Engaging Students by Moodleing a Course?

Case Studies at the Polytechnic of Porto – School of Engineering

http://dx.doi.org/10.3991/ijep.v2i3.2154

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***Abstract*—This work presents a comparative study covering four different courses lectured at the Polytechnic of Porto – School of Engineering, regarding the usage of a particular Learning Management System, i.e. Moodle, and its impact on students' results. This study addresses teachers who used this platform as a complement to their courses (b-learning) and identifies some particular issues in order to potentiate students' engagement and learning.Even though positive correlation factors exist, e.g. between the number of Moodle accesses versus the final exam grade obtained by each student, the explanation behind it may not be straightforward.Mapping this particular factor to course numbers reveals that the quality of the resources might be preponderant and not only their quantity. These results point to the fact that some dynamic resources might enlarge students' engagement.**

***Index terms*—Moodle resources, Moodle reports, case studies, performance analysis**

I. INTRODUCTION

In the educational landscape, almost all institutions now have some sort of a Learning Management System (LMS). The use of educational technologies emerges as a great opportunity to reverse the process of teaching and learning, encouraging the introduction of the most dynamic activities, not only for flexibility, but to provide new skills and new ways of learning. The implementation of LMS is a major task, which requires the mobilization of substantial resources for investment and considerable organizational effort. The LMS is a platform that facilitates creation of a web-based educational environment. It automates the management of a course of events, and aims to enable the creation of environments for which there is a real learning. This tool usually allows course management, educational support, generation and distribution of content to students as well as an interaction between all involved parties (students, teachers, monitors, coordination and support). For supervisors and administrators, the system keeps track of data, provides information, assists in the analysis and reports on the progress of participants. For teachers, the system allows supportingcourse planning, information sharing with other teachers, monitoring students' activities and interactions and provides a way of keep in touch with their learning progress. For students, the system helps planning their individual work towards the learning objectives, and allows them to collaborate by exchanging information and sharing knowledge with each other and receive feedback from teachers.

The practical training in these environments is a challenge. For example ,the issue of group identity is critical as there is a need to enforce the balance between the availability of content with the proposals for individual or grouping research activities, building knowledge in a flexible manner. This highlights the need for a careful pedagogical organization[1]. This careful planning is evidenced by Santos[2] by suggesting that, in the assembly of LMS, different resources in cyberspace should be considered., Amongst others, environment for formative assessment, where knowledge is constructed in a communicative process of negotiations and where decision making is a constant practice to (re)significance of procedural authorship and co-authorship. The role of the teacher towards the profitability of LMS is another object of many reflections. Silva [3], for example, argues that it is up to the teacher to make this a learning network through the involvement of students in a collective action. For the teacher to break with the logic of unidirectional communication where the student is seen as a passive recipient of information, Silva [3] proposes the creation of multiple devices allowing all parties' intervention, thus causing the participants to position themselves as co-authors of the interaction.

For these features, the system must be well chosen to provide a good variety of activities which may cause students' engagement in order to potentiate access to contents being worked on. Other aspects such as language and level of difficulty of handling required by the LMS should be taken into consideration and must be compatible with the infrastructure of higher education institutions, and especially with the level of training of employees, teachers and students involved in the process. Since the commercial offer is quite large, many institutions have opted to develop their own platform or to adopt an open one. Moodle [4] is one specific LMS that fits into the last category. According to its developers, the worldwide adoption of Moodle has exponentially grown since 2006, having reached a total number of over 66'000 registered sites, as of May, 2012[5]. Other figures reveal a total number of 216registered countries, the top-10 including countries such as the US, Spain, Brazil, UK, Germany, Mexico, Portugal, Columbia, Australia, and Italy (from first to last in rank). From these, Portugal occupies the 1st place when considering the ratio of number of registered sites versus population size (20% per million inhabitants).

Moodle is now in use at the Polytechnic of Porto – School of Engineering (ISEP) since 2006/2007, although few information has been shared about the benefits it brought to the school community or the ways it has been used in support of the many courses offered in-house (under and postgraduate). An initial study [6] was more focused on the general use of this platform by the school community, not including the learning gain achieved by

each course. In other words, no analysis of the correlation between the number of accesses and the student's results has been made. This paper addresses such a gap by presenting a first series of case studies, in attempt to stress the advantages of presenting a structured Moodle-based course page to the students and how the level of Moodle-students interactivity, verifiable through the "Reports" functionally, may cross correlate with the students' final marks.

