Selecting and Evaluating a Learning Management System:
A Moodle Evaluation Based on Instructors and Students

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ABSTRACT

This paper presents the rationale behind the utilization of a Moodle Learning Management System for the facilitation of a blended learning approach in our Informatics department. We present and analyze the steps followed in order to replace the prior decentralized organizational structure of the courses, which consisted of a multitude of different and incompatible systems. Our main goal was to implement a single system, which would be easy to operate, maintain, and update, and which would cater for the variety of instructor and student needs. Furthermore, we present in detail evaluation data of the new system. The analysis of the results serves to confirm the success of this department-wide migration.

Keywords: Distance Education, Web-delivered Education, Blended Learning, Technology-Enhanced learning, Learning Management System

INTRODUCTION

This paper concerns our department's decision to implement a Learning Management System (LMS) platform to support and aid instructors with managing their courses. The main focus of the paper is on the selection process and the applied evaluation methodology. For the selection process, we examined the most popular LMS solutions available and based on the objective and subjective criteria we set, proceeded with the

implementation of what we considered to be the most suitable platform to satisfy our department's needs. Certain implementation and expansion issues concerning the selected platform are also discussed in other sections of this paper.

In the past years the instructors in our department, were allowed the freedom of choice on whichever LMS they thought was appropriate for supporting their courses. This resulted in the concurrent operation of a number of different systems, each supporting only some of the department courses. This chaotic situation necessitated the adoption of a more centralized and concrete solution.

Therefore, our set goals as a department included: (a) easy access for instructors and students, (b) motivation of the instructors to adopt the new LMS, (c) support of communication (peer / student - instructor), (d) increase of student attendance and participation, (e) integration of additional systems (e.g., eCASE module), and (f) adoption of a single system solution. This single system would focus mainly on the ease of use. This would include simple maintenance, control, and usability (i.e., one account per user).

Although this paper is not aimed at a specific target group of readers, we consider the experience documented here to be of the most use to departments or individuals considering the implementation of an LMS system. Especially, when a combination of multiple systems is to be substituted by a more centralized organizational structure as was our case. Readers should find useful the information relating to the selection and evaluation process, as well as the major implementation issues which had to be resolved.

The rest of the paper is structured as follows. Initially we justify the necessity of applying a department wide LMS solution by presenting information concerning the previous organizational state. Following that, we include the theoretical background of blended learning, by defining it and presenting its pedagogical benefits and educational shortfalls. Our approach on blended learning is also discussed and justified. Next, we link our paper to related work, based on the study of relevant bibliography concerning the experiences of other researchers on implementing blended learning. Finally, we present the work phases which constitute the selection process and evaluation methodology we followed. These phases include: (a) analyzing the pre-existing condition in our department, (b) defining the requirements with which we would compare the available LMSs, and (c) implementing, expanding, using, and evaluating the selected LMS.

BLENDED LEARNING

Our department conceived the proposed LMS system as a preoperational or follow-up step to face-to-face education, thus facilitating a blended learning approach. In other words, one goal was for the LMS to suitably augment the quality of face-to-face education and student support. There is evidence that blended learning has the potential to be more effective and efficient when compared to a traditional classroom model (Heterick & Twigg, 2003 and Twigg, 2003).

Blended learning is defined as a learning solution, which implies a mix of the following (Garrison & Kanuka, 2004; Graham, 2005):

- Varied delivery media: e.g., non-technology-supported and online electronic multimedia material.
- Varied learning events: e.g., individual, self-paced and collective ones.
- Electronic performance support: e.g., instruction based and knowledge management support.

Research shows that learning based on the blending of face-to-face with online training, and of formal and informal learning is usually more easily accepted than online-training alone (i.e., Colis & Moonen, 2001; Rovai & Jordan, 2004). Also, evidence suggests that the learning experience is better and completion rates are greater where there

is tutor support either face to face, on-line or over the telephone (Hamburg, Engert, Anke & Marin, 2008). Some of the advantages of traditional face to face classroom education are: (a) social interaction through personal contact and the exchange of ideas, (b) familiarity, customary method, and (c) an environment which supports multiple communication channels. (Paraskakis, Konstantinidis, Bouras, Perakis, Pantelopoulos, & Hatziapostolou, 2009).

To enable the augmentation of the face to face learning, researchers suggest a blended learning approach that combines the use of distance learning methods with the interactions which occur within a traditional classroom. Instructors mention that the blended learning model enables them to complete their educational goals more effectively than the traditional model (Irons, Keel & Bielema, 2002). Most instructors note increased interaction with students and of the students between them.Much of the satisfaction and success of blended learning experiences can be attributed to the interactive capabilities of Internet communication technology (Garrison & Cleveland-Innes, 2003; Swan, K., 2001. What makes blended learning particularly effective is its ability to facilitate a community of inquiry (Garrison & Kanuka, 2004). Students' contact with departments increases through the blended learning model, as does their thoughtful participation in the educational activities (Garnham & Kaleta, 2002).

According to Voci & Young (2001), effective blended learning is balanced learning. This balance is accomplished by combining the advantages of two forms of teaching, traditional classroom education and self-adjusting distance learning. Some of the advantages of technologically supported education include: (a) respect towards student differences and preferences in style and rhythm of learning, (b) flexibility, since the virtual (online) classroom is available 24 hours a day, seven days a week, and (c) the educational material, which is available online, is not influenced by human weaknesses, such as instructor inability (e.g., sickness).

