

# Adult Distance Learning using a Web-based Learning Management System: Methodology and Results\*

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## Abstract

In this paper, we present the methodology and results derived from a distance learning programme offered by a higher education institute to adults. Computer Science and interdisciplinary courses are offered through a Web-based Learning Management System (LMS). Administrative, technical and pedagogical issues are considered systemically and a methodology is developed taking into consideration the group of learners, appropriate learning methods, assessment methods, social and economical aspects concerning distance learning and the technological infrastructure in place. An assessment procedure is reached and carried out thoroughly involving all components of the programme. Results depict success in certain aspects of the overall programme, as well as suggestions for enhancement of the distance learning setting.

Keywords: Adult Distance Learning, Web-based Learning Management Systems, Learning Communities.

## 1. Introduction

Distance teaching and learning is becoming an increasingly important part of lower and higher education. This type of education can take place over the Internet, in which occasion instruction and educational content are delivered via the Internet. The North American Council for Online Learning (NACOL) surveyed over thirty countries, with the help of e-learning leaders from the corresponding Ministries of Education. The survey aimed to highlight international trends in distance learning for K-12 students mainly, identify distance learning initiatives and projects in individual countries, and promote international dialogue for future collaboration ([1]). The survey results showed the continuous growth in the use of distance learning educational programmes in all countries.

Nowadays, more and more higher education institutes are offering lifelong learning programmes. In [2] the results of a set of surveys and interviews conducted in twenty-one higher education institutes of various types are summarized. The results showed that the corresponding institutes consider their usage of distance learning successful for undergraduate students mainly. In addition, some potential insights into the common success factors for successful adoption of Internet-supported learning are provided.

In order to support distance learning and cooperative work, various Web-based Learning Management Systems (LMSs) have been developed such as the Web Course Tools (WebCT), the Web Course Homepage System (WebCH), the Blackboard Learning System and the System for Multimedia Integrated Learning (Smile). LMSs have become popular since they incorporate a suite of functionalities addressed to learners, tutors and system administrators. These functionalities are designed, among other services, to create, deliver and manage learning content, track and report on learner activity and progress, enable offline and online collaboration/communication and provide centralized control and administration to tutors and system administrators. All such services are integrated within a robust, web-based environment effectively supporting many simultaneous users.

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Various LMSs have been used for distance learning programmes offered by higher education institutes. To name a few, in [12] distance learning critical success factors (CSFs) as perceived by university students are specified. A survey involving 538 university students revealed eight categories of distance learning CSFs, each including several critical acceptance and success measures. In [11] the Technology Acceptance Model is extended to include technical support as a precursor and then the role of the extended model in user acceptance of WebCT is investigated. In [6] the authors examined the effects of message constraints and labels on collaborative argumentation in asynchronous online discussions via the Blackboard LMS.

Technological Educational Institutes (T.E.I.) in Greece form the technological sector of higher education. T.E.I. of Lamia provides distance learning opportunities to adults, who are Computer Science graduates, or alternatively use computers as a tool in their work, via the Blackboard LMS. This paper presents the methodology, distance learning setting and derived results.

The curriculum contains thirty-seven (37) online courses mainly in the area of Computer Science, but there are also some interdisciplinary courses. The courses have been partitioned in three categories (introductory, fundamental and advanced-specialized). So far, three semesters have been completed, with totally over three hundred participations in the courses.

Two learning models have been applied in our distance learning programme: a learner-oriented model and a hybrid one combining collaborative learning and problem-based learning. The former has been applied to the majority of courses whereas the latter to selected courses.

The assessment procedure considers both the overall distance learning setting and the knowledge acquired by learners. LMS tools and conventional methods are used to assess learning outcomes in the learner-oriented model. In courses where the hybrid pedagogical method was applied, both individual and group progress is assessed through the use of an alternative assessment method. For individual progress in the collaborative activity the learner's portfolio is assessed, where his projects, degree of interaction with the tutor, the other learners and the LMS, and his contribution in the LMS's shared resources are recorded. Interesting results have derived from the assessment process assisting in the enhancement of the educational process from semester to semester. Furthermore, the results show the satisfaction of all participants from the activity as a whole.

