# The Blended Learning Ecosystem of an Academic Institution in Greece

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## ABSTRACT

Blended learning has been recognized as the most promising emerging trend in higher education, offering new capabilities, as it may significantly enhance the interaction and communication between instructors and students. The challenge of blended learning is to balance the weaknesses and strengths of face-to-face and e-learning teaching environments and effectively combine them to provide enhanced learning capabilities. Its success should benefit instructor-student relation. To this end, we adopt ecosystem-based approach to model the blended learning environment and identify its constituents (instructors, students, consultants, technology) and their evolving relations. The proposed concept was utilized to explore the potential of blended learning in the academic environment. A study was conducted in Harokopio University of Athens over a period of three years to explore the relations between blended learning ecosystem constituents, focusing on instructor -student relation. Towards this direction, students and faculty members participated in the study on a voluntary basis. The methodology applied, data analysis and major observations deduced are discussed in the paper.

*Keywords:*

Blended learning, blended learning ecosystem, assessment of learning methods, higher education, case study

# INTRODUCTION

The term “blended learning” is being frequently used in both academic and corporate institutions during the last few years. As stated in Rooney (2003), the American Society of Training and Development identified blended learning as one of the top ten trends to emerge in the knowledge delivery sector. Blended learning has also been widely recognized as the most promising emerging trend in higher education (Bonk et. al., 2006; Garrison and Hanuka, 2004; Young, 2002). Blended learning offers new capabilities for education, as it may significantly enhance the interaction and communication between educators and learners. There were many efforts to define blended learning (Bonk et. al., 2006). In the following, we adopt the definition presented by Graham (2006), according to which *Blended Learning* or *Hybrid Learning* is defined as the combination of face-to-face with computer-mediated instruction, identifying the central role of computer-based technology in the delivery of knowledge. In practice, one could realize blended learning as e-learning methods combined with traditional face-to-face teaching (So and Bush, 2008; Olapirivakul and Sher, 2006; Bonk et. al., 2006).

While e-learning emphasizes on learner-material interaction, face-to-face learning environments place priority to human-to-human interaction. The evolving symbiosis of technology with traditional pedagogical approaches, facilitating content richness, flexible content access and alternative communication channels, may benefit the learning process. However, it also introduces complexity, as it is more difficult to manage the increased number of learning channels and more time consuming to set up a blended course. The challenge of blended learning methods is to balance the weaknesses and strengths of face-to-face and e-learning teaching environments and effectively combine them to provide enhanced learning capabilities. This is not a trivial task, especially since

computer-based and more specifically e-learning technology is constantly evolving (Varlamis and Apostolakis, 2007). Apparently, blended learning methods create more complex relations between educators, learners, technicians, etc., i.e. stakeholders. They are *stakeholders* in the sense that they have a stake in the educational environment, the quality of which is affected by them and which, in turn, affects them. For blended learning to be successful, interrelations between stakeholders should be effectively explored. To this end, we adopt the concept of blended learning ecosystem, based on the principles introduced in Uden et al. (2007), in order to specify all the required constituents of such an environment and their respective interactions in a consistent manner. In biology, an ecosystem is a complex, dynamic functional unit consisting of a community of groups of organisms, interacting with each other as well as with the environment within which they live (Uden et al., 2007). Likewise, the blended learning ecosystem formed in an academic environment comprises different stakeholders, e.g. individual groups (instructors, students, consultants, technicians), utilizing e-learning technology, that are becoming increasingly collaborative, and through their interactions dynamically transform the ecosystem, thus leading to the gradual formation of a new learning paradigm. The ecosystem metaphor proposed in this paper focuses on assessing the way the relations between individual groups is affected by the introduction of e-learning technology, which is constantly changing. It may contribute to the constant assessment of blended learning environments, since it may enable a systematic way to monitor and access the evolution of the learning process, by evaluating the impact of specific technology features on it. It should be noted that the ecosystem metaphor has been widely used to explore different learning paradigms, even if e-learning features are not utilized (Babar and Roth, 2006). Corresponding learning environments may be constructed by utilizing technology, though this is not necessary.

This issue, though important, is not the focus of the paper. The approach proposed, may be used to evaluate the effect on instructor-student relation, when adopting such learning features.

The blended learning ecosystem discussed in the following, is formed in the Harokopio University in Athens, Greece, where blended learning methods have been systematically explored since 2004. The University administration received a grant from the Ministry of Education for that purpose and initiated a study involving students and faculty members. We mainly focused on the impact of blended learning features on undergraduate studies and especially on mandatory courses provided during the first two years of the curriculum.

The scope of this paper is, first to identify and describe the new kind of interactions evolving between instructors and students and the underlying e-learning technology infrastructure, based on the ecosystem metaphor, and, second, to identify factors influencing the extent and nature of blended learning utilization. In order to do so, a study was conducted with the participation of both instructors and students on a voluntary basis of a period of three years. The approach adopted combines the analysis of both qualitative (interviews) and quantitative data (questionnaires). The analysis of the case study (i.e. the application of blended learning to Harokopio University) was conducted using inferential statistics (i.e. for analyzing the questionnaires of students), in addition to interviews of instructors and technology specialists.

The paper is organized as follows: First, relative endeavors relevant to blended learning are discussed. Following, the constituents of a blended learning ecosystem are identified and analytically discussed. Based on these constituents, the blended learning ecosystem of Harokopio University is presented. Since it forms the basis of our research, it is important to familiarize the reader with the specific ecosystem to promote the understanding of the research objectives and the evaluation of the results. The research approach, data analysis and result interpretations are

described in the following sections. The last section includes conclusions and considerations for future work.

