TECHNOLOGY ACCEPTANCE ON HIGHER EDUCATION:

THE CASE OF AN ENGINEER'S SCHOOL

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Abstract

Despite having distinct approaches to Internet, Information and Communication Technology (ICT), adults and youngsters are both actors of an active social process of learning in schools, where a changing attitude is urging. Unfortunately, schools have problems in using technology on their own benefit and in involving students in interesting learning activities. Additionally, teachers are uncomfortable when using technology, specially knowing their students are digital natives. So how can we alter this scenario in order to use technology on behalf of the learning process?
The pressure to use technologies for learning emerged also from the implementation of the Bologna Declaration, which aims to harmonize the structures of Higher Education (HE). Its goal is to increase the competitiveness of the European HE system and to promote the mobility and employability of all the graduates. It is also intended that teachers monitor and contribute to the progress of technology by creating new learning environments.
Following these objectives, on this article our research hypothesis is based on the premise that technology should be adapted to education, instead of the opposite, in order to reach higher levels of effectiveness. Moreover, if the use of technology is not reflected in the change of educational procedures, the real influence on learning results is to be questioned. We believe that a change from the traditional education system to a model based on Web technologies implies adaptation and a willingness to implement these alterations within teaching procedures.
Within the new generation of Web applications, there are a few which are shared on the same platform. They represent a new level of interaction that facilitates collaboration and information sharing. They provide resources in different formats, like text, video and audio, links to sites, notices to students; and they ease student/teacher interaction through communication tools, which support collaborative learning and registration activities. Those platforms, in general, have been used in blended-Learning (b-Learning) or as a support to face-to-face education in HE.
This article analyses the current ICT usage in the context of HE, according to recent changes in the information society. In particular, it focuses on the adoption of online learning platforms and their impact in the teaching-learning model in HE, having as an example the integration of the MOODLE platform at the Instituto Superior de Engenharia do Porto (ISEP). It was found that there is a low rate of adherence to that online teaching platform, even when used as a repository of information; also, there is a great reluctance to use the platform for b-Learning settings.

Keywords: MOODLE, ICT, Higher Education, e-Learning, b-Learning.

1 INTRODUCTION

ICT made an impact on all aspects of society over recent years, and its potential to transform education is widely acclaimed. The high expectation on the role ICT can play in schools presents both opportunities and challenges for those involved in its implementation and application for teaching and learning. New technologies and digital media have made significant progress and generated impact and improvement on the conditions for learning in education, training and Life-long Learning (LLL). ICT usage is more widespread than ever before.

Access to internal or external networks from a company or a school, videoconferencing, shared use of documents and redistribution of phone calls are some examples of these new technologies. Communication is also responsible for the greatest advances. Communication is somewhat complex, since there are several ways to communicate. The aim is to show how the exchange of messages, information and human relationships are important for the development of new concepts, such as collaborative work (team work), knowledge management, distance learning (e-Learning) or Mixed - b-Learning, which promote greater democracy in human relationships by reducing space/time between them.

A multidisciplinary approach is a necessity in almost all professions. Technological knowledge, though, is essential for career development, especially in a market with a high level of technological development. One cannot expect the computer to do everything by itself: it provides us with information and resources, which in the educational context allows teachers to adapt the planning of the classroom. Teachers who feel they are unable to use the computer as a teaching-learning tool are outside the context of the current labour market.

Technological education allows learners to explore a variety of activities related to many areas where science, technology, engineering, and math intersect with society. Students can develop problem solving strategies and work habits that will be useful in almost any career or occupation.

Technology cannot stand alone. And neither can content or pedagogy. Today's instruction, evolving in a world of expanding technological capabilities, must include content, pedagogy, and technology. All three must be naturally blended by educators. The key is integration. Technology’s integration with both content and best practices motivates students towards learning. We are preparing students for responsible roles in a technologically advanced society.

