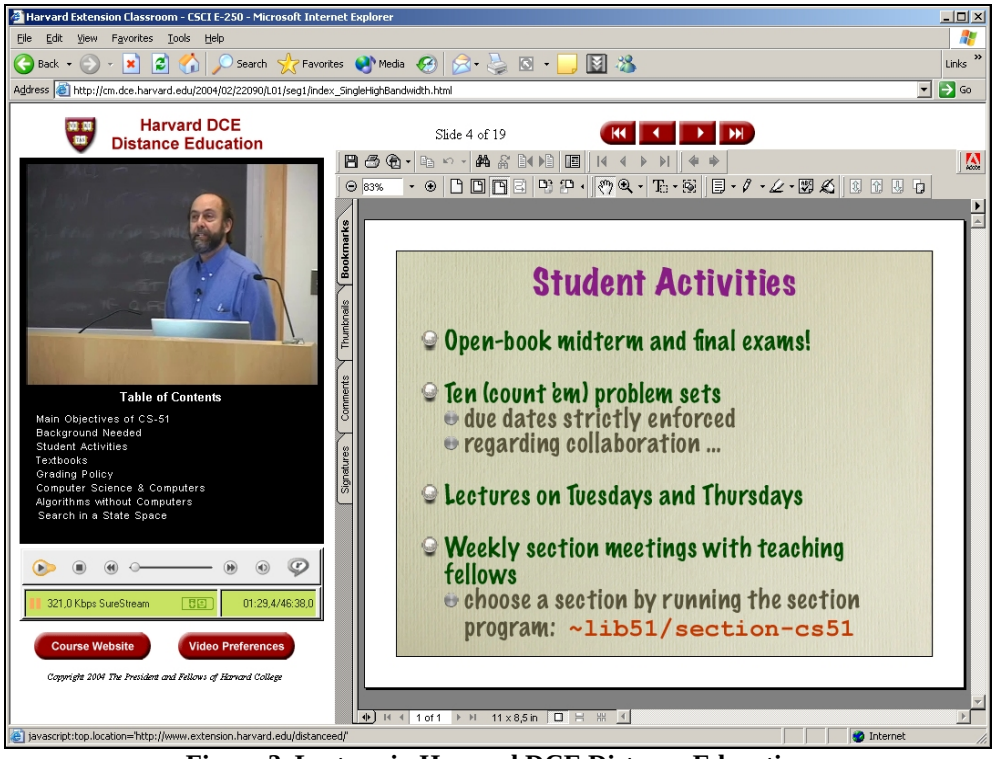

Figure 3. Lecture in Harvard DCE Distance Education

Depending on the system that supports this process, the members of the OLC may be able to actively participate (i.e. ask or answer to questions), or simply to attend the lecture remotely. A well-known system supporting online lectures for OLCs is eClass (http://www.cc.gatech.edu/fce/eclass). Online lectures are of course synchronous but future viewing could also be asynchronous. They are usually not collaborative but in some cases collaboration among the members of the community is possible, provided that active participation of community members is allowed.

Remote and virtual laboratories

Remote laboratories are laboratories that allow the members of an OLC to participate remotely in a real experiment (an experiment that takes place in an actual laboratory). In this case, the members' participation varies from defining a set of parameters and receiving the results to actual remote control of the experiment. Remote laboratories are synchronous and, in same cases, collaborative (in such cases they allow the collaboration and communication among the members of the OLC).

Unlike remote laboratories, virtual ones do not require actual establishments. They simulate laboratories allowing OLC members to practice. In most cases, these members act individually and are able to simulate (using from simple graphics to virtual reality tools) a real experiment by interacting with the system. In some cases, these experiments are collaborative and can be either synchronous or asynchronous, with the latter being the most common practice.

It should be noted that the laboratories category may also includes simple tools (such as programming tools, compilers, etc.) that allow OLC members to work remotely in a laboratory-like manner. Another tool of this category that is currently used for learning purposes in OLCs is collaboration games. In such games, members of the community are assigned roles and take part remotely. Such games are highly collaborative and in most cases synchronous.

Tools allowing synchronous collaboration

A number of tools have been developed to enable synchronous collaboration of the members of OLCs. Among them are shared blackboards, virtual working spaces and virtual classrooms. Most of these tools are enhanced with many communication tools such as the ones previously presented.