II. METHODS

This work is based on four case-studies (Table I), each one representing Moodle-courses integrations in three different degrees at ISEP, and covers examples from students'three initial semesters (1st year, 1st and 2nd semesters, and 2nd year, 1st semester). In these courses there were 3 head-teachers involved (which were also editors in each Moodle page).

TABLE I.
CASE STUDIES IDENTIFICATION

	Course 1	Course 2	Course 3	Course 4
Degree	Civil Engineering	Chemistry Engineering	Electronic Engineering	Electronic Engineering
Year / semester	1st y./2nd s.	1st y./1st s.	2nd y./1st s.	1st y./2nd s.
Number students	492	159	344	617
Editor teachers	Head-teacher A	Head-teacher A	Head-teacher B	Head-teacher C + one teacher
Moodle'spage main objective	Repository and a tool for learning	Repository	Repository and a tool for learning	Repository and a tool for learning
Course contents	Waves, Electricity, Heat transfer and Optics	Mechanics	Waves and Optics	Electromagnetism
Students' assessment	10% Moodle assessment+30% laboratory+ 60% exam	50%laboratory+ 50% exam	10% Moodle quizzes+35%laboratory assessment + 55% exam	50% of continuous assessment + 50% exam

Data was collected in 2010/2011 and the number of students enrolled on such courses ranges from 159 to 617. With this sample (Table I) our study focuses on the differences and similarities found in students' enrollment between different courses' objectives, different degrees, different semesters or years, while raising the following questions:

- Is there a specific culture of students enrolled in a certain degree, in the usage of Moodle, irrespectively of the year and the courses/resources under analysis?
- Are there different cultures associated to each degree?
- Does the type of resources allow differentiating the level of engagement of students from different year/degrees?
- Does the effort of the head-teacher and the number of available resources correlates with the students'activity (in Moodle) and results (in the final exam)?

In an attempt to answer these questions, we analyzed three data sources: (1) the Moodle logs indicating all actions performed by all users, during the entire semester; (2) the Moodle activity report, reflecting the level of adherence to each resource; and (3) the students' results in each course.

III. ANALYSIS AND RESULTS

This analysis implied an initial phase of intense cooperation with the Information Technologies (IT) department, as the Moodle logs and the statistics module require extreme computer storage and processing capacity. The analysis is presented in three parts, according to data collection.

A. Moodle' Logs Analysis

The total number of logs includes activity and resource accesses and any other actions on every resource or activity. In this kind of report, one can see what pages the student accessed, the time and date they accessed it, the IP address they came from, and their actions (view, add, update, delete). A course activity report shows the number of views of each activity and resource. In the standard Moodle installation package there are 13 different types of activities, which can be found on the "add an activity" pull down menu.

Table II presents a first overview of the Moodle resources and accesses per course. This first analysis allows a global view of teachers/students' commitment on the development/ enrollment. The distinction between participants and active participants refers to everyone enrolled in the course compared to those with at least one access. The majority of Moodle resources are static, meaning that they do not imply any formal activity from students (course contents, links to other pages, etc.).

TABLE II.
OVERVIEW OF MOODLE RESOURCES AND ACCESSES PER COURSE

	Course 1	Course 2	Course 3	Course 4
Total number of logs	75920	21507	72644	112943
Total activity accesses	29886	9719	27502	61772
Participants	498	160	350	617
Active participants	439	155	341	515
Moodle resources	57	50	44	92
Dynamic Moodle resources	2 Quiz 1 Lab		6 Quiz	6 Quiz 6 Lab 22 Forums
Editor teachers (number of accesses)	1706	287	1661	4673

Judging from a comparative cross-analysis, it is possible to detect differences and similarities on the ratio of the total logs over the number of participating students. For instance, two different courses in the same degree (3 and 4), but in different years and lectured by different teachers, present a very similar ratio (213 and 219, respectively). On the other hand, course 2, which was identified by the head-teacher as being only a repository of information for students, is indeed the one that presents a lower ratio (139 average accesses per student), as it was expected.In spite of this lower average per student, it is interesting to notice that, it is the one course where students accessed Moodle five or more times a week, while in the other courses the higher frequency was around one to two times a week. Nevertheless, the rate of zero accesses is still significant in all courses (Fig.1).