Furthermore, the main goal of blended learning is to combine the best features of traditional education with the most prominent characteristics of online teaching, so as to encourage independent learning and decrease the required classroom time. In order for the above goal to be accomplished, it is of vital importance to guarantee the correct ratio in the use of the different educational means.

To recapitulate, according to Trasler (2002) the advantages of blended learning include: (a) an ease in functionality and student time organization, (b) increase in interaction between students, or students and instructors, (c) spatial and temporal flexibility, (d) increased learning, (e) decrease in student drop outs, and (f) adjustability to each student's preferences (e.g., personalized learning).

In order to support blended learning, LMSs are widely used. An LMS is usually a web-based system facilitating the organization and coordination of the learning material of an educational institution. LMSs also facilitate communication and collaboration of the students through the support of communication, collaboration and Web 2.0 tools such as forums, blogs, wikis, chat rooms etc.

Although a large number of proprietary LMS solutions are available, open source technologies are more approachable in a research context. For example, the use of an open source package was also preferred by Milano, Vanfretti, & Morataya (2007) for the following pedagogical reasons:

- The mind of the learner should be opened. S/he should not become accustomed to a program that gives all the answers.
- The learning process should develop the curiosity of the learner. Only if the code is open can the learner explore all software features.

- The learners should understand that knowledge should be free and available to everyone
- An e-Learning course should match learners' needs and desires as closely as possible, and have the ability to adapt during course progression.

By taking the above reasoning into consideration, we opted to utilize an open source technological approach. The methodology we applied in order to select the open source LMS platform is presented in the following section.

SELECTION PROCESS

Educational institutions need more flexibility and control over their e-Learning environments to enable different schools, programmes, courses, or instructors to select and deploy the most appropriate tools suited to the pedagogy. For example, in 2003, 94% of colleges and universities in the United States were using at least one form of an LMS solution (Minielli & Ferris, 2005), for two primary purposes:

- To deliver distance learning and
- To supplement the traditional classroom (i.e., through blended learning)

To select the appropriate LMS solution for our department, we developed a specific evaluation methodology based on the study of related work and relevant evaluations carried out in other institutions. It should be noted that our methodology was designed and altered in such a way as to meet and satisfy the temporal and spatial availability of our faculty members. Before presenting the evaluation framework applied, the most influential bibliographical references are briefly discussed in the following paragraphs.

Researchers agree that there can be no such thing as the best LMS. A product needs to be chosen depending on the circumstances of a particular institution. Therefore, when evaluating LMSs, the results should be interpreted with the specific situation in mind. What is important for one organization may be of less value for another. In general, it is considered that an LMS touches all aspects of an institution. In other words, a selection of this type of core system must be conducted thoroughly to insure that all stakeholders' issues and concerns are properly addressed.

Furthermore, the evaluation of LMSs in learning for campus-based universities must focus on the whole learning experience, if the evaluation outcomes are to relate meaningfully to a blended experience (Ellis & Calvo, 2007). Part of this evaluation service needs to consider how LMSs are used in the student learning experience and how their use contributes to the quality of the learning outcomes.

In the next section, we will focus on the goals which are set by researchers before undertaking an evaluation procedure, as revealed from the study of related work.

Selection Difficulties

LMSs are complex systems that offer an overwhelming amount of functions. Such platforms have a broad range of users (i.e., students, authors, tutors, administrators) and each user group has its specific requirements. It is difficult, and sometimes impossible, to establish a formal list of requirements. An evaluation is therefore an extremely complex and expensive task.

Furthermore, the selection of LMSs for evaluation is a laborious and time consuming process. The reason for this is the considerable number of LMS packages that exist, as well as the fact that the LMS industry is a very active and dynamic one. In essence, any evaluation constitutes a snapshot of the industry at a specific moment in time. New software releases and new products will certainly emerge to improve the functionality of

LMSs, and if someone wishes to keep abreast of the technological evolution, evaluations will need to be conducted regularly.

Difficulties also arise when using log files for the evaluation of an LMS. A systems scan of designer and user behaviour within the LMS can never fully describe how designers and users are engaging with the use of online environments for teaching and learning (Heathcote & Dawson, 2005).

In addition, the integrity of mined data for a system as large as an institutional LMS can be affected by:

- Technical issues such as corruption of databases.
- Change in access settings for websites during the time period examined.

Finally, another important issue concerns institutions which use two or more LMSs concurrently. When the recommendation for a single system is announced, there will inevitably be a group of LMS users who will need to discontinue the use of their current system. However, it is the explicit responsibility of the evaluation researchers to perform an objective assessment of all available LMSs, in an attempt to recommend the single most appropriate LMS application.

LMS Selection Goals

Researchers state that evaluating various LMS products helps align the needs, vision, mission, and support structure of a university. Such a case has been presented by Instructional Technology Resource Center, Idaho State University (2007). For others, the goal is to collaboratively establish an e-Learning platform that minimizes the financial, organisational, and technological barriers of sharing resources across the education sector (Wyles & Udas, 2004).

The goals set by research teams, as well as the evaluation methodology they follow, usually depend on whether a department supports and maintains an LMS already or if this is the first time such a technological step is being considered. For example in the Edutech[1] project the main goals of the evaluation were:

- To help higher education institutions choose an open source LMS that can be deployed at the institutional level.
- To validate the LMS choice of those higher education institutions who do have an officially supported and maintained LMS at the institutional level.
- To find out which open source LMSs can be adequately deployed at a national level.

On the other hand, institutions which substitute their existing LMS solution usually do so due to the escalating annual LMS license fees[2]. This combined with a declining IT staff and budget, stimulates discussion to compare the renewal of a commercial license to an open source solution.