## RELATIVE WORK

Blended or hybrid learning is gaining importance over the last few years, while it is applied to various areas of education, as for example, teacher education (El-Deghaidy and Nouby, 2008; Kennedy and Hinkley, 2009; Owston et al., 2008), medical students education (Cockbain et. al., 2009; Maley et al., 2008), social workers training (Cooner and Hickman, 2008) and job education of nurses (Sung et al., 2008). Blended courses may increase student learning performance while lowering attrition rates with equivalent fully online courses (Dziuban et al., 2004). Blended learning methods provide new learning experience for students (Olapiriyakul and Sher, 2006) and, in addition, they have several positive externalities over traditional classroom teaching, since it can be cost effective and enhance learning methods and media (Ginns and Ellis, 2007; Sung et al., 2008; Roy et al., 2008). There are two, not mutually exclusive, ways to adopt the new technologies that are becoming available: either by using them as a complement or a substitute of traditional methods or to develop pedagogical innovations through them. For the time being, blended learning endeavors emphasize on an adaptation of traditional methods to the new means, rather than on true innovation (Dutton et al., 2004; Dillenbourg, 2008). However, it should be stressed that relying less on face-to-face interaction between instructors and students, the effectiveness of blended learning is by no means less dependent on the instructor's expertise and support than traditional classroom teaching (Paechter et al., 2009). According to Owston et al. (2008) the main rationales for blended learning are ameliorated teaching, better learning outcomes, increased flexibility, improved accessibility to learning and cost effectiveness of the overall learning procedure.

After establishing the potential of blended learning, there are several efforts in the literature to identify factors influencing its adoption. Dutton et al. (2004) suggest that the variables usually thought to affect use of computer-based resources (e.g. age, educational background) do not seem to affect the degree of adoption, at least in cases that relevant electronic platform is easy to use. The flexibility in the potential use of a platform, in the sense that it can accommodate a range of different instructing styles, is clearly distinguished as an important factor fostering adoption and use (Dutton et al., 2004; de Freitas and Oliver, 2005). De Freitas and Oliver (2005) have focused on the role of technical support and through their study have confirmed its importance for the adoption of e-learning features. Also, they argue that the collaboration among instructors and between instructors and supporting technical staff is very important in order to produce high level materials and to spread good practices. This is important as some universities rushed to set up the necessary technological infrastructure without providing adequate support to their faculty, in technical but also in pedagogical terms, for using it (Georgina and Olson, 2008). Moreover, Derntl and Motschnig-Pitnik (2005) stated that the effectiveness and added value of a blended learning scheme is highly related to the development of advanced skills for the educators and to the utilisation of reliable and easy to use technology. Students seem to value increased access to instructing material and especially the possibility to work on and off-campus (Dutton et al., 2004; de Freitas and Oliver, 2005). There is limited evidence that this access may negatively influence classroom presence (Dutton et al., 2004).

Most of the aforementioned studies focus on the relation between either instructors or students and the technological infrastructure (i.e. e-learning features). Some other studies focus on the benefits for students engaged in blended learning environments. For example, Ginns and Ellis (2007) explored student perceptions of the e-learning environment supporting blended learning

while they also indicated a beneficiary impact on student grades. In (Collis, 2004), criteria for evaluating the success of blended learning methodologies are proposed.

In the following, we focus on the effect of blended learning in the instructor – student relation, which is bi-directional and constantly affected by the technology available. The introduction of technology in the learning process involves another category of humans in it, the technology specialists that support information technology and more importantly the people using it. Since technology is constantly changing, the relation between different categories of people utilizing it also evolves. It would by interesting to study the effect of blended learning on the relations between all groups participating in this process, and do so in a dynamic rather than a static fashion. Thus, monitor the changes in those relations as technology is progressing. To explore the evolving relations between instructors, students and other groups involved in blended learning, an ecosystem-based approach is explored.

The term *e-learning ecosystem* has been adopted by a number of researchers to explore the complexity of e-learning environments (Gütl and Chang, 2008). Ecosystem-based models are introduced to describe the constituents of e-learning environments in different levels of complexity and study their interaction to enhance e-learning capabilities and services. The ecosystem-based model introduced by Brodo (2006) is used in Uden et al. (2007) to explore e-learning features. As suggested by Brodo, an e-learning ecosystem comprises three main elements: content providers, consultants and infrastructure. All three elements should interact effectively to provide high-level e-learning services (Varlamis and Apostolakis, 2006). The term ecosystem in this case is introduced to depict the evolving relation between content providers, the available technology to produce learning content and the consultants supporting them in their effort. The content itself is not considered as a constituent, as it is viewed as the outcome of the overall process. In (Gütl and

Chang, 2008) a distinction between abiotic and biotic units the e-learning ecosystem is made, where abiotic units consist of all learning utilities and biotic ones of all the stakeholders involved in e-learning. Furthermore, in (Chang, 2008) an attempt is made to propose indicators used to evaluate an e-learning ecosystem. These indicators describe its success and are evaluated viewing the ecosystem from outside, thus having a black-box view of it. We argue that such an ecosystem can also be evaluated by examining the relations between its constituents, either biotic or abiotic. The e-learning ecosystem concept has also been adopted in (Dong et. al., 2009), where the underlying technology was discussed.

On a different approach, the ecosystem metaphor has also been adopted in (Zhao et. al., 2006) to theoretically integrate and organize sets of factors that affect implementation of computer technology in schools and better understand other educational innovations. In this case, schools were viewed as ecosystem inhabited by different species indicating teacher, students and their familiarity with computer technology. Technology use was considered as an invasion, causing the ecosystem adjustment. A similar approach was also presented in (Ficheman and Lopes, 2008), where the dissemination of digital technology in children's everyday life was studied.

It should be noted, that the term ecosystem has been widely used to explore different learning paradigms, even if e-learning features are not utilized. In (Babar and Roth, 2006), ecosystem-based teaching methods are discussed to allow student to create knowledge on their own during the learning process. Corresponding learning environments may be constructed by utilizing technology, though this is not necessary. Apparently a blended learning environment may promote such efforts. A similar approach based on experience obtained within the classroom is presented in (Grotzer et. al., 2009).

In the following, we adopt the ecosystem metaphor, as suggested in Brodo (2006) to

describe an e-learning ecosystem constituents, and extent it to model the blended learning environment. Based on this model, the corresponding stakeholder's relations, treated as biotic units of the ecosystem, are evaluated in the academic environment of Harokopio University of Athens.