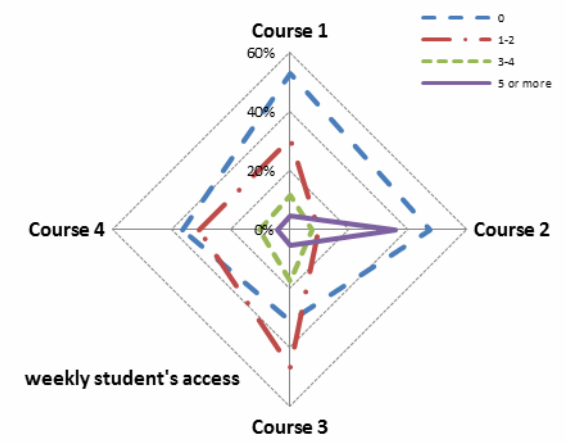

Figure 1. Characterization of weekly average frequency of accesses for each course.

B. *Moodle Activity Analysis*

In order to better understand the students' needs or students' acknowledgment of the Moodle activity advantages, each course was analyzed regarding the quantity of resources provided by editor-teachers and their variety.

Each course is now summarized in order to establish a rough measure of its quality in terms of the greater value presented to students. This analysis is based on Moodle course activity reports, which shows the number of views for each activity and resource.

1) *Course 1*

The purpose of this Moodle page (as stated by the head-teacher) was not only being a repository of information, but also a tool to help students scaffold their learning and infer their development. Several activities were posted during the semester (multiple choice questionnaires, simulations, etc.) in order to help students identify their needs and self-regulate their apprentices.

The Moodle' page organization was based in a sequential order of sections, according to lectures/content presentation related activities, as it is showed in Table III. Topic 1, 4 and 7 (in Table III) presents the classes material for the different types of class (lecture, recitation or laboratory). Other topics are meant to help students understand course-learning objectives and realize their difficulties. Precedingthe written tests, students were presented with a Moodle activity, which meant to help students in the learning process. These activities were online quizzes with only one attempt and with a duration limit and a mini laboratory project with a simulation, where students had to present an individual report online.

This analysis provides a general scope of students' interests while using the Moodle platform. It is clear that the activities that most capture students' attention are the questionnaires. This may be linked with two issues: first, students were assessed for their performance in these activities and secondly, this kind of activity is probably seen by students as a useful tool to self-evaluate their learning, since it preceded the written test.

2) *Course 2*

This Moodle course had a different perspective. Even though it was presented by the same head-teacher, in this course her main objective was simply to create a repository of information and organize the course materials. This course was organized by types of material, that is, the three main sections respect to the course information, lectures material, and recitation or laboratory materials (Table IV).

TABLE III.
MOODLE COURSE1ACESSES PER RESOURCE AND PARTICIPANT

Course 1Activities	Number of resources	Accesses	Average access per resource	Average access per resource per participant
General information				
News	7	1483	212	0.48
Weekly planning	4	1651	413	0.94
Useful tables and formulas	2	1339	670	1.53
Topic 1				
Program topic slides	6	3630	605	1.38
Proposed problems and activities	7	3838	548	1.25
1st Moodle Activity				
Multiple choice test (263 valid attempts)	1	2206	2206	**5.03**
1st written Test				
Test	1	326	326	0.74
Test grades	2	290	145	0.33
Topic 2				
Program topic slides	2	1142	571	1.30
Proposed problems and activities	2	1359	680	1.55
Some solved problems	1	476	476	1.09
2nd Moodle Activity				
Activity explanation	1	1071	1071	**2.44**
Simulation applet	1	829	829	1.89
Activity Submission (173 valid attempts)	1	2464	2464	**5.61**
2nd written Test				
Test	1	220	220	0.50
Test grades	1	612	612	1.39
Topic 3 and 4				
Program topic slides	3	1632	544	1.24
Proposed problems and activities	6	1773	296	0.67
Some solved problems	2	806	403	0,92
3rd Moodle Activity				
Multiple choice test (165 valid attempts)	1	1944	1944	**4.43**
3nd written Test				
Test	1	128	128	0.29
Test grades	1	215	215	0.49
Tests Resolutions	3	452	151	0.34
Total	**57**	**29886**		