According to Instructional Technology Resource Center, Idaho State University (2007), open source systems such as Sakai and Moodle offer unique advantages over proprietary systems such as WebCT and Blackboard: (a) the source program code is available, so open source applications are much more customizable than proprietary systems, (b) there is a community of developers at universities and corporations that add functionality to the systems and contribute those new modules back to the entire community for inclusion in the product, (c) open source solutions do not require license fees, (d) active open source communities have been providing support for their products successfully for quite some time, and (e) for very active open source communities, this results in a quickly evolving product.

LMS Selection Criteria

As previously mentioned, LMSs are complex systems that offer an overwhelming amount of functionality. A survey of Learning Connections[3] project revealed that usability (i.e., ease of use), reliability, and (to a lesser extent) support, are the three most important issues to consider in the selection of an LMS.

According to The Instructional Technology Resource Center, Idaho State University (2007) secondary criteria should include, pedagogical value, financial concerns, support issues, assessment criteria for accreditation, integration with the information technology services, and long-term viability (. Because there are so many LMS packages available, researchers suggest several additional criteria which can be used to shortlist candidates.

These criteria include (3waynet Inc, 2004; Wyles & Udas, 2004): fitness for purpose, architecture, user-friendliness, interoperability, ease of system integration, standards compliance, cost of ownership, costs of development and support, ease of maintenance, strength of community, number and quality of installations, standards compliancy, reliability, effectiveness, hardware and software considerations.

For the researchers in Webs (Moyle, 2007), in order to conduct an initial review of an LMS, an examination of the following factors was considered a good place to start:

- Known requirements: the system should meet both the academic and administrative requirements of the university community.
- Unknown requirements: the system should be flexible enough to adapt to the university's future needs.
- Implementability: the system should be implemented into the university community with ease. Such packages need to be user friendly; the key is to enhance the learning process, not hinder it.
- Associated costs: expenses associated with purchase, implementation, maintenance and support.

To ease the LMS evaluation process, hindered by the extensive breadth of the criteria which must be considered, some researchers organize them into groups or rubrics. For example, in Humboldt State University[4], there are (a) the Pass/Fail Rubric, which includes the minimum requirements set for the LMS, and (b) the Best Fit Rubric, which refers to requirements that will aid in the final LMS selection.

LMS Evaluation Methods

In this section, we will briefly discuss the evaluation methodologies which were most influential to our own.

Researchers in the Learning Connections[5] project used an evaluation methodology consisting of five phases: evaluation, request for proposal and acquisition, integration and testing, conversion and support, roll out. In the first phase, researchers looked for the best possible LMS that they can use to enhance learning at their college. One of the first steps in determining what the LMS user and system requirements for the evaluation process would be was to assess current levels of LMS use and user satisfaction. To ensure a fair assessment, all the vendors conducted presentations based on an evaluation criteria checklist. Following that they organized hands-on system trials. In an effort to be unbiased, they tested out the same functionality on all three programs by importing the same course content into all three systems. Next, there were student and faculty usability trials. Here, the same course was loaded into both candidate LMSs, and students were asked to use the system. More specifically, they were asked to communicate, send a message, create and upload an assignment, and several other basic learner tasks. In the second phase, researchers developed an RFP (Request for Proposal) that enabled their

college to acquire the new LMS. In phase 3 they began the integration process and run the new LMS in a test mode along side their previous LMS solution. In the penultimate phase, all course content was converted from the previous LMS to the new system. Finally, in the fifth phase, the new LMS replaced fully the previous system.

In Instructional Technology Resource Center, Idaho State University (2007), researchers followed a multi-part evaluation process. First, all the LMS candidates were investigated with regard to user (instructor and student) concerns and preferences. This first stage consisted of a series of focus group sessions that were held with students, support staff, and faculty members. Following this, they examined the platform's ability to support student, course, and program assessments. Next, technical and support issues relating to the migration of courses and content to the new system, support for a variety of platforms, browsers, etc. and ease of support by the staff were analyzed. Finally, financial considerations included the costs of new hardware, personnel, and license fees or software community support provisions.

LMS Comparison

As described before, there are many evaluation methods as well as different requirements of the specific departments and/or educational institutions according to their technological infrastructure. Therefore, we proceeded to design our own LMS evaluation and comparison methodology, which adopts criteria of the methodologies presented before. This methodology is based on two categories of criteria (we call these categories benchmarks). The first benchmark was the wide assortment of tools and services offered by each environment. The second benchmark considers adaptability, cost, expandability, interoperability, etc.

Table 1. Benchmark 1: Significance of tools and services

Tools and Services	Significance
Communication tools	
Forum	2
Forum management	2
File transfer (FTP)	2
E-mail	2
Online journal /Notes	1
Sharing of online journal /Sharing of notes	2
Chat	1
Whiteboard	2
Teleconference	1
Assistance tools	
Bookmarks	1
Search of educational content	2
Calendar	2
Online help for the students	2
Online help for the tutors	2
Group specific spaces	2
Self-evaluation tools	2
Creation of groups of students	2
Portfolio	1
Administration tools	
User authentication	2

Tools and Services	Significance
Role management	2
Students' enrolment in various courses	2
Course tools	
Scheduling of educational activities	1
Grading tools	2
Students' tracking tools	2
Test creation	2
Course management	2
Educational content creation tools	
Course templates	2
Graphical user interface (GUI) customization	2
Courses organization	2
Instructional design tools	2
Case-based learning tools	
Support of cases for instruction	2
Support of cases for examination	2
Application in different field	2
Support during learning process	2
Customization	2
Local installation	1

In point of the first benchmark, we categorized tools and services into tools supporting courses, tools creating educational material, case-based learning tools, communication tools, assistance tools and administration tools (Table 1).