1.1 UTAUT MODEL

Many models of technology acceptance have been proposed. Aiming to design a model that would unify the major studies in the area of technology acceptance, Venkatesh et al. [1] developed the Unified Theory of Acceptance and Use of Technology (UTAUT) through analysis and comparison of eight relevant models: the theory of reasoned action (TRA), the Model Acceptance Technology (TAM), the Motivational Model (MM), the Theory of Planned Behavior (TPB), the combination of TAM and TPB (TPA/TPB), the Model of PC Utilization (MPCU), the Innovation Diffusion Theory (IDT) and the Theory Social Cognitive (SCT). Venkatesh et al. emphasized that the selection of these models was due to the fact that they had already been extensively tested in IT environments, and approved by the academic community, since they were a reference in international journals.

Venkatesh et al. performed an empirical comparison between the eight models, conducting a longitudinal study of four organizations with individuals who were introducing a new technology in their work environment. The questionnaire they used was based on different features of all the models mentioned, which had been validated in organizational studies and in technology.

On Figure 1, we can see the representation of the theory that has generated a new integrated model, which features four variables that determine the intention and usage of IT and four moderators.

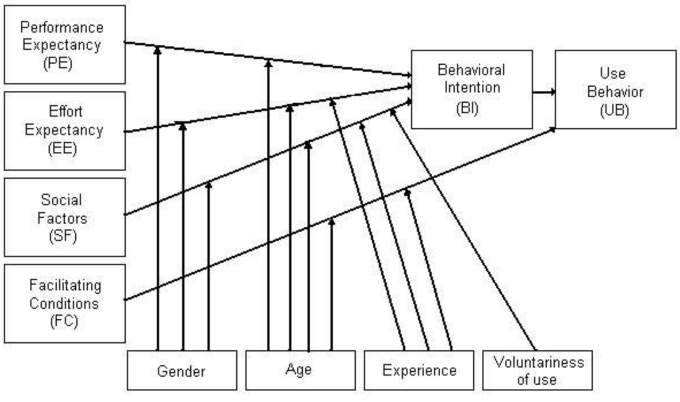

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Figure 1. Graphical representation of UTAUT theory [1]

According to this model, four critical variables directly determine the usage's intention and behavior. The core variables are:

- Performance Expectancy (PE): it is the extent to which an individual believes that using an information system will help him or her improve job performance.
- Effort Expectancy (EE): it is the degree of ease users feel regarding the use of an information system.
- Social Influence (SI): it is defined as the extent to which a person perceives that significant people believe he or she should use the new information system.
- Facilitating Conditions (FC): it is the way that individuals understand that an organizational and technical infrastructure exists to support the use of the new information system.

Gender, age, experience, and willingness to use are placed to level the impact of the four key variables on usage intention and behavior [1].

There are some published studies that explore the perceptions of HE teachers on System Information (SI) and investigate factors that influence the teacher's intentions to accept these systems, relying on the model UTAUT [2] [3] [4] [5]. It is in this context that this study is itself a proposal to investigate the determinants of acceptance among teachers of a HE school, with the aim of promoting understanding of this collective approach to teaching and learning, and help contribute to a better outcome from the use of platforms to support education in the world of higher education teachers.

1.2 MOODLE

MOODLE[1] is an open source learning platform created in 2001 by Martin Dougiamas. As usual in the open source software, MOODLE has been developed collaboratively by volunteers from different areas, with new features and functionalities continually being added. [6]

MOODLE includes a set of features that can be systematized in four basic dimensions: content, exercises; media services, synchronous chat or asynchronous forums; protected access and management of user profiles; control systems activities. In addition to the functional characteristics it possesses, the MOODLE platform is currently translated into 82 languages and it is free to use - these are the main reasons that explain its use all over the world.

MOODLE has continued to evolve since 1999 (or since 2001, with the current architecture). The current version is 1.9.9, which was released in June, 2010. Currently, there is an ongoing work to release MOODLE 2.0.