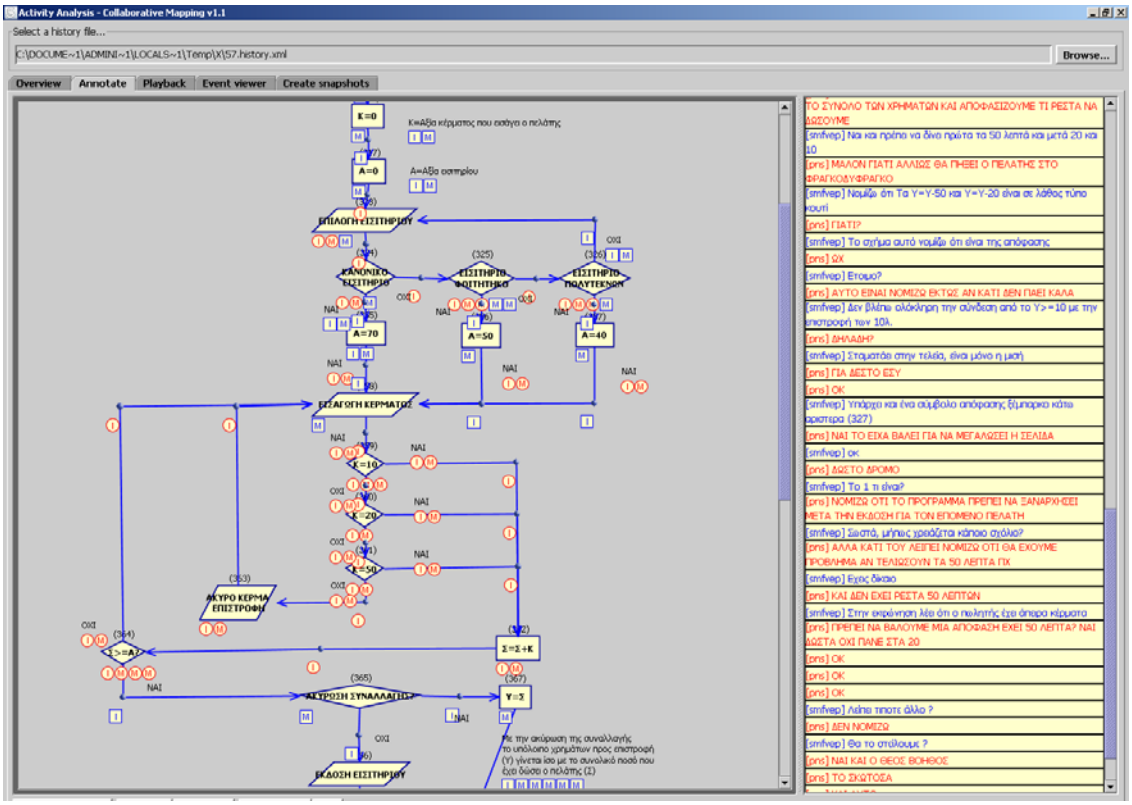

Figure 4. A common design space shared by two members of an OLC.

Shared blackboards, for example, have similar functionality to classroom blackboards and enable two or more OLC members to write (either by exchanging a key, or simultaneously) on a common blackboard. Such blackboards are integrated in most Learning Management Systems (LMS) and constitute a means of written expression that also allows collaboration among the members of the OLC.

A more complex form of blackboard is the virtual space, a system that enables a number of OLC members to share a common virtual space, while providing at the same time other communication tools as well. Virtual spaces are usually organized for a specific learning purpose, i.e. collaborative design. A representative example of such a system is Synergo (see Xenos et al., 2004), a peer to peer application that allows members of OLCs of the Hellenic Open University to manipulate a number of developed diagrams in a shared activity space and to communicate directly through a chat tool, while offering measurements related to the degree of collaboration (for the tutor or the researcher). Figure 4 illustrates the result of the collaboration between two distant partners using Synergo. These two OLC members have completed the design of a flowchart. Synergo enables the distinguishing of each contribution (different colors) and chat (frame in the right part of the screen). In most cases, the use of similar tools is synchronous and of course collaborative.