TABLE IV.
MOODLE COURSE2ACESSES PER RESOURCE AND PARTICIPANT

Course 2Activities	Number of re-sources	Accesses	Average access per resource	Average access per resource per participant
General information				
News	3	302	101	0.65
Useful tables and formulas	1	185	185	1.19
Previous years solved exams	4	242	61	0.39
Course information				
Weekly planning	1	395	395	**2.55**
Course curriculum	1	359	359	**2.32**
Lectures material				
Program topic slides 1	15	1458	97	0.63
Program topic slides 2	7	674	96	0.62
Program topic slides 3	3	371	124	0.80
Proposed Problems and Lab guides				
Lab students distribution	1	750	750	**4.84**
Lab guides	10	3487	349	**2.25**
Proposed problems and activities	4	1496	374	**2.41**
Total	**50**	**9719**		

In this course, as it was expected and already seen in Table II, students' Moodle attendance was lower than in the other courses. Since there were no activities held during the semester, students did not feel a greater value in it. Accordingly, the lecture materials show a lower average number of accesses per participant. But surprisingly the average in lab guides and proposed problems activities is higher than in course 1.

3) Course 3

This Moodle page is organized in topics by type of contents (Table V), i.e. the first topic provides general information on the course program, assessment components, previous year lab grades information (valid for the present course edition, since previous year students are dismissed from lab assignments) and also previous years solved exams. The following two resource topics include lectures materials, PowerPoint slides and PDF's (color and black-and-white printings, i.e. B/W) and proposed problems for practical classes and homework practice. Topic 4 includes links to lab guides for lab assignments, in a total of 5 assignments along the semester. Topic 5 includes 6 quizzes done in the weekend after the thematic unit was lectured in theoretical classes, where students have only one opportunity to take eachquiz. The last quiz is done in the last weekend of the semester, and is an overall quiz on all the subjects taught. The grade obtained in this quiz could substitute a worse mark in any other quiz. Finally, the last section is simply a complementary resource showing an applet on electromagnetic waves where the student can vary several parameters and better understand the electromagnetic field concept. Surprisingly, this resource is one with smaller number of accesses per student, showing that only 69% of students were curious enough to access it. All these topics account for 37 resources plus 7 quizzes, with a total of 27502 view accesses.Table V also shows that students prefer to download color copies than B/W. Also, related to assessment components grades, they access almost twice to learn about their performance. This course shows a greater average of accesses per participant in the static resource sections (lectures, lab guides and problems activities).

TABLE V.
MOODLE COURSE 3 ACESSES PER RESOURCE AND PARTICIPANT

Course 3Activities	Number of re-sources	Accesses	Average access per resource	Average access per resource per participant
General information				
News	14	1295	93	0.27
Course general information	3	1452	484	1.41
Previous years solved exams	3	2185	728	**2.12**
Present year lab and moodle grades	1	653	653	1.90
Lectures material				
Program topic slides	8	774	97	0.28
Program topic colourpdf	7	4043	578	1.68
Program topic BW pdf	7	1551	222	0.64
Proposed problems				
Exercises to practice	6	3054	509	1.48
Lab guides access				
Access link to lab guides	1	1855	1855	**5.39**
Moodle questionnaires				
6 Moodle Tests: 1 per topic +1 extra	7	10403	1486	**4.32**
Simulations				
Electromagnetic waves applet	1	237	237	0.69
Total	**44**	**27502**		

4) Course 4

This Moodle page is structured into topics (Table VI), where the first one contains general information about the course, the following 5 topics correspond to the 5 units that form the course curricula, and the last topic basically contains a final quiz with true/false questions for self-assessment purposes, the exams of the previous years, and the exams (plus marking criteria) for the present course edition.