Not having to pay license fees, an institution can add as many MOODLE servers as needed – the growth is not limited. The Open University of the UK is currently building a MOODLE installation for their 200,000 users [8]. This unlimited feature is often known for being used by individual departments of many institutions, such as the Math's department of the University of York.

At the moment, MOODLE is the most used platform in Portuguese educational institutions, both in secondary and HE levels, because of the above described features. As such, MOODLE can be used to assess the validity of the UTAUT model and the status of technology adoption in specific cases, like an Engineering School.

1.3 Bologna Declaration

In terms of education policy, the Bologna Process was born, informally, in May 1998, with the Sorbonne declaration [9]. It officially started with the Bologna Declaration, in June 1999 [10], and it defined a set of stages and steps to be taken by European higher education systems in order to build up a European area of globally harmonized higher education. The basic idea is that it should be possible for a student of any institution of higher education to start, continue or complete their education and obtain a degree recognized at any European University in any State Member, although still being subject to each of the national features.

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1 MOODLE [7] stands for Modular Object-Oriented Dynamic Learning Environment and simultaneously acronym Martin Object-Oriented Dynamic Learning and Martin is the name of its creator.

The general aims of the Bologna Declaration [11] are:

- To increase the competitiveness of the European system of HE and to promote the mobility and employability of university graduates in Europe.

Achieving these goals requires global success in reaching the following objectives:

a) Adoption of an easily readable and comparable system of degrees, that also includes the implementation of the Diploma Supplement;
b) Adoption of a system based essentially on two cycles, including:
   i. A first cycle, in which Portugal leads to a degree with a relevant role for the European labour market, and with a duration between six and eight semesters;
   ii. And a second cycle, in which Portugal leads to a master degree with a duration ranging from three to four semesters.
   iii. Establishment and generalization of a credit system (ECTS), not only transferable but also cumulative, regardless of the education institution attended or the country of its location;
c) Promotion of mobility within and outside the community of students, teachers and researchers;
d) Promotion of European cooperation in quality assurance;
e) Increase the European dimension of HE.

Following the political commitment made in Bologna, the European Ministers of Education meeting in Prague [12] in May 2001 acknowledged the importance and need for three more lines of action for the progress:

f) Promotion of LLL;
g) Increasing student involvement in the management of institutions of HE;
h) Improving the attractiveness of European HE Area.

In September 2003, the Ministers responsible for the HE meeting in Berlin [13] reaffirmed the objectives set out in Bologna and Prague, and added two more:

i) The need to promote closer ties between the European LLL Area and European Research Area, in order to strengthen the European investigative capacity and to improve the quality and attractiveness of European HE.
j) To extend the current system of two cycles in order to include a third cycle in the Bologna Process, consisting of the doctorate (PhD), and increase mobility both at the doctoral and post-doctoral levels. Institutions should seek to enhance their cooperation at the level of doctoral studies and training of young researchers.

At the meeting, in May 2005 in Bergen [14], the Ministers reinforced the importance of the objectives of Berlin relating to the promotion of closer ties between the European HE Area and European Research and PhD.

This small historical description gives us a temporary top-down evolution of the Bologna process in course at the moment in the higher education institutions of European Union States Members. It also shows the importance of a student-centred learning paradigm which inevitably conduces to the use of technology by the students and teachers.

1.4 Instituto Superior de Engenharia do Porto (ISEP)

ISEP was founded in 1852, during the rise of Portuguese liberalism [15]. It was, at the time, the first public system of industrial education, although there was not a Portuguese industrial policy in itself. Only between 1947 and 1950 was the role of the industrial institutes redefined as the apex of the structure of industrial education.

In 1974, it became the Institute of Higher Education for Industrial Engineering.

The Institutes were, from then on, integrated in the structure of higher education as independent schools, transforming the Industrial Institute of Porto into the current School of Engineering of Porto.