We organized the platforms into a table (by adding columns in Table 1) which contained the set of functions and tools offered by the compared environments. For each of the services that our envisaged LMS should provide, we applied a specific degree of significance. The awarded grades were based on a department wide requirements analysis. Thus, for every service that was considered significant a grade of 2 was awarded, while each service that was considered of secondary importance a grade 1 (Table 1). The sum of the respective weights of the services offered by a platform is the final value of the selection function. The total of the first benchmark is 65.

The second benchmark for the proposed solutions considers (a) if the system is customizable, (b) if it is open source or proprietary, (c) if the project development team has the necessary expertise and experience on the system, (d) if there is a possibility of future expansion of the system, and (e) if it can connect and work effectively with other systems. The total of the second benchmark is 25. An ideal LMS for our department should have as total score 90 (65 units for the first and 25 units for the second benchmark).

Based on the two benchmarks, we produced the data presented in Table 2. After following our evaluation methodology, we concluded that the Moodle platform would be the most appropriate in satisfying our needs. However, upon proceeding to implement Moodle in our department, two hindering issues emerged. These were the translation of the Moodle interface from English to Greek, and the connection of Moodle to eCASE (i.e., Demetriadis, Papadopoulos, Stamelos & Fischer, 2008; Papadopoulos, Demetriadis, Stamelos & Tsoukalas, 2010). We will elaborate upon these in the next section.

Table 2. The end results of the LMS comparison methodology

Evaluation Criteria	ATutor 1.5.4	Blackboard Vista 4.1 Enterprise License	Claroline 1.8.1	Dokeos 1.8	eCollege	FLE 3 1.4.2	SAKAI 2.3	ILIAS 3.7.7	Moodle 1.8
Results of the first benchmark	50	50	37	48	50	18	52	41	48
Adaptability	5	0	5	5	0	5	5	5	5
Cost vs. Open source	5	0	5	5	0	5	5	5	5
Project team experience	0	3	0	0	0	0	0	0	5
Expandability	5	0	4	5	0	3	5	5	5
Interoperability	5	2	4	4	2	3	5	5	5
Total of benchmarks 1 & 2	**70**	**55**	**55**	**67**	**52**	**34**	**72**	**61**	**73**

Implementing and Expanding Moodle

Translation of Moodle proved to be a difficult task, mainly because of the differences between the English and the Greek language, and also because of the way that the user interface terms are managed. Regarding the latter, Moodle allows the system administrator to replace the string of a term with another. Also, Moodle often uses the same term in various web-pages; hence, the replacement of a term usually affects many pages.

While this technique is efficient and has good results for English terms, it produces problems for the Greek language. Contrary to the English language, the Greek language is highly inflected, involves gender noun categories and four cases (nominative, genitive, accusative, and vocative), making it impossible to have an appealing and coherent appearance of the same translated term in every occurrence.

In addition, Moodle has multiple versions for each term (e.g., "teacher", "teachers", "teacher's", "Teacher", "Teachers" etc.). However, this is only applied to specific terms. In our translation process, we firstly opted for a completely Greek interface. This often resulted in incoherence. Finally, we were forced to leave many of the terms that appeared in various contexts in English. This solution had better outcomes, although it is clearly a drawback to have mixed English and Greek in the same page.

The translation issue is important because it directly affects the appearance and usability of the platform. With the current term replacement facility, the translation of Moodle to a highly inflected language is troublesome. In our case, a solution would be to have Moodle handle each term occurrence as a different term. In that way, we would be able to replace the English term with an appropriately translated Greek term.

The second major task in our Moodle implementation process was to extent Moodle functionality by creating a new block inside Moodle that would present information derived directly from the eCASE environment. The eCASE (http://kaleid.csd.auth.gr/ecase) environment was developed by the Multimedia Lab of our department fulfilling research needs. Its architecture is flexible in the sense that it can support a breadth of different cognitive objects. Its design follows the principles of cognitive flexibility theory and this is why it is more suitable for ill-structured fields.

Both Moodle and eCASE were using open-source technologies (i.e., PHP and MySQL), but different character encodings. This resulted in conflicts when combining databases and in data representation.

Moodle, in an effort to be more generic and to support more effectively different languages, uses UTF-8 encoding in its web pages and in its database. eCASE, on the other hand, uses ISO-8859-7 (a.k.a., ISO Greek). This difference caused many conflicts between