TABLE VI.
MOODLE COURSE 4 ACESSES PER RESOURCE AND PARTICIPANT

Course 4Activities	Number of re-sources	Accesses	Average access per resource	Average access per resource per participant
General information				
News	3	958	319	0.62
Teacher and Students' Foruns	22	3062	139	0.27
General course presentation	1	614	614	1.19
Weekly planning	1	1145	1145	**2.22**
Notes – Electrostatics	1	638	638	1.24
Notes – Electromagnetics & magnetostatics	1	433	433	0.84
Topic 1 – Electrostatics				
Lessons	7	3922	560	1.09
Quiz	1	2501	2501	**4.86**
Practice exercises	1	1146	1146	**2.23**
Lab assignments	2	1972	986	1.91
Instruction to fill online report	1	349	349	0.68
Online report	1	3901	3901	**7.57**
Topic 2 –Magnetostatics				
Lessons	4	1709	427	0.83
Quiz	1	1258	1258	**2.44**
Practice exercises	1	908	908	1.76
Lab assignment	1	804	804	1.56
Online report	1	2964	2964	**5.76**
Topic 3 – Electromagnetic induction				
Lessons	4	1622	406	0.79
Quiz	1	1407	1407	**2.73**
Practice exercises	1	790	790	1.53
Lab assignments	2	1666	833	1.62
Online reports	2	7718	3859	**7.49**
Topic 4 - Maxwell's Laws				
Lessons	1	382	382	0.74
Quiz	1	1053	1053	**2.04**
Topic 5 – Magnetic circuits & materials				
Lessons	5	1566	313	0.61
Quiz	1	758	758	1.47
Practice exercises	1	687	687	1.33
B-H curves	1	345	345	0.67
Lab assignment	1	701	701	1.36
Online report	1	2884	2884	**5.60**
Others				
Final quiz	1	3080	3080	**5.98**
Formulas for the exam	1	780	780	1.51
Exams	11	6655	605	1.17
Total	**92**	**61772**		

Each topic addressing a unit containing the slides used in theoretical classes, one quiz with multiple choice questions, the practical exercises, the lab assignments, and online reports for each lab assignment (except for lab assignment nr.1 due to lack of time). The quiz is open at the end of the unit, i.e. after all theoretical classes have been given to students, and each student is allowed two attempts, with an enforced time lapse of 48 hrs. These quizzes are only for self-assessment purposes and do not influence the final grade. The only connection with the final grade comes from the fact that group 1, in the exam,

is composed of 10 questions of the multiple choice type, extracted from the same database that is used for creating these quizzes in Moodle. Group 1 is valued 15% of the exam. Group 2, valued 20%, is composed of true/false questions, whereas students are able to practice (again for self-assessment) at the end of the semester. Again, students are allowed two trials, typically starting 3 days before the exam date (both seasons), with a time break of 24 hrs.

A closer look into the Moodle activity report, concerning Course 4, shows that almost half of the accesses are related to the general "Course view" action, which can be considered as an overhead and hence providing no significant information (expect for the number of times, in average, students accessed the Moodle course page, i.e. 100 accesses per user, during the entire semester). One may see that static resources such as notes, slides, lab assignments, and practical exercises show no difference between these two action categories. At the opposite side, dynamic resources such as the forum, the quizzes for each thematic unit, the online reports, and the final quiz (true/false questions), show a significant difference between the "view" action and the remaining ones. Even though static resources are the most consulted issues in a LMS platform [7], the dynamic resources provided by teachers, result in a more expressive activity. Fig. 2 shows this difference in course 4 when compared to all others.

This course provided 22 forum activities (contributing to the large number of dynamic resources)n as shown in Table VI. This activity denotes interesting results when seen in more detail. Analyzing head-teacher' contributions and students' contributions separately, one may see that students' posts (10, in number) generate more replies (26) than the ones initiated by the teacher (12 posts and 14 replies), which suggests a more intense interaction and hence that this type of forums should always be created in every Moodle course page (notice that the forum created by default, i.e. "News", does not allow students to post messages).

C. Students' Results

Correlation results between this Moodle usage (characterized in the former subsections) and students' academic grades (obtained on their final exam or on their continuous assessment component) are presented in Fig.2and Table VII. The correlations observed in Fig.2show a small positive trend, expressing that in some degree, students who access Moodle with greater expressivity, are more likely to have good grades. Of course this is not (and could never be) an unequivocal relationship, since students achievements in final examinations depend on too many variables (some of which cannot be expressed quantitatively). Even so, these small correlations, and particularly those with continuous assessment component, are statistically significant (Table VII), which implies that this hypothesis can relate those variables. These results are in agreement with the observed dispersion graphics showed in Fig. 3.