In 1989 the Institute of Engineering of Porto was integrated into the Polytechnic subsystem. That way, its training model incorporated two different courses: the Bachelor, lasting three years, and the Course of Specialized Higher Studies, with a two years duration; together with a consistent Bachelor, they conferred the graduation diploma.

In 1998, under a new change in Polytechnics, ISEP offered the current two cycle’s graduations, characterized by being structured in two cycles of studies - the bachelor, with a duration of three years

- allowing for the insertion in the labour market; followed by a second cycle of two years - attended primarily on after-work scheme - to obtain the degree.

In 2006, when Portugal's signed the Bologna Declaration, ISEP designed new syllabuses, for graduation and master's degrees in the various areas of Engineering. It was in that year that the MOODLE platform was chosen as ISEP's learning support platform.

2 RESULTS /ANALYSIS

To assess the validity of the UTAUT model in a moment where technology based learning was becoming paramount we conducted an observatory study, based on access and use of the e-learning platform at ISEP in the last 4 academic years[2].

In that first academic year (2006/2007), only the Curricular Units (CU) required by their teachers were created. On the following academic year all the units were operating in all the courses from the 7 departments of the ISEP. Each CU is assigned to a teacher-editor. By default, this teacher-editor is the leader of the CU and he is the one who decides on the involvement of other teachers. The role of the student is automatically defined when he/she validates his/her registration in the academic services in each school year.

The available records make a distinction between CUs that use the platform system for e-Learning[3] and CUs that use it as a simple repository. This division follows these criteria:

- CU with e-Learning: all the CU that have more than 5 events or more than 5 modules or more than 20 files;
- CU with repository: CU that is not in the previous category but has more than 20 files.

We can see the data from the departments of ISEP, the 4 academic year's duration of the Bologna model and the application platform in the tables that are listed below: Table 1, Table 2, Table 3, Table 4, Table 5, Table 6 and Table 7. Each represents a department.

Civil Engineering	2006/2007	2007/2008	2008/2009	2009/2010
Number of CU	7	106	104	59
Number of CU e-Learning use	3	5	2	1
Number of CU repository use	0	27	37	37
Number of CU e-Learning use [%]	*42,86*	*4,72*	*1,92*	*1,69*
Number of CU repository use [%]	*0,00*	*25,47*	*35,58*	*62,71*

Table 1. Data of CU of the Department - Civil Engineering for the 4 indicated years

Electrical Engineering	2006/2007	2007/2008	2008/2009	2009/2010
Number of CU	25	250	203	204
Number of CU e-Learning use	11	16	25	29
Number of CU repository use	6	63	92	90
Number of CU e-Learning use [%]	*44,00*	*6,40*	*12,32*	*14,22*
Number of CU repository use [%]	*24,00*	*25,20*	*45,32*	*44,12*

Table 2. Data of CU of the Department - Electrical Engineering for the 4 indicated years

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[2] The data was supplied by the E-Learning and Multimedia (GEM) Division of ISEP (DSI). This data refer to the time that MOODLE platform started being used by the ISEP community. Additionally, it corresponds to the school year of the implementation of Bologna curricula.

[3] The term e-learning is used here in a way which is not confortable to the authors. Nevertheless it is the terminology used by the data suppliers and we will keep it to maintain the consistency of the received data.

Physics	2006/2007	2007/2008	2008/2009	2009/2010
Number of CU	3	81	67	91
Number of CU e-Learning use	1	3	7	5
Number of CU repository use	0	10	25	36
Number of CU e-Learning use [%]	*33,33*	*3,70*	*10,45*	*5,49*
Number of CU repository use [%]	*0,00*	*12,35*	*37,31*	*39,56*