The paper is organized as follows. Section 2 discusses the overall design of the distance learning setting. Section 3 presents assessment methodology and results. Section 4 demonstrates aspects of the setting that can be improved. Finally, section 5 concludes and points out aspects for future work.

## **2. Design of the Distance Learning Environment**

### **2.1 Overview**

In this section, we present the overall design of the distance learning setting, encompassing learning model, human resources (teaching, technical and administrative personnel) and available technology. This design caters for effectively providing a setting for distance learning through a web-based LMS.

Thirty-seven (37) distance learning courses are provided involving various Computer Science and interdisciplinary fields (e.g. Bioinformatics, GIS, Computers in Education). The tutors have experience in teaching the same or quite similar courses at Greek higher education institutes. The courses have been organized into three categories in order to attract learners with different background and interests.

To facilitate the learning process, learners attending a course are limited to twenty at most. The learning content of each course is organized into units and consists of theory, examples, self-rating tests, unit tests, mid-term and final tests. For the creation of the learning content, LMS tools as well as other software tools have been used. The learning content includes presentations documents, animations, audio/video and SMIL files. Online and offline communication among tutors and learners is performed by employing collaboration tools of the LMS (such as shared workspace, virtual classroom, chat, discussion forum, bulletin board, email) and/or the use of the media server. The media server has been found very useful for online interaction among tutors and learners and streaming. The learning content of courses is accessible online at <http://blackboard.teilam.gr>.

We adopted two learning models: (a) a directed learning approach, namely learner-oriented model and (b) a more constructivist learning model, namely a hybrid one integrating problem-based with collaborative learning. The first model (presented in section 2.2) is the one most frequently used in our courses. The second model (presented in section 2.3) is mainly applied to advanced courses.

Apart from the learning model, other crucial factors affect success of a distance learning course as well. In [16], some of these factors are identified, namely degree of interaction, support during course and administrative/technical issues. In the following sections, our efforts to address these factors are integrated within the learning environment. In our design considerations, we took into account that, as far as web-based courses and programs are concerned, characteristics of successful online courses include among others ([16]) well-designed and structured courses, engaging collaborative activities and an interactive learning community.

## **2.2 Learner-oriented Model**

In a course carried out according to a learner-oriented scenario, the availability of learning content is combined with tests, projects and (both online and offline) interaction among tutors and learners. The scenario is implemented in a weekly or fortnightly basis. The remainder of this section presents the learning scenario.

At predetermined intervals the tutor makes available the learning content of each course unit in the LMS. Sufficient amount of time is given to learners to study the learning content. Learners interact with the tutor in an online and offline fashion by using LMS tools and/or media server functionalities. The main purpose of the interaction among learners and tutor is for the tutor to scaffold and facilitate learners in mastering course units. In most courses, online interaction is mainly accomplished with the virtual classroom and chat tools of the LMS. In certain courses, real-time audio transmission functionalities of the media server have also been employed in online interaction sessions. Offline interaction is mainly performed through messages posted on the discussion forum and bulletin board. Online interaction of the tutor with learners, takes place according to a predetermined time schedule.

To avoid coordination problems among tutor and learners during the online interaction session, learners are organized into groups of at most ten members. The organization of learners into groups takes place prior the beginning of the course. The tutor interacts with each group at different time schedules. Furthermore, certain arbitration rules are applied during online interaction of the tutor with each learner group. For instance, learners pose questions according to a predetermined (round robin) order. This means that each learner asks the tutor a question only when it is his/her turn (unless previously ordered learners do not have a question to pose). The learners' order in posing questions is determined prior to the beginning of the online interaction session.

Communication through email for posing questions to the tutor is discouraged. The reason behind this policy is that messages posted to the discussion forum by tutor and learners are available to all learners as opposed to email messages. In case the tutor receives an interesting question by a learner through email, he/she should post the question as well as the answer on the discussion forum to make it available to all other learners. Recorded audio and/or video lectures may also be stored as streaming media in the media server.