## THE BLENDED LEARNING ECOSYSTEM

Based on the concepts introduced in (Brodo, 2006) and (Uden et al., 2007), we adopt the term blended learning ecosystem, to effectively explore the relationships between the stakeholders involved and the necessary computer-based technology. As in e-learning ecosystems, content providers and consultants are identified as stakeholders. Furthermore, since face-to-face learning also takes place, content consumers play an important role, actively contributing in the learning process. Thus, content providers, content consumers and consultants consist the biotic units of the blended learning ecosystem. It follows that e-learning technology is an intrinsic part of the ecosystem (abiotic units).

The content itself is not considered as a constituent in our approach as well, since it is perceived as one of the means of communication between content providers and content consumers. In our case, the ecosystem paradigm is considered to monitor the changes in the relations between blended learning participants as technology is progressing. Specific on-line or face-to-face learning paradigms adopted in the blended learning environment are considered as discrete features of the technology used and are assessed individually, as they affect the relation between blended learning participant groups. Such features may include ecosystem-based teaching approaches as those discussed in (Babar and Roth, 2006; Grotzer et. al., 2009).

According to our point of view, a blended learning ecosystem consists of four main elements, as presented in Figure 1.

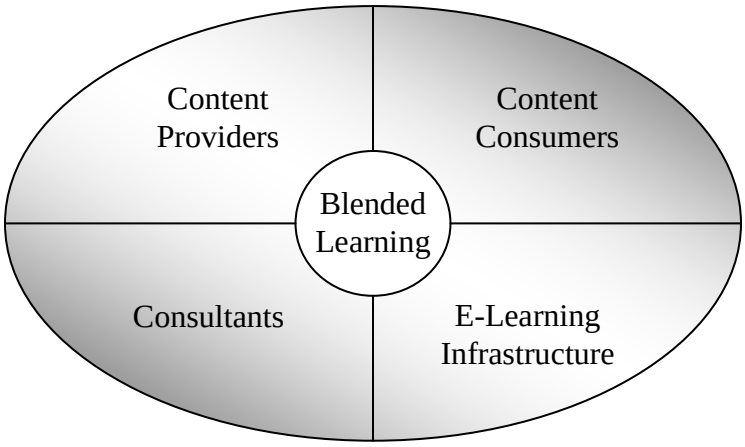


**Figure 1: Blended Learning Ecosystem Constituents**

*Content providers* are those developing and/or offering the content for learning, while *content consumers* are those expressing interest in exploiting the content for educational purposes. Content consumers are considered important as their actions constitute stimuli for content providers. Besides, a great deal of the latter's activities are oriented towards content consumers. Consequently, content consumers affect and are affected by the blended learning ecosystem and hence they should be regarded as one of its constituents. *Consultants* are responsible for supporting education either from a strategic point of view, i.e. offering advice and guidelines for the deployment and application of educational practices and evaluating educational content, or from a technological perspective, i.e. offering technical help and maintenance of the technological infrastructure and assisting in the creation and deployment of digital educational material. *Infrastructure* comprises all necessary hardware and software for providing any kind of e-learning services (simple or complex ones) and, as such, it plays a significant role in the blended learning ecosystem.

The e-learning infrastructure comprises four types of systems (Morten, 2002): *Content Creation Tools, Learning Management Systems, Student Management Systems* and *Accounting Systems*. Content creation tools are those used by content providers to compose the electronic learning material, i.e. text, images, video, animation, etc. They comprise generic tools with few

features developed for e-learning purposes and tools specially developed for the creation of educational content. Learning management systems are those used for management and organization of e-learning courses. Also they provide access to on-line learning services to learners, instructors and administrators. Student management systems are used for the administration of students, courses, exams, grades, etc. Accounting systems are used for recording the economic transactions between the institution and the content providers and consumers.

In essence, the introduction of e-learning infrastructure is the component that has differentiated the traditional educational model and has introduced new complexity in the interactions of ecosystem individuals. As shown in Figure 2a, in the traditional face-to-face model, three types of relations are specified (all between humans): a) between content providers and content consumers, b) between content providers and consultants, and c) between consultants and content consumers. In traditional learning, consultants are people designated by the educational institute itself or by another authority in order to provide guidelines or specifications for various educational matters.

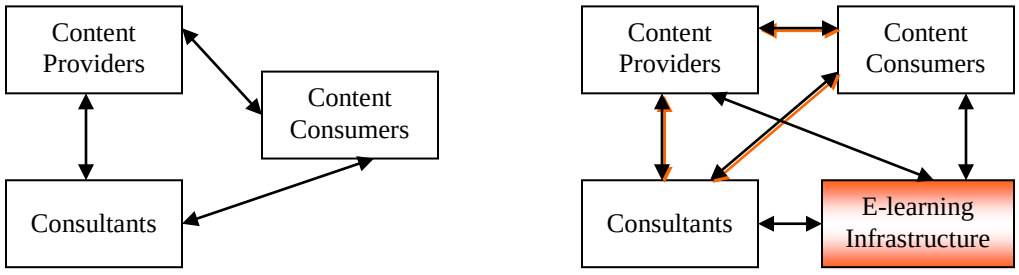


**Figure 2: (a) Entities and interrelations in traditional face-to-face learning**
**(b) Entities and interrelations in blended learning**

The introduction of e-learning infrastructure as an abiotic unit, which facilitates non-direct communication between biotic ones (i.e. humans), created three additional relations between humans and technology, thus, bringing about organizational change (de Freitas and Oliver, 2005):

a) between content providers and infrastructure, b) between content consumers and infrastructure, c) between consultants and infrastructure. Moreover, it altered existing relations, as implied by the shade in the respective arrows, especially between content providers and consumers. The role of consultants is also affected, since another consultant group was added apart from strategic consultant. *Technology specialists,* regarded as consultants, are responsible for supporting the use of e-learning technology and digital material creation. By adding new technology features, e-learning technology is constantly evolving, thus all the relations depicted in figure 2a also evolve. This is why the term ecosystem was chosen to describe the blended learning environment. Furthermore, in order to evaluate the introduction of a new technology feature, one should explore how it affects all the relations between the ecosystem elements. The methods chosen to depict and evaluate this effect may also vary, though, as humans play a significant part in blended learning, interviews and surveys should most commonly be applied.