Table 3. Data of CU of the Department - Physics for the 4 indicated years

Geotechnical Engineering	2006/2007	2007/2008	2008/2009	2009/2010
Number of CU	2	81	52	51
Number of CU e-Learning use	2	2	3	1
Number of CU repository use	0	7	24	24
Number of CU e-Learning use [%]	*100,00*	*2,47*	*5,77*	*1,96*
Number of CU repository use [%]	*0,00*	*8,64*	*46,15*	*47,06*

Table 4. Data of CU of the Department - Geotechnical Engineering for the 4 indicated years

Computer Engineering	2006/2007	2007/2008	2008/2009	2009/2010
Number of CU	29	207	121	131
Number of CU e-Learning use	10	24	30	27
Number of CU repository use	10	46	34	34
Number of CU e-Learning use [%]	*34,48*	*11,59*	*24,79*	*20,61*
Number of CU repository use [%]	*34,48*	*22,22*	*28,10*	*25,95*

Table 5. Data of CU of the Department - Computer Science Engineering for the 4 indicated years

Mechanical Engineering	2006/2007	2007/2008	2008/2009	2009/2010
Number of CU	2	115	59	92
Number of CU e-Learning use	0	3	3	5
Number of CU repository use	0	16	23	38
Number of CU e-Learning use [%]	*0,00*	*2,61*	*5,08*	*5,43*
Number of CU repository use [%]	*0,00*	*13,91*	*38,98*	*41,30*

Table 6. Data of CU of the Department - Mechanical Engineering for the 4 indicated years

Chemical Engineering	2006/2007	2007/2008	2008/2009	2009/2010
Number of CU	8	166	91	78
Number of CU e-Learning use	1	3	5	4
Number of CU repository use	2	26	43	49
Number of CU e-Learning use [%]	*12,50*	*1,81*	*5,49*	*5,13*
Number of CU repository use [%]	*25,00*	*15,66*	*47,25*	*62,82*

Table 7. Data of CU of the Department - Chemical Engineering for the 4 indicated years

The data presented in the tables represent each of ISEP's departments, with at least a course each. They were reorganized in order to generate Figures 2 and 3.

Figure 2. Number of CU in regime of e-learning, percentile value of the use of the platform in the 3 years