## **2.3 Hybrid Learning Model**

The hybrid learning method combines problem-based with collaborative learning. We first briefly present the two combined pedagogical methods and afterwards the hybrid one.

### **2.3.1 Problem Based Learning**

Problem Based Learning (PBL) is a pedagogical method focusing on the learner ([4]). It is primarily a 'learning-by-doing' procedure. A typical course structured according to PBL starts with the presentation of a complex and (preferably) applied problem that cannot be dealt with by learners based on their current knowledge status. Further on, the learning process focuses on two main aspects involving learners: (a) how to determine the lacking knowledge skills contributing in the handling of the problem, and (b) to learn how to acquire these skills. In other words, the learners learn 'to know what they do not know'.

The primary characteristics/advantages of the method are the following: (a) learners actively participate in the learning process, (b) learners learn to handle problems with initially unknown parameters, (c) learners learn how to effectively exploit the various information sources (i.e., books, papers, technical reports, the Web, etc.) when searching for specific knowledge items determined by them, and (d) the role of the tutor is to guide, supervise and encourage learners ([5]). In certain (extreme) cases, learners may have to find the answers to their questions by themselves.

### **2.3.2 Collaborative Learning**

Collaborative Learning (CL) in general adopts a socialized view to learning by considering that learners cooperate in order to achieve their common learning goals ([14]). CL aims to enhance individualized learning through the cooperation of individuals in working groups when fulfilling a learning task. There may also be 'group goals' requiring teamwork to be achieved. CL acknowledges that every person should play an active role for the formation of his/her knowledge. CL is applied to a 'class' encompassing the following characteristics: (a) knowledge is shared among learners and also among tutors and learners, (b) tutors act as mediators of knowledge and (c) there may be heterogeneous groups of learners.

The tutor acts as a mediator of knowledge through discussion and cooperation. Mediation in collaborative learning can be defined as scaffolding, coaching, modeling and facilitating learners throughout the learning process. Ideally, the tutor should train learners to the point they have matured enough to learn by interacting with other group members ([13], [16]).

### **2.3.3 The Hybrid Learning Model**

Research has shown difficulties in applying PBL and Collaborative Learning in the early stages of a learning process. In fact, PBL resembles (to a large degree) the research process during postgraduate studies. More specifically, the roles of postgraduate students and supervising teaching staff in postgraduate studies resemble the roles of learners and tutors in PBL ([3]).

A hybrid pedagogical method was applied integrating PBL and CL methods. The teaching process consists of two main phases: an initial phase resembling (to a large degree) the learner-oriented method and a subsequent phase based on the integration of PBL and CL methods. A more constructivist approach seems reasonable in an adult distance learning setting, taking into account that adults pursuing lifelong learning are generally exposing motivation in achieving learning objectives and willingness to cooperate in learning communities ([15]).

In the initial phase, the teaching scenario resembles the learner-oriented method. Individual and group projects are frequently assigned to learners. The purpose of these projects is threefold. Firstly, the learners' response is used to evaluate their performance. Secondly, they contribute in acquainting each learner with the other group members. Thirdly, learners within groups get used to collaborating. During the initial phase, the tutor creates groups of learners based on their knowledge level, place of residence and maturity to pass on to the next phase of the learning process. By and large, the purpose of the initial phase is twofold. On the one hand, it introduces learners into the learning process by providing the essential knowledge background. On the other hand, it points out possible problems within learners' groups and primary aspects of each learner's performance ([7], [10]).

In the second phase, a PBL approach is employed. The tutor assigns each group a specific problem, which is part of a larger problem that has to be dealt with. This means that special care should be given to the organization of the task each group has to fulfill. Some amount of time should be initially given to learners to ponder over the posed problem. Meanwhile, group members can use communication tools provided by the LMS to discuss problem issues. The recording of these discussions enables the tutor to observe the thinking process within each group. Using the available interaction facilities, the tutor may provide clarifications in case the thinking process has taken the wrong direction.