In the following, we focus on: a) the impact of technology on the relation between content providers and content consumers, b) the relations between content providers and e-learning infrastructure as well as technology specialists, and c) the relations between content consumers and e-learning infrastructure as well as technology specialists. It is assumed that technology specialists provide all necessary support to both content providers and content consumers to effectively use the e-learning infrastructure. These five relations are explored based on the research contacted in Harokopio University of Athens during a period of three years. The blended ecosystem formed is described in the following section in respect to the four constituents identified in figure 2(b).

## The Blended Learning Ecosystem of Harokopio University of Athens

### *Content Providers*

The main content providers in the case of a University are the instructors. Harokopio University nurtures scientific fields of diverse scope. The University departments participating in the study are: a) Geography, b) Home Economics and Ecology, and c) Dietetics and Nutritional Science. Instructors cover the whole range of computer familiarity, from being very familiar to being not familiar at all, due to their age, educational background, field of expertise and personal interest. They teach different types of courses, purely theoretical or applied.

### *Content Consumers*

The undergraduate students of Harokopio University have different background and skills depending on their studies. Based on the observations of our research team, students of Geography are usually more open to technology mainly due to their intense involvement with Geographical Information Systems. On the other hand, students of Home Economics and Ecology are less exposed to information technology, as the theoretical nature of this department does not encourage them to use technology. Students of Dietetics and Nutritional Science are placed somewhere in between.

### *E-Learning Infrastructure*

Management and delivery of the learning content was realized through a web-based learning management system (LMS), called *e-class* (http://eclass.hua.gr). E-class is an open source LMS supported by the Greek University Network (GUnet) association for e-learning purposes. The scope of GUnet is to utilize open-source technology to provide common network-based applications (as mail/web servers or digital content management systems) to the members of the Greek academic

community and assist them in maintaining and customizing them according to their needs. Greek language support is one of its main concerns. In Harokopio University, the e-class platform runs on an Apache web server using MySQL database management system installed on a Windows 2003 Server.

Through e-class, instructors can provide the course content, announcements that can be automatically sent by email to the students, self-testing exercises such as multiple choices, and digital material, such as presentations, text files, links, simulations and videos, while they can also manage and rate exercises and projects. Besides managing their courses, instructors using e-class may also manage the group of students that attend them. A course may be specified as open, or require registration or be restricted to certain students defined by the instructor. Lastly, instructors can view statistics concerning student participation and access in their courses. Since Harokopio is a public University and education is offered free of charge, there is no cost for the students, accessing e-class platform.

*Technology Specialists (Consultants)*

E-class platform is supported by the Network Operating Center (NOC) of the University. The NOC is responsible for conducting hands-on seminars to demonstrate e-class usage for both instructors and students twice a year (at the beginning of each academic semester), while it also provides on-line usage instructions and support. Furthermore, the software engineers responsible for e-class platform administration and support, also aid instructors to develop digital content for their courses, for example simulations or videos, and solve technical problems. They play the role of technology consultants, aiming to facilitate the familiarization of instructors and students with the e-learning platform and effectively promote e-class usage.

While instructors organized the blended learning strategy for their courses mainly on their own, they were given general guidelines by the University as part of the pilot project objectives.

## METHODOLOGY

Case study research relies on multiple sources of evidence, i.e. it should be carried out in a manner that incorporates the views of all the "actors" in the case study (Yin, 1994). Our approach is based on the examination of the case study from both a positivist and interpretive approach. Lee (1991) refers to "interpretive approach" to describe such procedures as those associated with ethnography, hermeneutics, phenomenology and case studies. By the "positivist approach", the same author refers to such procedures as those associated with inferential statistics, hypothesis testing, mathematical analysis, and experimental and quasi-experimental design. Lee (1991) demonstrated how the two approaches are mutually supportive, rather that mutually exclusive. Moreover, Cavaye (1996) states that case study research is an acceptable research strategy in Information Systems area, in general, and that qualitative and quantitative data can be combined and used together.

The study on the impact of blended learning in Harokopio University commenced in 2005 and ended in 2007. The overall objective of the project was to implement a blended learning approach for various courses in the three departments of the University. During this period, e-learning methods were applied in a blended manner with face-to-face learning. Blended learning was introduced in specific courses of the three departments involved, selected on the basis of voluntary participation of their instructors.

The evaluation of the pilot implementation was conducted in two phases, during the academic years 2004-2005 and 2006-2007, respectively. The aim of the evaluation was to investigate the experiences of both students and instructors in an organised manner and collect

feedback for the overall improvement brought by the blended learning process. The evaluation by the students was performed via a structured, closed-type questionnaire, as other studies conducted in the University indicated that this is the preferred method by them and would encourage participation. An open-type questionnaire section was also included to enable students to express their opinion regarding blended learning methods and e-class infrastructure. Very few students actually filled the free text section. Some of their comments are incorporated in the qualitative analysis presented in the Discussion section. The instructors were interviewed and filled in an open-type questionnaire in order to qualitatively investigate their opinion. The three technology specialists, supporting this endeavour, were also interviewed regarding the difficulties faced by both instructors and students.

The closed type questionnaire, filled in by the students, consisted of 12 questions plus questions on demographics (age and sex). The first part concerned the availability of: a) computers at the students' residence, b) connection to the Internet, and c) the students self assessment on their computer literacy. In the main body of the questionnaire, questions were classified into two sections. The first section referred to students' attitudes and views on the e-class platform, its corresponding services and blended learning; the second concerned practices related to the e-class platform. In the questionnaire, ordinal variables were measured, while the attitudes/views were measured by Likert 5 scale. Indicative questions from both sections are presented in Table 1.

Eight undergraduate and two postgraduate courses were included in the study. Five of them were developed by the two instructors of the Department of Geography (GEO), two from the Department of Home Economics and Ecology (HEE) and three from the Department of Dietetics and Nutritional Science (DNS). The specific names of the courses are included in Table 2. The nature of each course (theoretical or applied) is also mentioned, while individual instructors

teaching each course are identified by letters, to indicate which courses are taught by the same instructor.