Virtual classrooms are currently used in distance education to emulate real classroom lectures. In virtual classrooms the members of an OLC log on to the system and attend a lecture, while interacting with the tutor and with each other. Virtual classrooms allow community members to interact with the object used (i.e. to write on the slides, to share their computer desktop or view, etc) and therefore are a highly collaborative tool. Virtual classroom courses may be recorded and stored for later review, therefore their use is not only synchronous but could also be asynchronous. An example from a virtual classroom lecture in the Hellenic Open University is shown in figure 5. In this picture a tutor is giving a lecture to 10 OLC members.

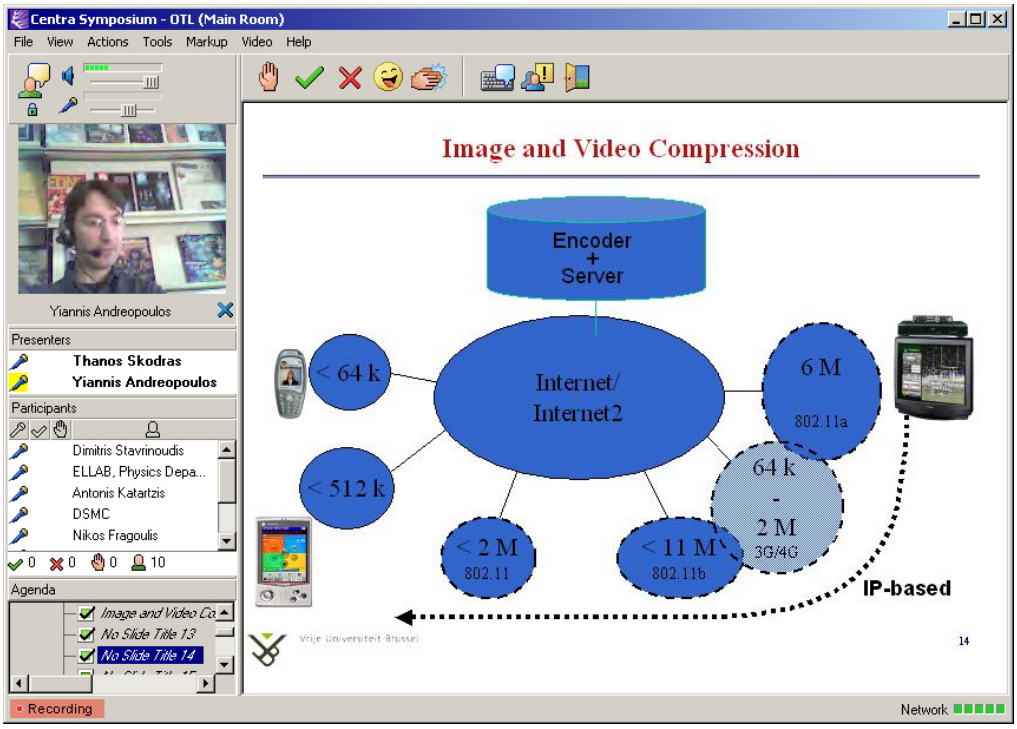

Figure 5. A virtual classroom photo.

EVALUATION METHODS FOR ONLINE LEARNING COMMUNITIES

This section presents the most commonly used methods for evaluating systems of OLC, as well as their classification. It begins with a categorization of these methods according to the models they are based on and the way they can be applied. Typical examples are given for each case. Finally, a statistical method for the analysis of the results of these evaluation methods is described.

It must be noted that most of the presented methods were not initially developed for evaluating OLCs. In fact, they can be applied to any software product, supporting OLCs. For example, they can be used to surveys for measuring users' opinion of software quality in general. However, when these methods are applied in the case of OLCs' systems, specific conclusions can be drawn for their evaluation.

Classification of evaluation methods

The evaluation methods for OLCs, just like the evaluation methods in general, can be firstly divided to *analytic* and *empiric* ones (Nielsen, 1993), as presented in figure 6. The analytic methods are theoretical models, rules or standards that simulate user's behaviour. They are mainly used during the requirement analysis phase and usually even before the development of the prototypes of a product. As a result, the users' participation is not required in these methods. On the contrary, the empiric methods depend on the implementation, the valuation and the rating of a software prototype or product. In this rating it is necessary to have the participation of a representative sample of the end-users or/and a number of experienced valuators of the quality of a software product. The empiric methods can be divided into *experimental* and *inquiry* ones.