the two systems, both in the database connection and in presenting data from the two systems on the same page (Figure 1). Moodle has adopted UTF-8 as standard and it is not possible to change it easily (or at all). Thus, the solution was to change the eCASE code to use the UTF-8 encoding.
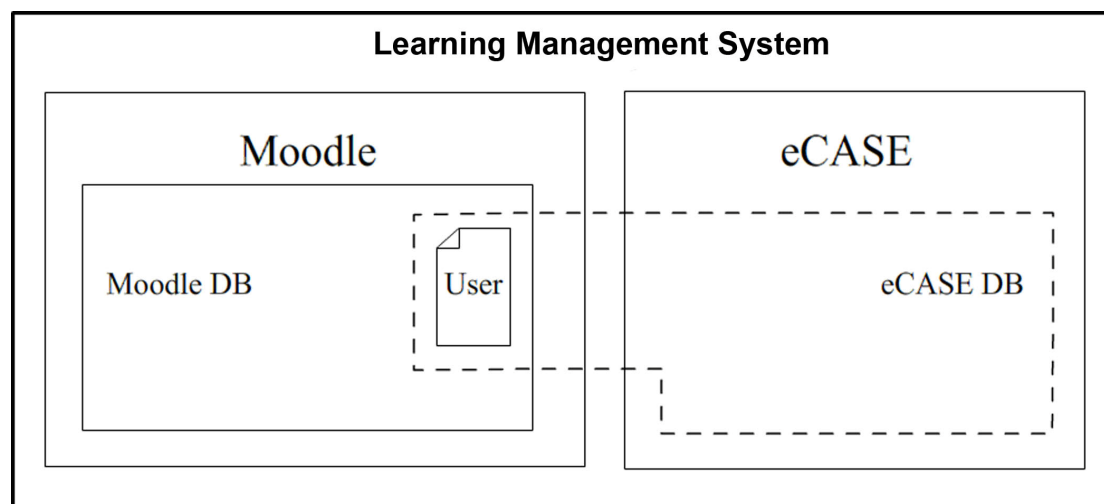

Figure 1. The implemented system architecture

Although one of the major advantages of open source technologies is adaptability, it is obvious from the previous paragraphs that it is not always feasible to adapt every feature exactly to ones needs. For our implementation to be perfect, we would have to design a new term replacement facility and alter a significant part of the Moodle code in order to use a different character encoding. Instead, we chose more efficient middle ground solutions with acceptable outcomes.

Method of Evaluation

In order to evaluate the implemented system, we considered a set of quantitative and qualitative data, collected during and after the usage period. The data was derived from questionnaires and system log files concerning both instructors and students.

Instructors' acceptance of the new system was crucial, since they were the content providers and without their active participation the new system would be inept. The number of instructors that migrated to Moodle and the consequently number of available courses gave us an indication of instructors' intentions to adopt the new system. Additionally, we asked instructors who used the system to complete an evaluation questionnaire to record their opinions and suggestions about the system. The instructors' questionnaire had 24 statements organized into 3 general categories:

- General evaluation: these questions focused on the degree of acceptance of the system in general.
- Course support: these questions investigated whether the use of the new system helped instructors in various aspects of course teaching, such as communicating with the students.
- Functionality: these questions concern specific tools and characteristics of the system, such as course material management.

Instructors expressed their agreement to the statements using a 5-step Likert scale from 1="Strongly Disagree" to 5="Strongly Agree". Additionally, there were 3 open-ended questions so that instructors could comment on the weaknesses and strengths of the system and suggest additions or modifications of the provided tools and services.

A major goal of our work was to increase the students' participation in courses. Attendance in class is not mandatory in many courses. Students that do not show up in class often miss valuable course material such as lecture notes and presentations distributed in class. This causes many students to be left behind and eventually drop out. By helping instructors organize and distribute course material in Moodle, we expect that more students will participate and have access. For students' participation we considered the number of students enrolled in each course in Moodle, the number of enrolled students who logged in and downloaded course material in Moodle, the average visits per course during the semester, and the number of students enrolled in the typical course according to the secretary office. Eventually, we compared these values with what was reported by the instructors regarding attendance in their courses prior to Moodle.

We asked students to complete a questionnaire similar to that of instructors with 30 statements organized in the same 3 categories, plus a category concerning the user profile of the students, e.g., their experience with other learning management systems. The same 3 open-ended questions of the instructors' questionnaire were also concluded in the students' questionnaire. Despite the obvious similarities, the statements in the two questionnaires differ, because of the different functionalities that Moodle provides to the instructors and the student user roles.

Results of Data Analysis

We derived the usage data directly from the system. Information, such as the number of registered instructors and students, were straightforward, while for more complex information, such as the visits per course resource, we used the activity reports and log files of the system.

Due to the small number of instructors, we proceeded with descriptive statistical analysis. Concerning the students' answers, we went further by grouping the students into two categories according to their previous experience with LMSs