After the initial 'pondering' phase, a 'seek' phase should follow. The tutor should provide additional tips or teaching material regarding the problem. The main purpose of this phase is to assist the coordination between

group members in order to figure out by themselves how to proceed. The available communication tools are employed by learners to communicate with each other and with the tutor. This interaction also assists the coordination of the learning process, an issue that is dealt with within each group, with tutor's guidance.

## 2.4 Tutors

It is generally admitted that distance learning tutors need different skills than instructors teaching traditional courses. Some of them are described in [18]. Such skills can rarely be possessed by distance learning tutors unless they have experience as instructors in distance learning settings. To overcome this shortcoming, prior to the beginning of courses, tutors that did not have previous experience in distance learning became learners in at least one online course offered by another tutor, using the distance learning setting of our institute ([16]).

The role that the tutor must perform and the skills that he/she should possess are: (a) preparation of learning content and creation of the course environment in the LMS, (b) assessment of learners' performance, (c) online and offline scaffolding and facilitation of learning process, and (d) assessment of the distance learning setting.

## 2.5 Available Technology

An abstraction of the overall distance learning environment is depicted in Figure 1. The primary software platform supporting distance learning is the Blackboard LMS. The LMS communicates with an Oracle RDBMS storing data concerning learners, tutors and the offered courses.

The application server also hosts the project's Web site (<http://esp.inf.teilam.gr>) and the management information system (MIS) supporting the overall process. The project's Web site provides information regarding the project such as course outlines, tutors and prerequisites. The MIS consists of an RDBMS and a Web-based user interface. It provides administrative services (e.g. submission and management of candidate learners' applications, submission and management of learner and tutor questionnaires etc.) and learning process services (e.g. statistics regarding learners' performance and the learning process).

Audio and video transmission can be done either online or offline. This is achieved with the operation of the Media Server (i.e., the Helix DNA Server), which in cooperation with the Helix DNA Producer enables webcasts and video streaming (<http://www.real.com/>). The Helix DNA Server, provided that adequate network and hardware infrastructure exist, can support over a thousand simultaneous audio and video transmission sessions.

T.E.I. of Lamia provides the tutor a room fully equipped with videoconference hardware/software and also the assistance of experienced staff in order to prepare the learning content and conduct the course. Lectures can be given either online (i.e., webcasting) with the use of the Media Server or offline. In the offline case, tutor can get support for a SMIL editor to synchronize static learning content (e.g. slides, animations) with his video.

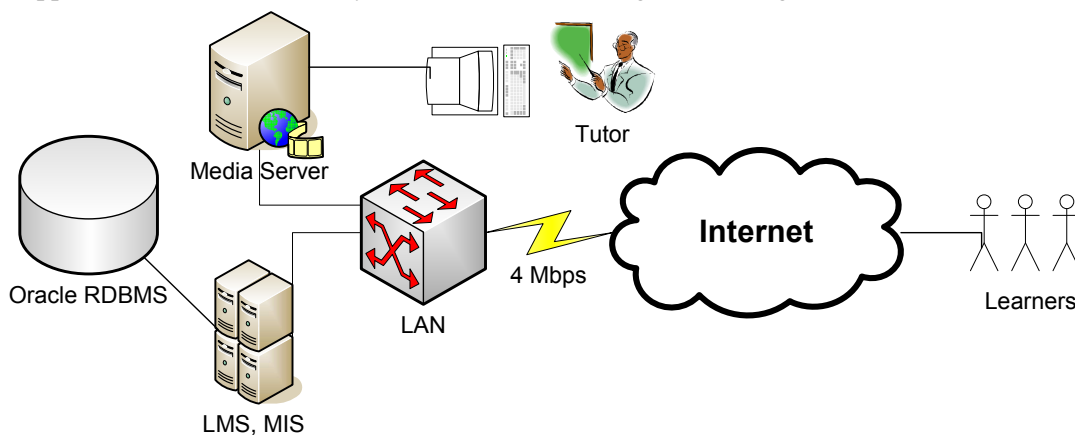


Figure 1: An abstraction of the overall distance learning setting.