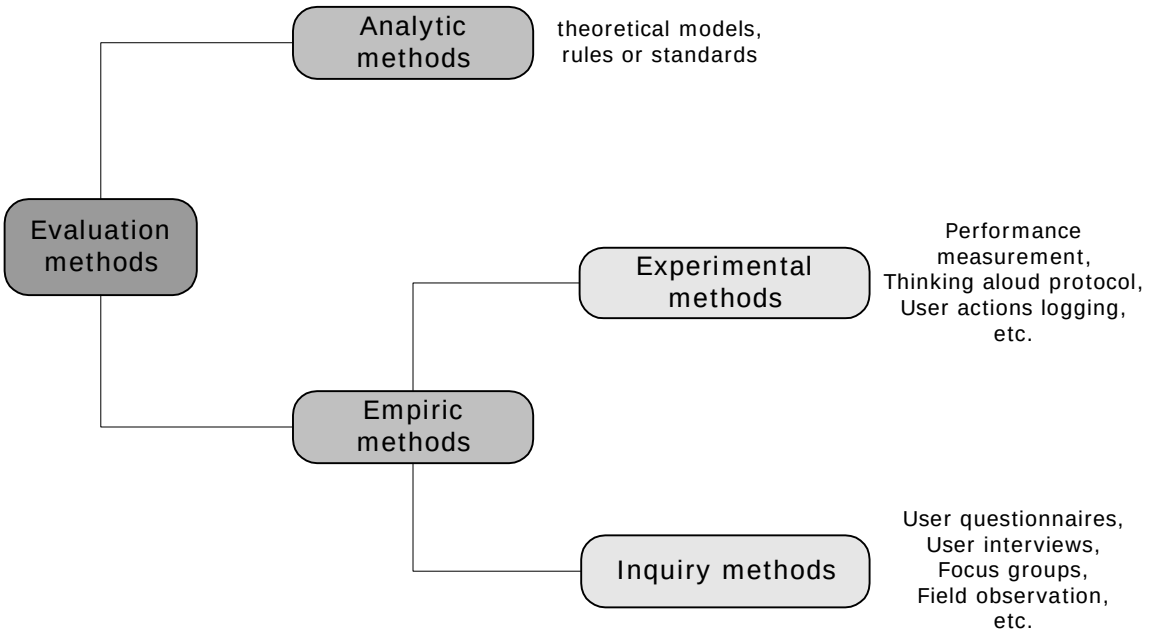

Figure 6. Classification of evaluation methods.

The experimental methods require the participation of the end-users in a laboratory environment and the most known comprise:

- *Performance measurement.* The performance measurement is a classical method of software evaluation that provides quantitative measurements of a software product performance when users execute predefined actions or even complete operations. The users are let to perform these actions having only a narrow guidance at the beginning,

so that the interaction between them and the responsible person of the survey will be restricted to a minimum.

- *Thinking aloud protocol.* The thinking aloud protocol method focuses on the measurement of the effectiveness of a system and the user's satisfaction. According to this method, a small number of users, usually 3 to 4, interact with the system, while they state aloud their thoughts, opinions, emotions and sentiments of the system. All the above are recorded, in order to be analysed in combination with the users' actions, which are also recorded.
- *User actions logging.* As far as the user actions logging method is concerned, there are many techniques to record the actions of users while they interact with a software product. The most common are the notes of the researcher, the voice recording of the users, the video recording of the users, computer logging and user logging. The researcher can use one or more of the above techniques simultaneously.