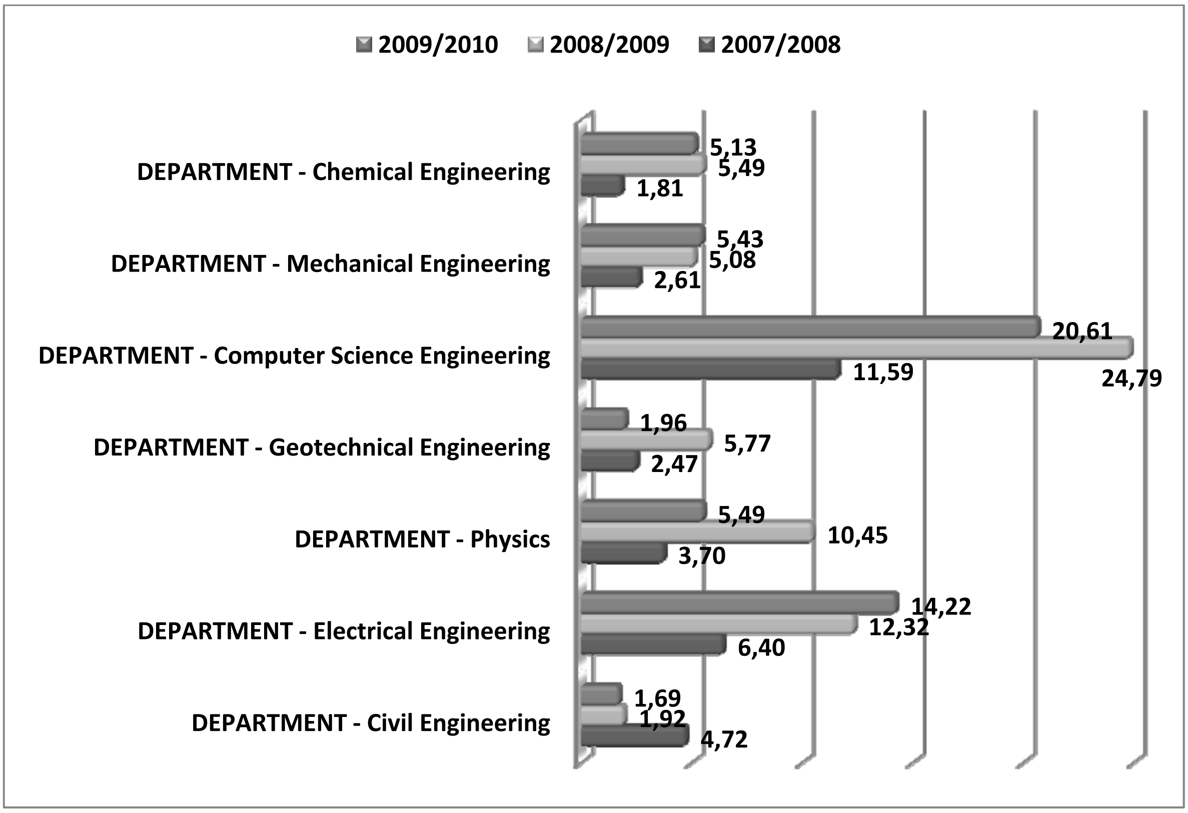
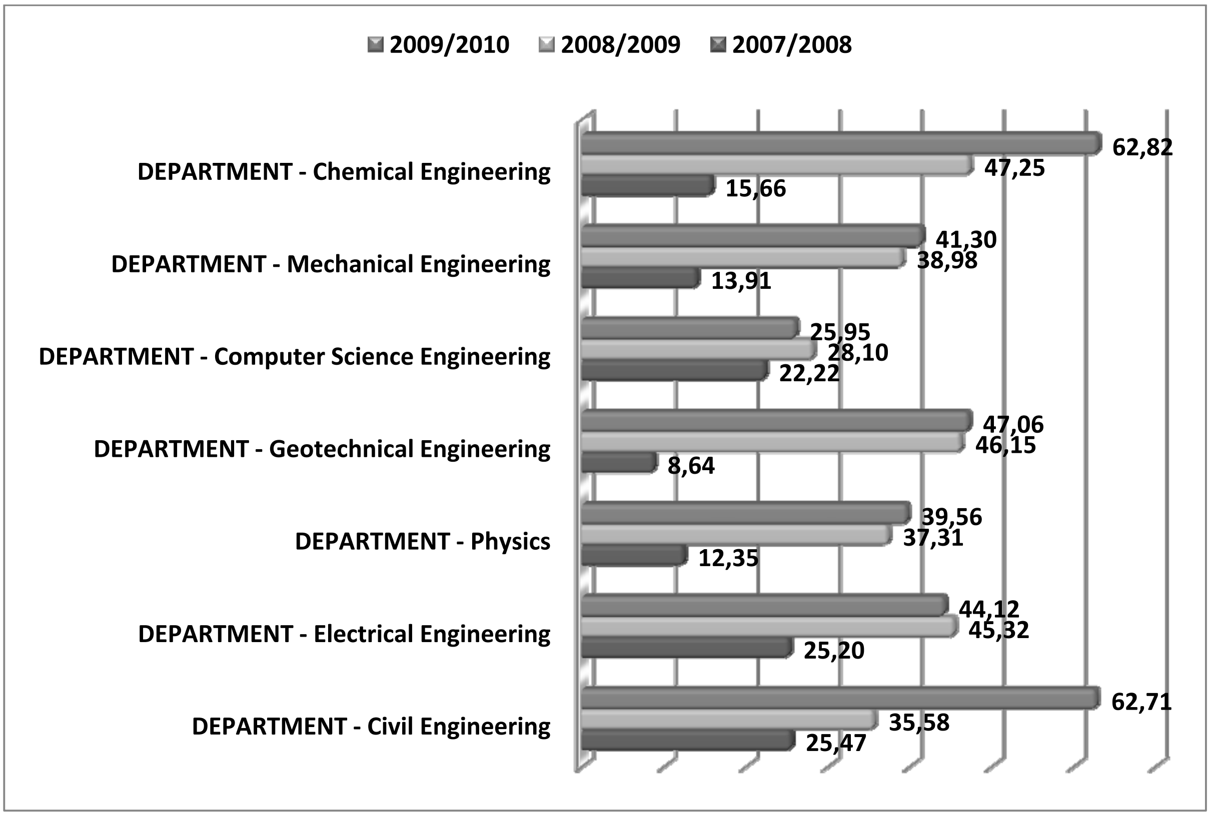