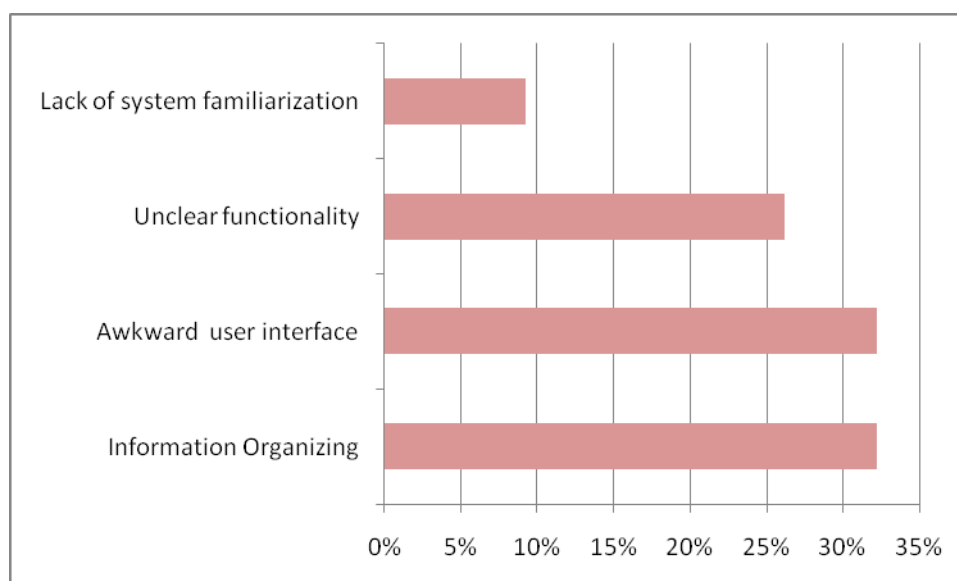### Instructor-Based Evaluation

The system was initially available 4 weeks before the beginning of the semester so that instructors could have ample time to get familiar with the tools and services offered. During the semester, 14 instructors decided to support their courses in Moodle, creating in total 23 undergraduate and 11 graduate courses spanning across the curriculum. The above numbers, representing almost a third of the total number of courses offered in our department, were very encouraging, because they show that, even from the beginning, there was a clear interest from instructors to support their courses on the new platform. Half of the instructors (n=7) said that this was the first time that they had used an LMS to support their courses, while the rest revealed that they moved to Moodle from other platforms (i.e., 5 from Blackboard, 1 from Compus, and 1 from FirstClass). The system was initially funded to support the courses of the undergraduate curriculum. The decision of several instructors to also support their postgraduate courses in Moodle provides an additional hint for the necessity of such a platform.

According to questionnaire results, Moodle was highly accepted by the instructors as a helpful and useful system for their educational needs. The advantages of the platform according to instructors are presented in Figure 2. More specifically, all instructors declared that Moodle helped them in their teaching duties (M=4.37), enhanced their communication with students (M=4.87), and made course material distribution a lot easier (M=4.87).
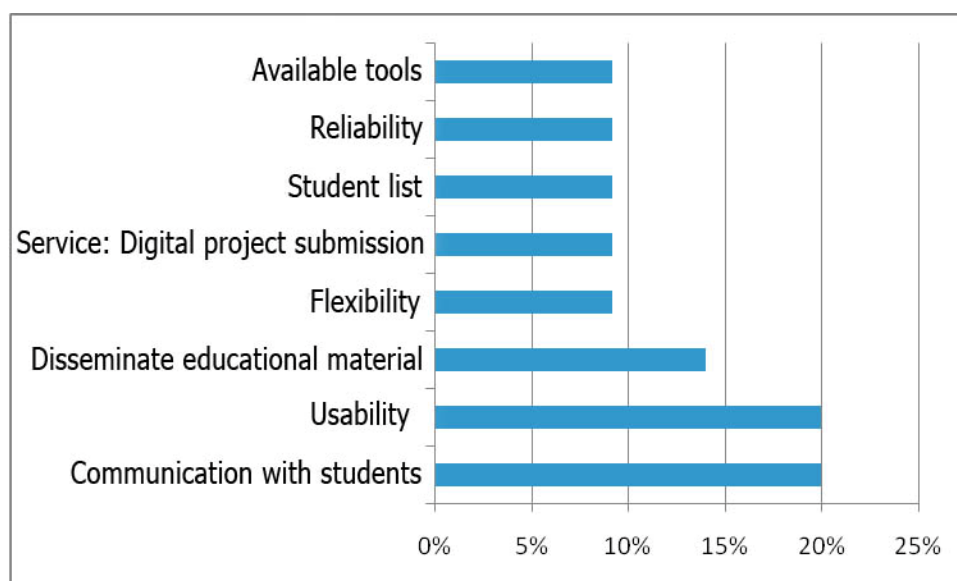
Figure 2. The advantages of the platform according to instructors

However, there are also issues that need attention as they indicate possible problems. The disadvantages of the platform according to instructors are presented in Figure 3. Hence, 6 instructors (mostly those without prior experience with another LMS) pointed out that they needed more help or system feedback on how to post and organize their material. As a solution, they propose a series of short informative seminars prior to the usage of Moodle, although, they note that after a rather short period they became familiar with the environment and were able to overcome their initial difficulties. Another issue that caused concern was Moodle's screen layout. Instructors were split in this issue (M=3.25), as almost half of them said that they did not like the way the information is presented on screen, and that an improvement of the user interface is necessary. Some instructors commented that very often the screen was flooded with information and this was frustrating because it made finding necessary information harder. Concerning the technical aspects of the evaluation, the instructors seemed very positive saying that the system was stable (M=4.75) with satisfactory response time even during heavy traffic (M=4.62).

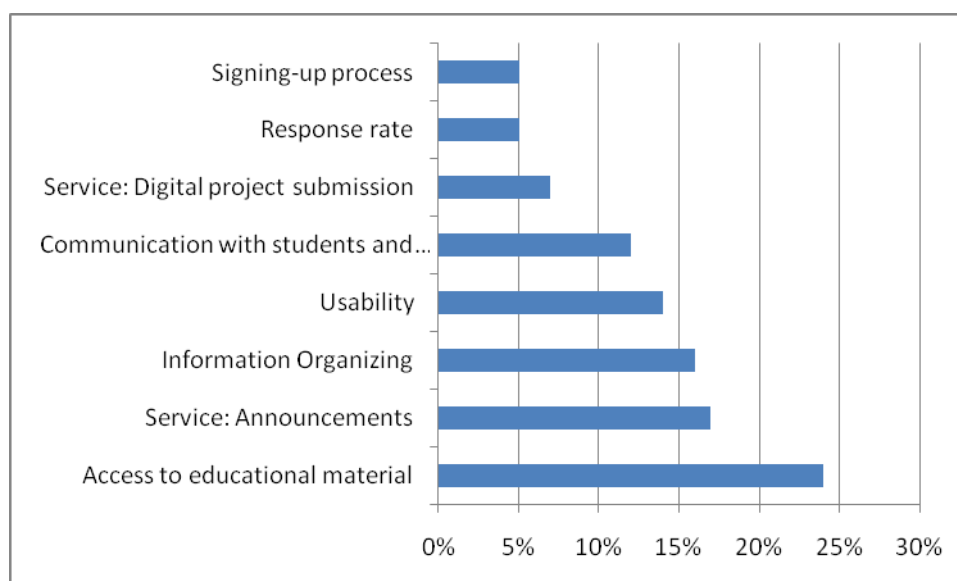**Figure 3. The disadvantages of the platform according to instructors**