The inquiry methods concern the examination of the quality characteristics of a software product by measuring users' opinion. According to these methods, the survey is generally conducted at the physical working place of the users, who evaluate either a forward prototype of a product or its final version. A large number of users are needed for the inquiry methods and the most popular are the following:

- *User questionnaires.* In this method, users are requested to express their opinion of the quality of a software product by completing a structured questionnaire, which consists of questions usually with a multiple-choice format. These questionnaires are sent to users, who answer them unaffectedly, i.e. without any possible influence from the person who conducts the survey. Each question addresses a specific quality characteristic, such as the quality characteristics of ISO9126 (ISO/IEC 9126, 2001), and has its own weight to the whole questionnaire. These weights are either equal for all characteristics or may vary in order to allow emphasis on one or more specific characteristics. In the former case, the questionnaire designer aims at the assessment of the quality of an OLC as equally affected by all quality characteristics. In the latter case, emphasis is placed on some specific quality characteristics of an OLC.
- *User interviews.* This is a structured method of evaluating a software product, where the researcher is in direct contact with the user. The questions of the interview follow a hierarchical structure, through which the general opinion of the product is captured first, followed by more specific matters of the quality characteristics are considered.
- *Focus groups.* This method is a variation of the previous one, where a group of 5 to 10 users is formed under the supervision of a coordinator, who is responsible for the preparation of the topics of their conversation. At the end of this conversation, the coordinator will gather their conclusions on the quality of the software product.
- *Field observation.* With this method, the researcher observes the users at their working place, while they are using and interacting with the software product.

Examples of evaluation methods

The most commonly used methods for the evaluation of OLCs are the user questionnaires and the user interviews. Both of these methods are based on a questionnaire about the quality characteristics of a system of an OLC. In the first one the questionnaire is filled in directly by the user, without any further contact with the researcher. On the contrary, in the second one the researcher while interviewing the user fills in the questionnaire. In both cases, the responses of the user during the survey must be judged by the following criteria (Javeau, 1992):

- The capability of the user: Does the user know the real subject of the questions? Is it a knowledge understandable to the user or not, deep or surface, present or past?

- The understandability of the user: Does the user understand the content of all the questions of the questionnaire? Does the user meet any problems with the glossary or the terms used in it? Is there any external condition or personal situation of the user that disallows him/her to participate in the survey appropriately?
- The honesty of the user: Does the user respond while participating in the survey according to his/her conscience or does he/she lie either knowingly or even unknowingly?
- The reliability of the user: Does the user express himself/herself with the appropriate words or expressions? Does the user's memory fail him/her?

Furthermore, the various cultural acknowledgements that are mainly related to the individual behavior and the customs of the user may also be included in the criteria mentioned above.

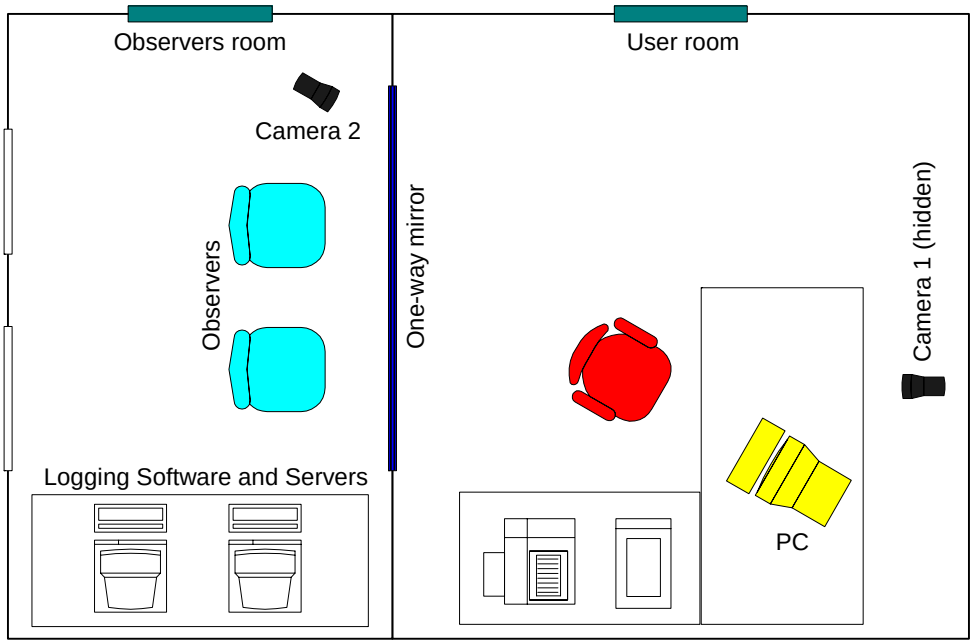

Figure 7. Usability laboratory.