Figure 3. Number of CU as repository of information, in percentage, using the platform in the 3 indicated years



We will focus our analysis on the last 3 years, where the data is more consistent. That way, the analysis of the data in percentage by the departments allows the possibility to make comparisons, which would not be possible or fair if done in another way.

The use of the platform for e-Learning stands out, with values between 10 and 25%. It is used more intensely by the departments of Computer Science Engineering and Electrical Engineering. Even so, it is a low usage value concerning what is available. In the other departments, we can hardly notice the use of e-learning, with values from 2 to 6%, in general.

Moreover, it appears that, in general, in the school year 2008/2009, the departments chose e-Learning but in the following year there was a slight decrease. The exceptions were the departments of Mechanical Engineering and Electrical Engineering. Compared to 2007/2008, all departments had a growth of its use, with the exception of Civil Engineering.

When we move on to the analysis of the values of the platform as a repository of information, we can already observe its more frequent usage. In this case, the department that uses it less in that way is the Computer Science Engineering - it did not get to 30% in the end of the year. All the others show a value over 40%. Moreover, there are two departments that go over 60%: Civil Engineering and Chemical Engineering.

We find that all departments have been struggling to make a greater use of MOODLE, with the exception of Computer Engineering and Electrical Engineering, who had a slight decrease last year (2009/2010). In general, they all progressed in what concerns the repository use from 2007/2008 to 2008/2009.

3 CONCLUSIONS

In general, the platform is more and more used as time goes by. However, regarding its two most common uses, e-Learning (or b-Learning, to be more accurate) and repository, the first hasn’t grown as expected, considering the whole paradigm of Bologna, the alteration of the CU and the contents and methodologies associated to the teaching-learning process.

Regarding the second kind of possible use (as an information container), it has had a significant growth, but do not take full advantage of its potential. In this case, teachers only use it to make contents available, without using its full potentialities. We must underline the departments of Civil Engineering and Chemical Engineering, with a use of the platform as a repository in over 60% of their CUs. But all others departments are above 50% of usage in the similar classification.

Final explanations for such low results are still to be found, yet some factors may be pointed out: lack of time to learn how to use the tool; operational difficulties; lack of knowledge among the teachers.

To analyse the core variables of the UTAUT model PE, EE, SI, FC, we still do not have enough data or information to sustain a complete model validation. In spite of that, we believe that using the platform will help to improve the job performance. We do not have information about how comfortable the users feel when using the platform. We do not have information about the extent to which a person understands how important it is for others to believe that he or she can use the platform. And we also have no information about the way(s) that teachers intend to use the help provided by the platform.

Still analysing the four main variables of the UTAUT model, with the data supplied, we can verify its volunteer use in the year of 2006/2007, because only at that time could we identify the UC that were initialized by request; and after verify the ways the data were used.

This data will be used to support the preparation of a questionnaire, which, after validation, we intend to present to ISEP teachers. We expect their support to this initiative and to others that are now being considered to increase the quantitative and qualitative use of the MOODLE platform, for the benefit of the improvement of teaching and student learning.

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