**Table 1**
**Indicative questions of the student questionnaire**

| |
|---|
| ***Section 1: Attitudes and views*** |
| - How useful do you consider e-class platform? |
| - How user-friendly do you consider e-class platform? |
| - How effective do you consider its services? |
| - Assess in terms of usefulness the secondary services |
| ***Section 2: Practices*** |
| - How often do you use each of the secondary platform services? |
| - How often do you use e-class during the semester? |
| - In which field do you use e-class mostly? |
| - How did the introduction of blended learning influence your physical presence to the classes? |

A total of 251 questionnaires (N=251) were collected by students who had attended at least one of these courses on a voluntary basis. 66% of them were female and 44% male. 44% of the students who filled the questionnaire studied Geography, 29% Dietetics and Nutritional Science and 27% Home Economics and Ecology. The statistical analysis of the questionnaires included, initially, descriptive statistics and factor analysis. Some secondary analyses followed: the factors revealed by factor analysis were utilized as independent variables and correlated to the rest of the variables in the questionnaire. This process utilized the extraction of conclusions regarding the way students were using e-class with respect to their previous experience with information technology and how this affected their relationship with instructors.

As stated by Brew (2008) “Making the transition from a traditional face-to-face course to a blended learning course is not simple”. The six instructors, two from each department, who participated in the study, were asked to report their experiences via an open type questionnaire. All of them (5 males and 1 female) hold PhDs, are in their early 40s and participated voluntarily to the

research. None of them had any previous experience on blended learning. In this interview, the instructors provided answers about: a) the e-learning services they deemed more useful for their courses; b) the contribution of the e-learning platform to the educational procedure; c) the difficulties/problems they encountered in supporting blended learning; d) possible enhancements of the provided services or additional services that could be offered; and e) the students' receptiveness to the new methods. Only qualitative analysis of those data was performed.

**Table 2**
**Courses participating in the study**
*(note: UG: Undergraduate, PG: Postgraduate)*

| | Title | Instructor | Nature |
|---|---|---|---|
| 1 | IT applications (GEO/UG) | A | Applied |
| 2 | Environmental Protection Technologies (GEO/UG) | B | Applied |
| 3 | Environmental Quality Assurance (GEO/UG) | B | Theoretical |
| 4 | Geographical Information Systems I & II (GEO/UG) | C | Applied |
| 5 | Nutrition & Exercise (DNS/UG) | D | Applied |
| 6 | Dietary Treatment for Trainees (DNS/PG) | D | Applied |
| 7 | Exercise Physiology (DNS/PG) | D | Applied |
| 8 | Global Environmental Problems (HEE/UG) | E | Theoretical |
| 9 | Environmental Biology (HEE/UG) | F | Applied |

The most important results of the evaluation from the stakeholders of Harokopio University blended learning ecosystem are presented in the following sections.

## DATA ANALYSIS

The presentation of data analysis is divided in three parts. The first concerns data collected through the questionnaires filled by the students, while the second involves data collected through the interviews of the instructors. The third one summarizes the observations of technology specialists regarding their cooperation with both students and instructors.

## Blended Learning Evaluation by the Students

### *Self assessment of computer literacy*

Regarding the student's self-assessment of their familiarity with computer and Internet usage, the introductory part of the questionnaire was processed. Most of the students (91%) have a computer at their residence, while 70% of them have Internet access. These statistics are almost the same for the three Departments participating in the study. All the students consider that they are computer literate, while almost 55% of them consider themselves as expert users. The percentage of expert users (self evaluation) in the three Departments differs. In the Department of Geography 62% of the students consider themselves as expert users, while more than 55% of the students studying Dietetics and Nutritional Science have the same opinion. In the Department of Home Economics and Ecology almost 47% of the students consider themselves as expert users.

### *Usage of E-class platform*

All the students participated in the hands-on seminars conducted by technology specialists. Almost all of them (98%) claimed they had no difficulty familiarizing with and using e-class platform. Most of them claimed they did not have to contact technology specialists for assistance. When they did, they rarely did it in person; the most preferred way of contact was via e-mail (92%). Though, almost 22% of them did not actually use the platform (accessed it less than 5 times during a semester). No correlation between e-class usage and student's familiarity with technology was identified. From the rest of them, all students claimed they accessed the platform prior to the examination period, while more than half claimed that they were regular users (accessed it more than twice a week). These statistics are similar in all three Departments.

E-class platform supports a number of services, utilized by the instructors in their courses. These are: *module description,* providing information about the scope and content of the course, *agenda,* enabling the instructor to provide information regarding the progress of the course during the semester (for example lecture timetable or assignment deadlines), *links,* providing useful links and material, *announcements,* facilitating announcement posting that could be automatically e-mailed to students registered in the course, *material,* enabling digital material download, *assignments,* enabling assignment management, *student projects,* enabling group assignment management, *discussion board,* facilitating the structured discussion between the instructor and students upon a specific subject and *chat,* supporting free discussion between the users of the platform. All of them were used during the study.

Students were asked to rank the provided service according to their usage and perceived usefulness. They reported that the three most frequently used services of e-class platform are: material download (74%), announcements (68%) and assignments (54%).

Factor analysis was performed to explore the relationship between the perceived usefulness of each one of the individual e-class services and their usage frequency.

### *Perceived usefulness of E-class platform services*

Usage and usability variables of the questionnaire were subjected to principal components analysis (PCA). Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients with values of 0.3 and above. The Barlett's Test of Sphericity reached statistical significance, the null hypothesis that the correlation matrix is an identity matrix was rejected, and therefore factor analysis is considered appropriate. The Kaiser-Meyer-Olkin value was mediocre (0.618), exceeding however the recommended value of 0.6. Thus, the factors extracted will account for a fair but not a substantial

amount of variance (Pett et al., 2003). Principal components analysis revealed the presence of five components with eigenvalues exceeding 1, explaining 16.30%, 15.65%, 12.80%, 11.35% and 8.90% respectively. Table 3 presents the five factors revealed by the analysis.