So, Moodle activities seemed to have helped students along the semester in their learning. Furthermore, courses where the teacher's effort was lower (2 and 3) the encountered correlation is also lower. This is in contrast with the information provided by Table I that indicates course 1 and 3 to be very similar in terms of total number of students and head-teacher's accesses. Furthermore, if one considers the ratio between number of accesses and number of active participants, a better correlation would be expected in course 3, which was not the case. This suggests that a deeper and fine-grained analysis should be carried out, in particular considering the number and type (i.e. quality) of Moodle resources available in each course. For instance, analyzing Table II, course 3 presents a higher number of dynamic resources, but all of the same type (quizzes), while course 2 presents a lower number but a higher variety.

Courses with higher diversity of activities (with dynamic resources) available to students, as shown in Table VII, have a higher statistical significance. This fact may be related with a greater teacher's effort in making students more engaged in the Moodle course, providing several activities along the semester in which students had more real opportunities to learn and evolve.

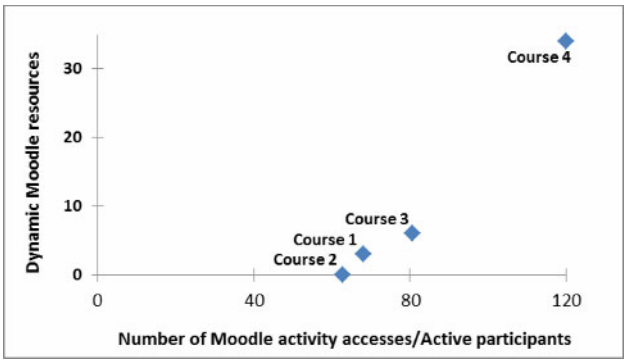

Figure 2. Relation between the number of activity accesses (relatively to the number of active participants) and the number of dynamic resources.

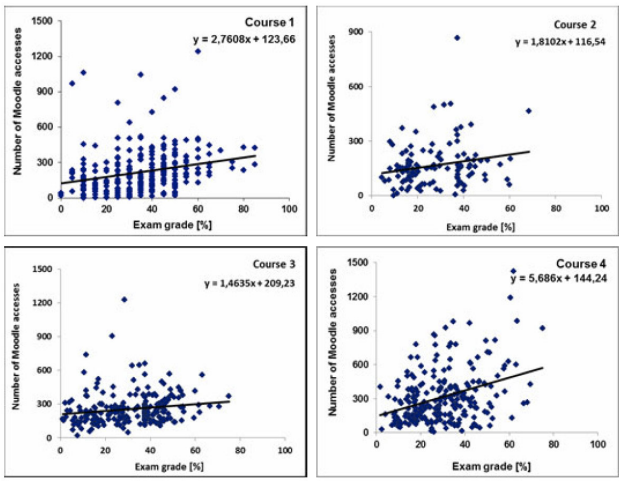

Figure 3. Correlation between students' Moodle accesses and their final examination grade for each course (1, 2, 3, and 4).

TABLE VII.
PEARSONS' ANALYSIS BETWEEN MOODLE ACESSES AND STUDENTS' GRADES

Correlations of students' number of Moodle accesses with:	Course 1	Course 2	Course 3	Course 4
- frequency	0,410**	0,210*	0,324**	0,453**
- exam	0,259**	0,200*	0,166*	0,380**

**Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

On the other hand,in Course 4 (with highest statistically significant correlation with frequency assessment) those Moodle activities (dynamic resources) didn't account for the students' grade. Knowing for a fact that students engage more naturally in activities in which they are assessed [8], this constitutes a surprising result and may indicatethat students felt those activities as important means to develop their learning.

IV. DISCUSSION AND CONCLUSIONS

Summarizing data from all cases, it becomes clear what students search in such LMS resources. As seen in Table VII, students search for static materials (such as lectures, lab guides and proposed problems) is somehow similar in all cases, being the 2nd year students who present a great average. The same magnitude is also found in students search for course information, now being the 1st year, 1st semester students who present a higher value.

TABLE VIII.
CASE STUDIES SUMMARY RESULTS

Average access/participant	Course 1	Course 2	Course 3	Course 4
Lectures, lab guides, proposed problems	1.24	1.34	**2.85**	1.33
Course information	0.94	**2.44**	1.41	1.71
Quizzes contributing to final grade	**4.73**	-	**4.32**	-
Quizzes for self-assess	-	-	-	**3.25**
On-line report	**5.61**	-	-	**6.95**

Even though some authors say that the frequency of use decreases as the LMS functionality becomes more 'engaging'[7], these results show that particularly for quizzes and laboratory online reports, students respond to teachers solicitations. This might be related to students' perception of its utility towards their learning objectives. The number of students who find usefulness in other dynamic resources like forum discussions or online appointments is residual. This doesn't mean the resource is not useful, it just means that it only helps a small percentage of students.