Student-based evaluation

In the first 5 months of system operation, 623 students registered in the system. The registration and use of the system was not mandatory for the students, but was affected by the instructors' degree of evolvement, i.e., some instructors encouraged more their students to visit their course pages in Moodle regularly, while others did not. We should note that we used the e-mail authentication method for registering, allowing only students from our department to register. Additionally, we allowed students to enroll in every course offered in Moodle, unless the instructor had chosen otherwise. Analysis of the system log files revealed that the use of the platform was extensive, reporting an average of 138 logins per day for the total of the 5 months period. This figure was almost doubled during the semester exams period and tripled during the weeks with important assignment deadlines.

To investigate whether the participation of students in courses was affected by the new system we asked instructors to estimate the average percentage of enrolled students that were attending their courses in class and we compared these figures with the usage data of Moodle. We used a 5-step scale from "0%-20%" to "80%-100%" and we encouraged instructors to select the upper interval, in case they were between two intervals (e.g., if the attendance in class was varying between 40%-70% during the semester, the instructor should select "60%-80%" in the attendance scale). As an "attendance" measure for a course in Moodle we calculated the percentage of enrolled students that visited the course page and downloaded the course material (referred to as e-attendance). Course material (i.e., "Resources" in Moodle) can include lecture notes, presentations, papers, assignment descriptions, multimedia files, documents etc. The e-attendance of a course was the average of the e-attendance values of each of the course resources. Results analysis showed that:

- 19 courses had e-attendance values higher than the upper limit of the attendance estimation of the instructors.
- 8 courses had e-attendance values inside the percentage interval estimated by the instructors.
- 7 courses had e-attendance values lower than the lower limit of the attendance estimation of the instructors.

Theses results suggest that more students use Moodle to download material and be informed of a course than attending the course lectures in class. Further analysis showed that even in the cases of lower e-attendance, the difference between e-attendance and class attendance was close. On the contrary, in several cases the e-attendance was significantly higher than class attendance, indicating that in some courses students prefer to study the posted material than go in class. A highly important finding of the attendance analysis was that in some courses the users that enrolled in the Moodle course were more than the users that had actually taken the real course. Consequently, many students that had not enroll in the actual course, downloaded course material in Moodle. According to students, there were two reasons behind this attitude: (a) some courses have resources that are useful also in other courses, e.g., a textbook about programming, and (b) students are interested in being informed about several courses in order to chose which ones to follow in each semester, hence by enrolling in a course that is typically offered in a later semester they become more aware of their choices. Based on the above, we argue that the use of Moodle supported students' participation in courses and increased their access to course material.

Figure 4. The advantages of the platform according to students

From the 623 students registered in Moodle, only 136 (89 males and 47 females from every year of the curriculum) completed the evaluation questionnaire. Thus, the following statistical analysis is based only on this student sample. According to their responses, the students were very experienced computer users having on average 9.40 years of experience (SD=3.26). The majority of students said that they use the Internet more than once per day (M=4.66, SD=0.61) and that they are very familiar with using e-mails (M=4.63, SD=0.60) and searching information online (M=4.43, SD=0.75). Students generally reacted positively to the system (M=4.33, SD=0.63). More specifically, they would suggest the use of Moodle to their peers (M=4.32, SD=0.79) as they felt that it helped their educational activities (M=4.62, SD=0.63) and increased their access to learning material (M=4.63, SD=0.74). Regarding the content organization, students accepted the week-based (M=4.10, SD=1.00) and the theme-based (M=3.96, SD=1.05) organization scheme, but they expressed some concerns about the on-screen information organization (M=3.77, SD=1.13). Evaluating the technical aspects of Moodle, students said that the system was stable (M=4.21, SD=0.75) with very good response time even during heavy traffic (M=4.38, SD=0.68). Finally, students felt that Moodle did not increase communication with their peers (M=2.65, SD=1.34), while it was rather helpful with regard to communication with instructors.