**Table 3**
**Factor analysis on the usefulness of the individual e-class services**

| Variable | Loading |
|---|---|
| *I. Teaching process* | |
| assignments | 0,775 |
| student projects | 0,879 |
| *II. Cooperation* | |
| discussion board | 0,906 |
| chat | 0,882 |
| *III. Updating* | |
| announcements | 0,593 |
| material | 0,59 |
| *IV. Additional information* | |
| agenda | 0,648 |
| links | 0,826 |
| *V. Module description* | 0,925 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

More specifically, factor 1 (the most powerful) includes “assignments” and “student projects”, is termed as *teaching process* and is related to assignment/project management using the e-learning platform. Factor 2, termed as *cooperation*, includes “discussion board” and “chat” and is related to instructor-student interaction. Factor 3 includes “announcements” and “material”, is termed as

*updating* and is related to the provision of any type of digital teaching material. Factor 4, termed as *additional information*, includes "agenda" and "links". Finally, the 5th factor consists of a single variable "module description". The high values for each of these factors express frequent use and perceived usefulness of the relevant services, which contribute to the development of that factor. The five service categories revealed by factor analysis are summarized in figure 3.

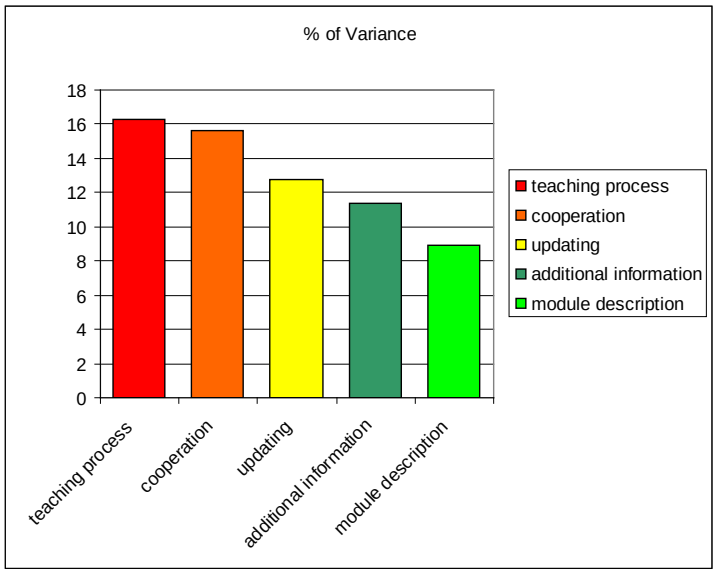


**Figure 3: E-class service categories revealed by factor analysis and their perceived usefulness**

The five factors arisen were then used as independent variables for secondary analyses. Using the independent-samples t-test, we examined the correlation of the five factors to i) gender, and ii) self-assessed computer literacy. The *updating* factor is related to gender ($p<0.05$). More specifically, it is observed that female students seem to be more interested than males in e-class platform services, such as "announcements" and "material", focusing on material/information download, while male students seem to prefer more interactive services, as "chat" or "assignments". The same behaviour pattern characterizes students regardless of their studies. Computer literacy is not related to any factor.

The correlation of the factors to the three Departments was examined using ANOVA ($p<0.05$). The relations to the *Teaching process* and *Module description* factors are statistically significant. It is observed that students of the Department of Home Economics and Ecology do not seem to use or prefer to any large extent, e-class services, relating to the *Teaching process.* On the contrary, students of the Department of Dietetics and Nutritional Science seem to rank it as the most useful one and use it more often. The *Module description* service is used most by students of Home Economics and Ecology, while other students do not regard its contribution significant.

### *Blended learning process evaluation*

Variables of the questionnaire indicating students' attitude towards blended learning adoption were also explored. ANOVA ($p<0.05$) was utilized to investigate the correlation of the factors of e-class services to students' attitudes and opinions on the e-class platform. The results correlating *Teaching process* and *Updating* factors to the view for extending blended learning adoption to other courses are statistically significant. More specifically students, who favour e-class platform services relating to *Teaching process* ('assignments', 'student projects'), consider the expansion of blended learning utilisation and especially the utilization of such services in other courses as advisable. Students, who favour material/information download services the most, consider the expansion of blended learning utilisation to other courses as mandatory.

Moreover, blended learning adoption is not correlated to e-class access premises (i.e., student's residence or university campus), nor to potential difficulties in e-class usage.

Attempting to detect if and how variables such as "PC literacy", "e-class usefulness", "physical presence restriction (due to e-class implementation)" and "e-class expansion" are interconnected, an inter-correlation analysis of the variables ($p>0.05$) was performed. By this analysis, it is presumed that there is no statistically important correlation. Physical presence does

not seem to correlate at all to the other variables. However, half of the students of the sample state that they reduced, slightly or moderately, their physical presence in the classroom, due to the availability of the e-learning services.

## Blended Learning Evaluation by the Instructors

For the purposes of the evaluation of blended learning, the participating instructors were asked to fill-in an open-type questionnaire. All instructors felt comfortable using information technology and were familiar with digital media usage in the classroom. Though most of them utilize e-mail to communicate with their students, none of them had constructed a Web page for the dissemination of information regarding their course or the digital material used in their lectures.

### *Usage of E-class platform*

None of the instructors had experienced any problems using the e-class platform, while all of them indicated that they had effective support by technology specialists. However, they indicated that they had to dedicate more time for the preparation of electronic content, although all of them were using digital presentation material for their lectures before using e-class. In addition, the instructors from the Department of Geography had extra electronic material developed in the form of simulations, maps, data and output from specialized software. The contribution of technology specialists in the creation of additional digital material was considered essential by all instructors. Since the development of a course in electronic form requires a substantial investment in man-hours, many of them indicated that this would be a major obstacle in the endorsement of the platform for course development from other instructors who do not use electronic material in their teaching, especially as time for teaching preparation is increasingly in conflict with time dedicated to research in academic institutions (de Freitas and Oliver 2005).

*Perceived usefulness of E-class platform services*

The first question was about their opinion on the overall contribution of the e-class platform to the educational process. All six instructors favored greatly the introduction of technology to their classes. The main reasons listed for this attitude were: i) technology enhances the teaching process via the use of attractive figures, tables, maps and pictures, ii) portability of course material, iii) anytime and anyplace access to course material and discussion among the students, and iv) ease of course material and progress updating. Two of the instructors report that the introduction of the electronic material helps the students to actively participate in the class discussion instead of trying to catch-up with the material presented during class time.