In spite of students' degree, year, semester or contents, students respond well to resources which will either help them in their learning - like quizzes which they can go back and evaluate their own answers – or resources they are obliged to download/report regularly – like lab guides or on-line reports. This last activity undoubtedly shows students' preference, although there may be a distracting factor, i.e. students were asked to save their answers every 10 minutes so as to refresh the Moodle online report, while doing the lab assignment.

These results are obtained regardless of their different objectives, degrees, years or semesters. This allows us to answer the first two questions we address: within the context of engineering students it was not observed a different culture of students enrolled in the usage of Moodle, stated by their degree. However, comparing to results obtained in different communities [7], it might depend on the learning knowledge area. Further studies are needed in order to reach a greater understanding.

There is a small difference between 1st and 2nd year students regarding the search for course information (greater in the first ones) and static resources (greater in the last ones). This might be linked to natural students concerns while being freshman and seeking to get acquainted with the environment or, in the latter, more adapted to the system.

It became clear that the major differences encountered regard the kind of activity and not the course itself. Independently of their weight in their final grade, students seek Moodle quizzes in order to infer and support their learning, but when it did count to their grade (courses 1 and 3), the number of accesses is higher, as it would be expected.

On-line reports, where students had to submit a report with a simulation or laboratory experiment, gather students' attention the most. Even if these numbers (presented in Table VI) account for the teachers' effort in assessing each work, the obtained ratios without it are still higher than any others. This allows inferring that when teachers' effort in scaffolding students learning is present in a Moodle page by presenting different kinds of activities in order to help students to evolve, students respond positively to this effort. Adding to this relation is the fact that those courses where the ones who obtained greater values of statistically significant correlations with students' grades.

This work is meant to be helpful in identifying important aspects in order to potentiate LMS usage, not only as a repository of information, but as a mean of involving students, using different types of resources. This richness may foster a greater number of students to enroll in course accompaniment and hopefully learning development along the semester. It is also possible to infer that when the LMS page is rich (course 4), even the static resources become more visited by students, than in courses that were simply a repository of information (course 1 with static resources only).

One of the resources we intend to implement through Moodle usage in the future addresses one important aspect in Science & Engineering education, i.e. students' experimental competences development through remote labs [9,10]. By having the possibility to access remote labs, through this platform (i.e. adding remote experiments as a Moodle resource), we expect to later extract meaningful information from the Moodle analysis tools. These results (presented in Table VII) encourage this future implementation as a mean to allow students to have at their disposal different types of activities that can help them develop different kind of competences in each subject. Nevertheless, in this work only a small number of the different type of activities possible within Moodle is presented.

It is important to note that a comprehensive and profound change, which aims to use the new technologies in every classroom courses, is not done at once, but in a more or less continuous process, where individuals are co-opted for change, to undertake the action, and need setting mechanisms. The entire educational process is the need to "translate" the educational content. For this reason, the deeper the research and development of educational technologies, the more that is present within an institution of higher education, through: an integrated system of educational administration; a repository of learning objects; collaborative virtual environments; synchronous and asynchronous; environments and web conferencing (webcasting) to support classes enriched by video, sound, im-

age and application software, all simultaneously, providing a unique learning experience.

By becoming more prevalent within the institution, the technology will gradually disappear within organizational processes. That is, it will be the protagonist ceasing to become an adjunct. In doing so, highlight is on the relation between teaching and learning, which is the core of the educational dynamics.

These results indicate the need to develop a process for evaluating the effectiveness of learning in this new environment, with courses developed with the methodology adopted. Further studies appear to be useful for developing comparative metrics that allow qualifying and quantifying learning.

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This article is an extended version of a paper presented at the International Conference IEEE EDUCON2012, held at University Mohammed V Souissi, Marrakesh, Morocco in the period of 17-20 April, 2012. Received 15 June 2012. Published as resubmitted by the authors 24 June 2012.