### 3. Assessment Methodology and Results

Courses have been carried out for three semesters since autumn 2005. Not all thirty-seven (37) courses have been available in each of the three semesters. More specifically, ten (10), twenty-two (22) and eleven (11) courses were available in the first, second and third semester respectively. In total, the registrations for course participation were over 300. It should be mentioned that a learner is allowed to enrol to two courses at most.

#### 3.1 Assessment Methodology

Apart from the traditional assessment options offered by the LMS, we designed and applied an alternative assessment methodology that is tailored to the specific needs of our web-based courses. Alternative assessment strategies can be found at <http://www.ncrel.org/sdrs/areas/as0cont.htm>. Among the forms of alternative assessment that apply to online learning ([16]), we selected to use the portfolio assessment, where students create a collection of their work throughout the learning process that best determines their efforts and achievements. A pass/fail mark for each learner in a course is determined as a combination of all these factors.

The evaluation of learner achievement in a course, when learner-oriented approach is used, is based on the following factors: test results, assignments and participation in the discussion forum and online interaction sessions.

Learners take the following types of tests:

1. A pretest prior the beginning of the course. The purpose of this test is for the tutor to obtain an indication of the learners' knowledge level regarding the course. Furthermore, by comparing the results of the pretest and the posttest, an indication of each learner's progress is obtained.
2. Unit tests upon completion of a course unit.
3. A midterm test or project.
4. A final test. The results of the final test are compared with the results of previous tests.

Learner's degree of interaction with the LMS is an essential component of learner's portfolio, because it demonstrates learner's commitment in the course. This parameter involves aspects such as the learner's recorded activity in the shared resources of the LMS.

In the hybrid learning method, assessment of individual and group achievement ([8]) is accomplished using the portfolio approach. Another dimension of assessment, is that learners and tutors assess the distance learning setting by completing questionnaires, preparing reports and conducting face-to-face meetings.

For assessment purposes, all interactions among learners using communication tools of the LMS are recorded ([9]). In this way, the tutor will be able to observe how the learning process progresses. Progress will be assessed not only based on the final outcome but also on the recorded interactions among group members, among group members and tutor and among whole groups. Therefore, the tutor will be able to obtain a thorough view to individual and group progress. Moreover, useful conclusions could be reached concerning actions required in order to improve the learning outcome. Such actions could involve group support and encouragement of group members to collaborate among themselves and with learners of other groups.

#### 3.2 Questionnaire Results

Tutors and learners completed questionnaires to evaluate the overall process, point out aspects requiring improvement and propose their suggestions. Learners were asked to complete three questionnaires: right before the beginning of courses, at midterm and right after the end of courses. The questionnaire before the beginning of courses includes general questions regarding the interests of each learner and the reasons for choosing to participate in the distance learning process. The other two questionnaires involve the following aspects: (a) learning content evaluation, (b) evaluation of the overall process, (c) evaluation of the LMS, (d) problems encountered during the learning process, (e) suggestions for improvement of the overall process. Tutors were asked to complete questionnaires at midterm and right after the end of courses. Tutors were asked to make remarks regarding their interaction with learners and learners' response to the overall process.

The learner and tutor questionnaires (in Greek) are available online at the project's Web site (<http://esp.inf.teilam.gr>). Tutors and learners have completed questionnaires during the first three semesters that courses have been carried out. Useful conclusions have been reached from the completed questionnaires. In the following, we present part of the outcomes and discuss various interesting aspects. Elaborated questionnaire results (in Greek) can be found at the project's website. In the remainder of this section, we use the term 'final questionnaires' for questionnaires completed right after the end of courses.