The instructors were then asked to describe more specifically the main points of improvement of the educational process resulting from the complementary introduction of the e-learning platform. The main points reported differed depending on the nature of the course and its former planning. The instructors of theoretical courses with no assignments mainly utilized the platform features for the dissemination of course material and considered this feature as the main contribution in the educational process. The instructors of applied courses, where assignments and projects form a main part, favoured the platform's feature for project assignment and management. They claimed that project assignment was simplified and became more effective. When the projects were announced via e-class, the students received a relevant notification by email and hence, they could sign in any time to download it. As far as the project submission was concerned, the students did not need to bring portable hard disks, CDs or even hard copies that quite often were not arranged into folders. They could simply upload the project. The system did not allow project submission after its deadline. Moreover, since student could find all project related information in e-class platform, the work load of personal communication with students regarding their

assignments was decreased.

In all cases, the electronic announcement feature of the platform, with automatic email notification to the registered students was positively assessed, since this feature enables easy and immediate notification of students on every-day course-related progress, without requiring the students' physical presence at the University in order to read printed announcements or individual student notification by the instructor through e-mail.

The less-used feature of the platform was the "discussion board" service, which facilitates the structured discussion between students upon a specific subject posted by the instructor with his/her active participation, even for courses, for which instructors attempted hard to encourage it. Follow-up of electronic conversations of students would enable the instructor, through argumentation, to detect gaps, conflicts etc. and to address them timely. The lack of use of this feature was attributed by instructors to the insecurity of undergraduate students to express themselves in writing on a scientific issue. Students seem to prefer a face-to-face discussion with their instructor in a more direct and personal way, rather than state their opinions openly and argue them with their co-students.

### *Blended learning process evaluation*

All instructors observed that, although the platform was an obvious facilitation for those students who could not attend a lecture, with the on-line availability of slides and update on the course status, the physical presence of the students in the classroom was not affected. On the contrary, students who were systematic in class attendance were also systematic in checking the information provided through e-class platform. Apparently, it favoured those who were circumstantially absent, without altering the configuration of the classroom. On the contrary, the fact that various technical issues were available at any time (e.g. course status, syllabus, announcements for course

replacement etc.) was time-effective for the classroom, since the oral explanation was not required. All instructors agreed that e-class has largely contributed to the planning and coordination of the educational work, without affecting the physical presence of the students in the classroom.

The final question was on how the students responded to the introduction of the e-class platform. The common feeling of the instructors was that students responded particularly positively to blended learning features: they familiarized quickly with its services, they used them systematically and their participation was high. Instructors, giving lectures in students of more than one Department, indicated that the familiarisation degree differed among students of different Departments, especially during the first semester of their studies, since they had a different degree of exposure to Internet and computer technology. For example, first semester students studying Dietetics and Nutritional Science felt more comfortable using e-class services, than their colleagues from the Department of Home Economics and Ecology.

### Blended Learning Evaluation by the Technology Specialists

The three technology specialists supporting e-learning infrastructure were interviewed separately regarding their experience working with both students and instructors. All of them agree that students had no difficulty to familiarize with e-class and computer technology in general, even when they did not have any previous experience. Students were interested in e-learning services and they eagerly participated in hands-on seminars. Their preferred way of communication was e-mail, though chat service was also available during office hours.

None of the instructors had any trouble using e-learning services, although in most cases they needed more time to familiarize with the e-class platform than students. Their preferred way of communication was face-to-face interaction. Some of them actually visited Network Operations Centre regularly for that purpose, especially the first time they employed blended learning features

in one of their courses. The main difficulty they experienced was the creation of digital material, which they considered time-consuming. In many cases they also experienced technical difficulties in creating digital material, for example videos, which they solve cooperating with technology specialists. All of them were easy to work with and devoted in this effort. They were also interested in learning to produce any digital material they needed on their own. All of them tried to incorporate blended learning features in their teaching style, while after a period of three years they shall continue to apply blended learning in their courses. Most of them were skeptical on whether they should alter their teaching style in the future as the result of the facilitation of such features in their courses.

## DISCUSSION

The discussion provided in this paragraph involves the major observations deduced concerning: a) the relations between content providers, i.e. instructors, and technology infrastructure as well as technology specialists; b) the relations between content consumers, i.e. students, and technology infrastructure as well as technology specialists; and c) the relation between content providers and content consumers in the academic environment of Harokopio University of Athens.

### *Relations between Content Providers and Infrastructure - Technology Specialists*

All instructors were experienced users of computer and Internet technology, though they were not experts. Their field of scientific expertise had no actual impact in their decision to participate in the study. However, since participation was decided on a voluntary basis, their basic common characteristic was their willingness to explore the potential of blended learning. Since none of them employed any means of digital communication in their teaching habits (for example using a Web page to upload material), other than e-mail exchange in some cases, they were not considered as

expert users of such technologies. However, they were quickly familiarized with all e-learning features and had no difficulty in using them. They also had an excellent cooperation with technology specialists. Thus, they reported no obstacles in utilizing specific e-class services. Their decision to employ (or not) more interactive features of e-learning, as discussions or assignment management and grading, had only to do with their teaching style and the structure of the course itself. All of them shall continue to exploit blended learning in their courses, while most of them were skeptical on whether they should alter their teaching style in the future as the result of the facilitation of e-learning features in their courses, in accordance to the findings of other studies (Dillenbourg, 2008). Technology specialists also shared this opinion, although they expected that instructors shall eventually adjust their teaching style after employing e-learning features over a longer period. Some guidelines towards this direction are considered very useful.

The opinion of all instructors converge to the fact that the introduction of e-class services contributed to a better course planning and coordination and made many of the common educational processes simpler and more effective, in accordance to the literature (Dutton et al., 2004). The only obstacle they indicated in employing blended learning in other courses was the preparation time required to develop a course in electronic form. Since this was considered as a difficulty the first time they employed blended learning in their courses, the assistance of technology specialists in the creation of digital material may significantly contribute to overcoming this barrier. Another obstacle is language, since for all undergraduate course lectures and basic teaching material must be in Greek by law, therefore instructors can not use existing digital resources that might be available (for example through WWW), depending also on the course subject.