Another common method for the evaluation of OLCs is the direct observation of users while they participate and interact in them. The researcher observes the users either at their working place or in a usability laboratory. Figure 7 presents a typical example of such a laboratory, where the researchers are able to see the user working through the one-way mirror, whereas the user cannot see them at all. Moreover, by the means of cameras and logging software and servers all the actions of the user can be recorded.

As far as the user actions logging method is concerned, the researcher may also use appropriate software tools to record the actions of users while they interact with OLCs' systems. By the means of these tools the actions of every user, such as the mouse movements and clicks, the keyboard inputs, the display on the user's screen etc., are stored into a database. Afterwards, the researcher may retrieve these data in order to playback these actions of each user. Figure 8 presents an example of a software logging tool.

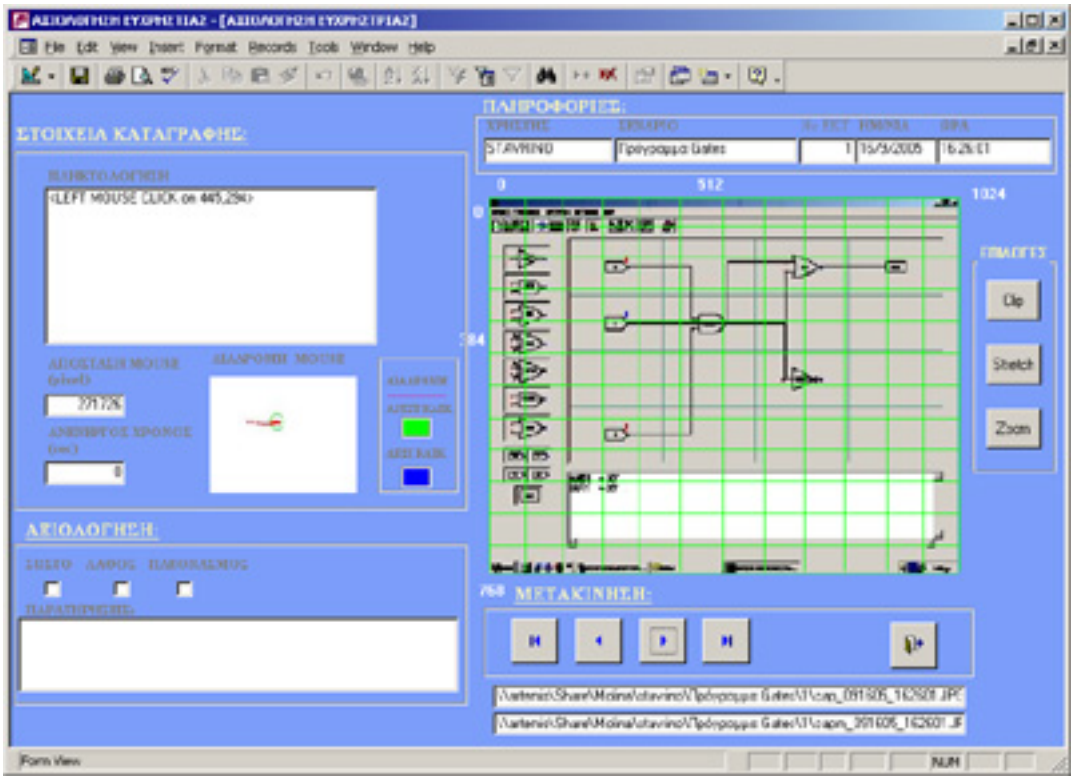

Figure 8. Example of software logging tool.

Statistical analysis method

In order to analyse statistically the data derived from the evaluation methods, an appropriate statistical method is described in this section (Stavrinoudis et al., 2005). This analysis focuses mainly on questionnaire-based surveys. However, it can be easily generalized, so that it can be applied to any of the aforementioned methods of evaluating OLCs. First of all it is assumed that all the questions of the questionnaire have a multiple-choice format and the users select predefined responses. The users are given specific instructions that the differences among the possible answers are of equal gravity, so as responses to be considered in interval scale instead of ordinal. In order to determine a user's opinion of the quality of an OLC, his/her responses to the already conducted survey must be retrieved. In the case of a structured questionnaire, the questions are clustered in groups, according to which quality characteristic they refer to.