### 3.2.1 Learner Questionnaire Results

A significant finding is that the vast majority of learners had none or little experience in distance learning. Another finding is that several learners had experience in using stand-alone educational software. Assessment results and administrative statistics have revealed that an overall 44% of the enrolled learners dropped the lessons two or three weeks after the lessons have commenced. 40% of the enrolled learners succeed, while the remaining 16% attend the lessons but they did not manage to succeed.

The results demonstrated the learners' motivation in acquiring knowledge as the primary reason for attending distance learning courses (34%). Flexibility in controlling pace of learning as well as learning content in certain courses are also important reasons for learners' participation.

Table 1: Learners' evaluation of learning process.

	unsatisfactory ←—————→ satisfactory					
midterm questionnaires	0%	0%	4%	35%	48%	13%
final questionnaires	0%	5%	0%	25%	40%	30%

Learners have generally expressed positive opinions about the learning process. Table 1 depicts learners' evaluation results corresponding to midterm and final questionnaires respectively. An interesting result is that right after the completion of the course, for 5% of the learners the learning process did not come up to their expectations, while in the middle of courses the same figure was 0%. In midterm questionnaires, 61% of learners expressed a very positive opinion about the learning process. The corresponding portion of very satisfied learners in final questionnaires reached 70%.

Learners classified the advantages of a distance learning setting as the ability to learn at home, the inexistence of alternative ways of learning, the ability to communicate offline and online with tutors and learners. A general disadvantage is the impersonal communication among learners and tutors.

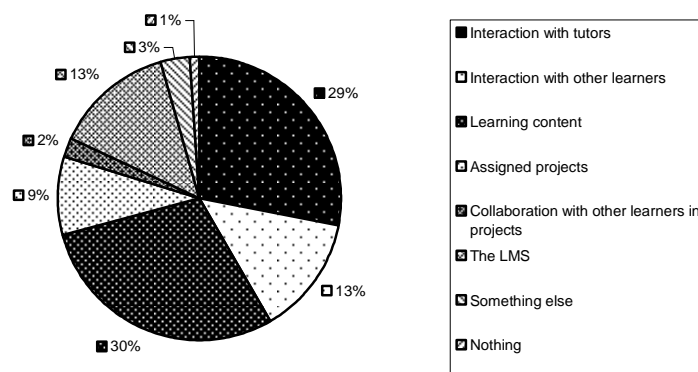


Figure 2: What learners like most in the learning process.

Additionally, learners had a positive view towards the learning process. Primary reasons for the learners' positive opinions were considered the tutors, the learning content, the LMS and the interaction with other learners (Figure 2). Working with other learners in team projects does not seem to be of importance in adding up to the overall positive views. Certain learners stressed out other learners' lack of interest in the learning process. Deficiencies in the learning process are discussed in section 4. At the end of the semester, roughly 95% of learners expressed the willingness to enrol to other courses and would also suggest to other interested learners to enrol to courses.

Table 2: Learners' satisfaction regarding interaction with other learners.

less ←-----→ more					
8%	5%	15%	34%	23%	15%

Learners were not very satisfied by their interaction with other learners (Table 2). Only 38% of learners deemed the interaction with other learners very satisfactory, while 13% deemed the interaction unsatisfactory.

Table 3: How often learners take part in online interaction sessions.

Always	Once every fortnight	Less Often	Never
57%	23%	15%	5%

Over 90% of learners accessed the LMS very often (i.e., everyday or several days a week). However, learners did not use frequently enough the discussion forum for offline communication (Figure 3), a result revealing lack of collaboration mentality (probably due to the fact that most courses adopted the learner-oriented model). Roughly 50% of learners reported to use the discussion forum very frequently (i.e., everyday or several days a week). Furthermore, online sessions are popular among learners (Table 3). Only 20% of learners reported that they do not take part in online sessions frequently.