According to students' comments in the open-ended questions, the three most important strengths of Moodle (Figure 4) are: (a) the potential for increasing the access to educational material (57 students), (b) the immediate access to information about various educational issues via the announcements and boards tools (33 students), and (c) the general usability of the system (24 students). On the contrary the three most important weaknesses of Moodle (Figure 5) are: (a) the on-screen organization of information (20 students), (b) the appeal of the user interface (11 students), and (c) the slow response time from instructors (8 students). In addition, 25 students suggested the support of more courses in Moodle.
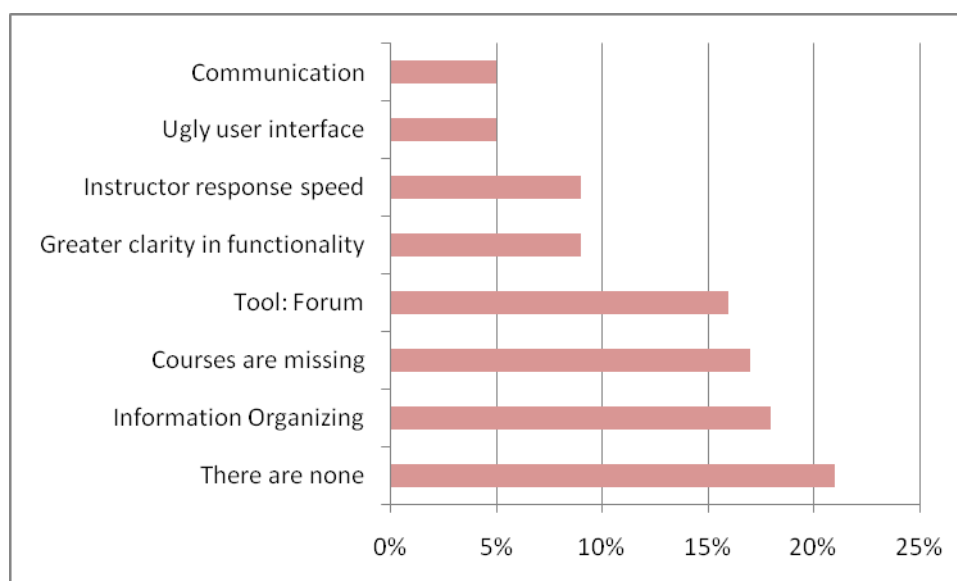
Figure 5. The disadvantages of the platform according to students

A set of statements in the questionnaire tried to record students' previous experience with other LMS. Out of the 136 students that answered the evaluation questionnaire, 70 students said that they had used in the past an LMS for an average of 2 years ("experienced"), while 66 students said that this was the first time they had used a system such as Moodle ("novice"). The majority of the experienced students (n=60) had used Blackboard, because this was the platform used mostly by instructors prior to Moodle. We decided to further analyze students' answers in the questionnaires, to investigate the effect of prior experience to the acceptance of an LMS.

T-test results showed that students who had used an LMS in the past were more experienced users in general. Specifically, they had longer computer experience (t[134]=2.114, p=0.036), they used the Internet more often (t[134]=2.185, p=0.031), and they believe they are more familiar with e-mail (t[134]=3.363, p=0.001) and internet searching (t[134]=2.244, p=0.026). Experienced students tended to accept the system more (t[134]=1.629, p=0.112), but they also are more judgmental about the theme-based (t[134]=1.768, p=0.079) and the week-based (t[134]=3.658, p=0.000) organization schemes that Moodle uses to organize and present material.

Evaluation Discussion

Both instructors and students described the new system as helpful and satisfactory for their respective educational activities. This is encouraging in our effort to eventually have the complete curriculum supported by Moodle. This goal is also supported by many instructors who admitted that they would suggest Moodle to their colleagues, and many students who explicitly asked for support of more courses. Additionally, results showed that the use of Moodle increases students' access to learning resources – a major goal for every educational institute.

The technical and functional characteristics of Moodle received positive comments from instructors and students. However, the communication among users and the user interface raised concerns. It is interesting that, regarding communication, instructors and students had clearly different opinions, with the first suggesting that Moodle enhanced their ability to communicate with their students, and the latter that Moodle's potential to increase communication was untapped. The instructors' attitudes could be expected, since Moodle provides tools such as automatic mailing lists (per group, per course, per

semester) and forums. These enable instructors to address a larger set of students simultaneously and find students' contact information without searching through a central LDAP (Lightweight Directory Access Protocol) server.

On the contrary, Moodle tools did not affect the communication between students and their peers or instructors. Although the use of a forum may add to the communication between students and instructors, the main method still used by students to contact their instructors are face-to-face meetings, phone calls, and e-mails – and none of these methods were affected by Moodle. Additionally, students are less likely to use indirect methods like a forum to contact their peers, thus making Moodle contribution to their communication abilities even less significant.

The on-screen organization of information was another issue of concern, as both instructors and students said that it was troublesome. Instructors focused mainly on the volume of information that each screen presents noting that in many cases there is some much information that is difficult to spot the part that is relevant to their needs. A possible solution for this problem would be to add additional layers of organization and modify the hierarchical structure so that information would be organized (and presented) in simpler parts.

Students on the other hand focused mainly on the graphical aspects of the user interface. It is important to have an appealing interface, as students spend a considerable amount of time in the environment. If students do not like the interface, they are more likely to abandon the system. To address this issue a new evaluation is needed focusing on the design aspects of Moodle. An interesting finding related to Moodle's organization scheme is the difference between experienced and novice students. One would expect that experienced students would be more receptive of the theme-based and week-based schemes, because these are also used in other LMSs. Results revealed an inverted picture with novice students accepting more positively the information organization. A possible explanation would be that the differences between Moodle and the previous LMS solution by the experienced students were so important that affected students' attitudes. This possibly indicates the need for improvement of Moodle's content organization method. However, it is also very important that the students with previous experience accepted Moodle more positively than novices, suggesting that despite any weaknesses Moodle is highly appreciated.

Conclusions

In this paper we presented the rationale behind the utilization of the Moodle LMS for the facilitation of a blended learning approach in our Informatics department. Our main goal was to replace the prior decentralized course organizational structure by implementing a single system, through which we could cater for the variety of instructor and student needs. The evaluation of the Moodle implementation was presented in detail, and the analysis of the results usefully demonstrates the success of this department-wide migration. According to the users, the main benefits of the migration include increased access to the learning material, use of tools such as forums and bulletin boards and system stability and usability. On the contrary, the main issues concerned the organization of the available sources and the lack of prompt feedback from instructors.

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Endnotes

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