The formula C_jO_i measures the opinion of a single user 'i' for the quality of the OLC, according to a quality characteristic 'j'. In equation (E.1) 'm' is the number of questions for this characteristic in the questionnaire, 'Q_k' is the weight given to the question 'k' and 'V_k' is the value of the response that the user selected.

$$C_jO_i = \frac{\sum_{k=1}^{m}(Q_k \cdot V_k)}{\sum_{k=1}^{m} Q_k} \quad \text{(E.1)}$$

The formula O_i measures the opinion of a single user 'i' of the quality of the OLC according to all the quality characteristics that are dealt with in the questionnaire. In equation (E.2) 'n' is the number of the different quality characteristics, 'C_j' is the weight given to the quality characteristic 'j' (by the questionnaire designer) and 'C_jO_i' is the opinion of the user for this quality characteristic.

(E.2) $$O_i = \frac{\sum_{j=1}^{n}\left(C_j \cdot C_j O_i\right)}{\sum_{j=1}^{m} C_j}$$

Finally, in order to measure the average users' opinion of the quality of an OLC, either the QWCO (Qualifications Weighed Customer Opinion) technique, which is measured using the formula shown in equation (E.3), or the $QWCO_{DS}$ (Qualifications Weighed Customer Opinion with Double Safeguards) technique, which is measured using the formula shown in equation (E.4) can be deployed.

(E.3) $$QWCO = \frac{\sum_{i=1}^{x}\left(O_i \cdot E_i\right)}{\sum_{i=1}^{x} E_i}$$

(E.4) $$QWCO_{DS} = \frac{\sum_{i=1}^{x}\left(O_i \cdot E_i \cdot \frac{S_i}{S_T} \cdot P_i\right)}{\sum_{i=1}^{x}\left(E_i \cdot \frac{S_i}{S_T} \cdot P_i\right)}$$

The aim of these techniques is to weigh users' opinions according to their qualifications. In order to achieve this, 'O_i' measures the normalised score of user's 'i' opinion, as shown at the equation (E.2), 'E_i' measures the qualifications of user 'i', while 'x' is the number of users who participated in the survey. In order to detect errors, we use a number of *safeguards* embedded in the questionnaires. Safeguard is defined as a question placed inside the questionnaire so as to measure the correctness of responses.

In equation (E.4) 'S_i' is the number of safeguards that the customer 'i' has replied to correctly, 'S_T' is the total number of safeguards and 'P_i' is a boolean variable which is set to zero in the case that one or more errors were detected by this safeguard when measuring the qualifications of user 'i'.

CONCUSIONS

This chapter defined and described the notions of online learning communities in general and OLCs more specifically and presented some of the most popular platforms and tools for building and maintaining such communities. It provided a twofold classification (learner and technology based) of tools and methods that support OLCs and suggested a number of community tools evaluation methods, along with a method for the statistical analysis of the derived data.

As regards the foreseen future trends in the field, OLCs may greatly benefit from incorporating personalization. More specifically, Rigou and Sirmakessis (2005) examine the integration of personalized functionalities in the framework of OLCs and study the advantages derived from generating dynamic adaptations on the layout, the content, as well as the learning scenarios delivered to each community student based on personal data, needs and preferences. The proposed personalization functions are based on (a) the user role in the community, (b) the level of user activity, (c) the discovery of association rules in the personal progress files of students, and (d) the predefined content correlations among learning topics. Moreover, the introduction of the Semantic Web combined with the peer-to-peer technology introduce new potential for OLCs of a much wider scale, allowing for

personalized access to distributed learning repositories and platform independent learner profiles (Dolog et al., 2004; Dolog and Schaefer, 2005).

Currently prevailing open issues that are expected to become even more important in the near future comprise privacy, security, universal access and scalability in large communities (Preece, 2000). In the case of more sophisticated community platforms, the designer should also consider issues regarding speed of interaction (system response times), accuracy of produced adaptations, loss of user control, as well as user intrusion (Rigou, 2004).

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