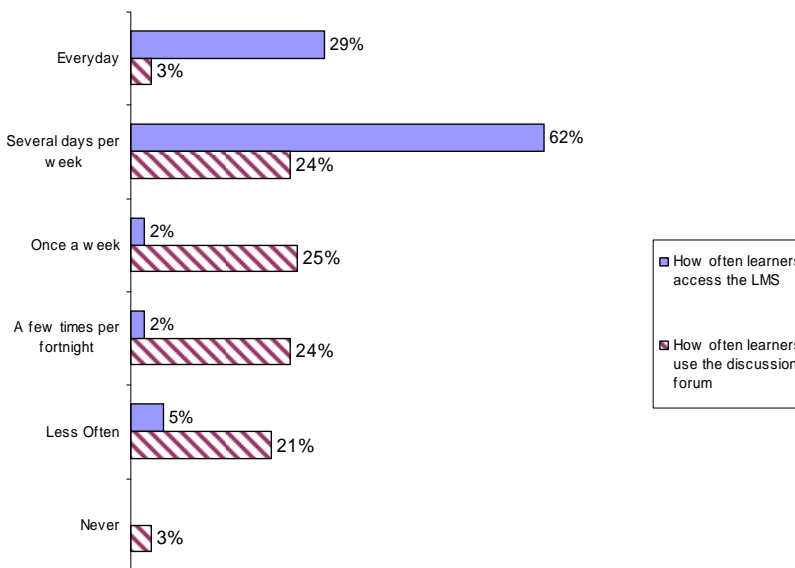


Figure 3: How often learners access the LMS and use the discussion forum.

### 3.2.2 Results from Tutors' Questionnaires and Reports

Overall, tutors expressed positive opinions about the learning process. Nevertheless, tutors were not very satisfied by learner participation in the learning process. Only 30% of tutors reported to have been very satisfied by learners' participation. It turned out that learners that had enrolled to more than two semester courses had difficulties in keeping up with the pace of the learning process. Furthermore, certain learners had not realized the distance learning requirements.

Over 95% of tutors expressed positive opinions concerning the following issues: (a) they would like to continue teaching distance learning courses in the following semesters, (b) they would suggest to other learners to enrol to the courses, (c) they would suggest to other colleagues to teach courses in a similar way and (d) they would suggest to other higher education institutes to teach courses in a similar way.

#### **4. Issues of Distance Learning Setting Requiring Improvement**

Despite the fact that the overall process has been carried out successfully, there is room for improvement. Learners and tutors were asked to point out issues requiring improvement in their questionnaires as well as proposals for their improvement. Such issues were discussed during meetings involving tutors, learners and project managers. Some deficiencies pointed out during the first semester, have already been dealt with in the second and third semester.

The following administrative issues that need to be improved have been pointed out:

- Description of a successful applicant's profile, that should be provided to potential applicants in the call for applications period: This would allow applicants to consider more thoroughly if they can meet certain requirements of the programme (familiarity with new technologies, commitment, ability to study alone or in small groups) and would therefore lead to reduced drop rates.
- Availability of sample learning content (i.e., whole course units) to candidate learners.

The following aspects have been pointed out regarding learning content:

- Further enrichment of learning content to encompass multiple representations of knowledge.
- Provision of printed teaching material: All teaching material was electronically available through the LMS and certain learners expressed the desire for availability of printed teaching material.
- Though an effort was made in order for learning content to be adjusted to the requirements of distance learning, steps need to be taken to enhance this adjustment.

The following issues concerning the learning process have been pointed out:

- Voice transmission during online communication sessions: During the first semester, online communication sessions among tutors and learners were exclusively performed by means of chat (i.e., text) messages. This means of online interaction was proven to be inadequate in certain cases. During the second semester, tutor's voice transmission was made available in online communication sessions by employing the media server. This facility has been shown to be effective in the second and third semester as it fosters the formation of community and helps sustaining the "classroom".
- Encouragement of learners to use the discussion forum.
- Greater emphasis on the hybrid model of learning: The hybrid learning model has not been extensively employed and tested during the first three semesters. One of the project goals during the following semesters is the extensive testing of the hybrid pedagogical method.
- A mini tutorial for the effective distance learner: Such a tutorial could address issues that a learner should be aware of, in order to maximize learning outcomes from the distance learning experience.