Simple features, such as electronic announcements and electronic student assignment/ project management and rating, contribute to the deduction of workload. None of them endorsed the mandatory adoption of blended learning, but they rather felt it should be decided by each instructor individually, based on his/her skills and workload.

*Relations between Content Consumers and Infrastructure - Technology Specialists*

Students seemed enthusiastic about the introduction of e-learning services in the teaching process. None of them reported any real difficulty in familiarizing with the platform and working with the technology specialists. Hands-on seminars contributed towards this direction. Though, more than 22% of the students did not actually use e-learning services, this was not related to their familiarization with technology. In fact, in many cases, they considered such services useful, although they did not benefit from them. Since attending lectures or sitting for exams in all the courses of the semester is not mandatory in Greek Universities, we may assume that those students were simply not interested for the specific course at this semester. In fact, it was proven that the students, who attended classes regularly, were also regular users of e-learning facilities.

Students access e-learning services by both their home and the University computer clusters. Residential Internet connection speed was the only obstacle reported in accessing e-learning material from home, a barrier that is gradually removed by the relevant technology improvement in Greece.

Gender, computer literacy and scientific field had no impact on student familiarization with e-learning services and their willingness to use e-class platform. The type of services that each student uses, depends on the nature of his/her curriculum and on the style of the instructor. However, the more interactive services (for example chat, student assignments/project management) seem to be more popular among male students. Whether students considered

themselves as expert users did not affect their preference. Teaching style and the nature of the courses also affected students' preference regarding provided e-learning services. The students of the Department of Home Economics and Ecology, who preferred material download than interactive services, attended more theoretical courses. One of the least used services was the discussion boards. For example, if they had any question, they preferred to resolve it traditionally, i.e. face to face with the instructor, rather than publish it in the relevant board. We believe that students were not comfortable to publicize their opinion, because they felt insecure of they scientific knowledge, and that their constant involvement with e-learning features should hopefully help them express themselves more openly.

*Relation between Content Providers and Content Consumers*

Both instructors and students endorsed the utilization of e-learning features complementary to the traditional learning process. None of them experienced any obstacle in the teacher-student personal communication. On the contrary, both parties indicated that one of the major advantage experienced was that the organization of the course during the semester became more effective, contributing in the learning process. Furthermore, instructors indicated that their lectures also benefited from the existence of complementary electronic material, since attending students were better prepared, and they could better utilize the lecture time. On-line notification for the course progress was highly evaluated by students, while it also helped instructors to deduce workload.

Regarding the physical presence of students in the classroom, there was no evidence that it has been reduced. Attending lectures is not mandatory in Greek Universities. In Harokopio University of Athens usually an average of 65% of registered students for a course regularly attend its lectures, while an average of 75% participate in the exams. Although students admitted that the availability of electronic material may encourage them to skip classes, we could not relate such

claim to the usage of the platform. On the contrary, students who were systematic in class attendance were also systematic in using e-learning features. Apparently, it favoured those who were circumstantially absent, without altering the configuration of the classroom. Furthermore, students not attending lectures do not seem to have benefited from blended learning facilities either. To summarize our observations regarding student involvement, blended learning has largely contributed to the planning and coordination of the educational work, without negatively affecting the physical presence of the students in the classroom. Face-to-face instructor-student communication was also not affected, since this is still the preferred manner for students to solve their questions or ask for additional material.

Blended learning can improve the performance of instructors, though the creation and maintenance of electronic material is a time-consuming effort. To establish a successful blended learning environment, it is important to provide effective technical support to all the instructors willing to participate in such process, especially in their first attempt. Furthermore, technology specialists may actively assist instructors to benefit from the employment of e-learning features in their teaching habits to improve their teaching style. This should be a personalized effort taking into account the skills and views of each specific instructor. Almost all students endorse the mandatory introduction of blended learning in all the courses, though the way it should be employed depends on the instructors' decision. Not all supported e-learning features should be employed in every course. Students expect their instructors to regularly update the digital course material and promptly respond to their inquiries and request. Instructors share the same opinion. Since the participation in this research was voluntary, we had no indication on whether the utilization of e-services helped students to improve their performance.

# CONCLUSIONS / FUTURE WORK

The challenge of blended learning methods is to balance the weaknesses and strengths of face-to-face and e-learning teaching environments and effectively combine them to provide enhanced learning capabilities. This is not a trivial task, especially since computer-based and more specifically e-learning technology is constantly evolving. To this end, we proposed to model the blended learning environment using an ecosystem-based approach. To explore the evolving relations of major stakeholders in a blended learning ecosystem, a study was conducted in Harokopio University over a period of three years, focusing on the relation between content providers and content consumers. Relations of each one of them with e-learning infrastructure and technology specialists were also explored.

Complex pedagogical approaches utilizing technology can be difficult to set up and slow to develop, though they have the potential to provide more engaging learning experiences for students. The ideal pedagogy should allow each particular educator to effectively create educational material, while, at the same time, provide the most engaging educational experience for students. Both instructors and students evaluated the employment of blended learning in Harokopio University very positively.

Students perceive the existence of computer and communication technology as a natural part of their life and seem more comfortable with them, than instructors, which hesitated to adjust their teaching style to better utilize blended learning features. For both instructors and students, gender did not affect their willingness to facilitate blended learning.

One of the most interesting observations of our research is that the introduction of blended learning methodologies, despite some initial worries, did not reduce physical presence of the students in the classroom, neither face-to-face instructor-student communication, while basic

computer skills was the only prerequisite for e-learning services employment. Blended learning should enhance instructor-student communication inside and outside the classroom, in an on-line and off-line fashion. Students regularly attending classes responded very eagerly and were particularly excited about blended learning. Thus, we concluded that the existence of alternative ways of communication (digital or not) encourages students to participate more actively in the learning process.

In the future, we plan to explore how the provision of streaming video downloads for all the lectures of specific courses may affect the blended learning ecosystem of our University, since such methods are already extensively applied in renowned academic institutions world-wide. Furthermore, we investigated alternatives on improving the teaching style of instructors widely adopting blended learning features in their courses.

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