#### **5. Conclusions and Future Work**

In this work, we present an adult distance education approach supported by the use of a web-based LMS and a media server. A number of Computer Science and interdisciplinary courses were conducted and assessed. We developed a systemic methodology to carry out the programme based on state-of-art research in education and psychology concerning adult distance education and learning theories as well as taking into account available information and communication technologies.

A specific for the programme, alternative assessment method was developed, encompassing all aspects of the learning environment. Results are positive and depict that, although considerable issues must be taken into account in order for such approaches to be efficient, there is a growing interest for the potential of this method.

It should be mentioned that the installed version of LMS does not support the SCORM standard that would facilitate construction and sharing of the teaching material through the use of metadata. We plan to tackle this issue as part of our future work.

## References

- [1] A. Powell and S. Patrick, "An International Perspective of K-12 Online Learning: A Summary of the 2006 NACOL International E-Learning Survey", November 2006.
- [2] R. Abel, "Achieving Success in Internet-Supported learning in Higher Education: Case Studies Illuminate Success Factors, Challenges, and Future Directions", Available online via [http://www.a-hec.org/IsL\\_orig\\_study.html](http://www.a-hec.org/IsL_orig_study.html), 2005.
- [3] M. Albanese, S. Mitchell, "Problem-based learning: a review of literature on its outcomes and implementation issues", *Academic Medicine*, 68(1), pp. 52-81, 1993.
- [4] P. Ertmer, T. Newby, "Behaviorism, Cognitivism, Constructivism: Comparing critical features from an instructional design perspective", *Performance Improvement Quarterly*, 6(4), pp. 50-72, 1993.
- [5] B. Hoffman, D. Ritchie, "Using multimedia to overcome the problems with problem-based learning", *Instructional Science*, 25(2), pp. 97-115, 1997.
- [6] Jeong, S. Joung, "Scaffolding collaborative argumentation in asynchronous discussions with message constraints and message labels", *Computers & Education*, to appear.
- [7] D. H. Jonassen, K. L. Peck, and B. G. Wilson, "Learning with Technology: A Constructivist Perspective", Merrill, Prentice Hall, 1999.
- [8] P. Lampsas, V. Triantafylloy, and K. Antonis, "On the Systemic Overview of the Introduction of Information and Communication Technologies in Learning Environments", *Open Education Journal*, 2(4), pp. 36-50, 2006.
- [9] J. Lave, E. Wenger, "Situated Learning: Legitimate Peripheral Participation", Cambridge University Press, 1991.
- [10] Y. Miao, J.M. Fleschutz, and P. Zentel, "Enriching Learning Contexts to Support Communities of Practice", Integrated Publication and Information Systems Institute (IPSI), in Proc. of CSCL, 1999.
- [11] E.W.T. Ngai, J.K.L. Poon, and Y.H.C. Chan, "Empirical examination of the adoption of WebCT using TAM", *Computers & Education*, Volume 48, Issue 2, February 2007, pp. 250-267.
- [12] H. Selim, "Critical success factors for e-learning acceptance: Confirmatory factor models", *Computers and Education*, 2005, available online 2 November 2005.
- [13] R. E. Slavin, "Cooperative Learning: Theory, Research and Practice", Prentice Hall. 1990.
- [14] L. S. Vygotsky, "Mind in Society", Harvard University Press, 1978.
- [15] E. Wenger, "Communities of practice: Learning, meaning, and identity", Cambridge Univ. Press, 1999.
- [16] M. D. Roblyer. "Integrating Educational Technology into Teaching", 4<sup>th</sup> edition, Prentice-Hall, 2005.
- [17] B. G. Wilson, "Metaphors for Instruction: Why we talk about learning environments", *Educational Technology*, 35(5), pages 25-30, 1996.
- [18] T. E. Cyr, "Competence in teaching at a distance", In T. E. Cyr (Ed.) *Teaching and Learning at a distance: What it takes to effectively design, deliver and evaluate programs*, Jossey-Bass, 1997.