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A full-stack model proposal to willingly implement e-learning at small universities: The University of Trás-os-Montes e Alto Douro Case

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Abstract

This paper presents a model of a system capable of addressing the training needs identified for small universities, using the University of Trás-os-Montes e Alto Douro (UTAD) as a case study. In addition to supporting the typical needs of distance learning/education (e.g., e-learning), it is also intended that the proposed system complements the traditional classroom-based teaching. This model will have two modules: the physical/infrastructural module and the policies/practices module. While the physical module will have all the infrastructure services associated with educational practices, such as the e-learning platform, the policy module will include institutional policies and rules in the creation, development, practice and management of courses, equipment and physical spaces, such as exam rooms.

In line with these, UTAD has come to recognize that e-learning should be part of its strategy for its training offer and, consequently, is being adopting new policies, namely through the signing of protocols with other institutions with more experience using e-learning. As such, a review of other models and systems that have been successfully implemented in other international reference universities will also be briefly presented here. The courses implemented so far, and the results achieved, are also presented and commented.

KEYWORDS: E-learning, LMS, Higher Education, Collaboration

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1. Introduction and motivation

Technological developments in society over the last two decades, in particular those associated with digital communications, have profoundly changed the way people live, with particular emphasis on how they interact, how they work and how they learn. This change has a strong impact on the development of the individual's social capacities and educational skills.

E-learning, which for now can simply be defined as both a technological and pedagogical method for distance learning, can be seen as the main reason for this significant change in teaching and in the acquisition of new skills (learning). The effectiveness of the processes used in the transmission of knowledge and the rapid access to the courses are conducive to attracting new audiences. Likewise, this modality of teaching can be a complement to face-to-face teaching.

E-learning should not be evaluated as a facilitating and secondary teaching model, but rather as a new opportunity for educational institutions to broaden their educational offer and reach a new public, hitherto unattainable (Bichsel, 2013; Means et al., 2009).

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At the University of Trás-os-Montes e Alto Douro (UTAD), e-learning is considered as an "unknown-recent" teaching modality and as such, still without great prospect in this area. Although the institution shows some willingness to embrace this teaching methodology and has already done so previously by using teaching plans in the b-learning modality, it eventually collapses due to several different classes of difficulties. These can be classified into two distinct classes: technological – lack of e-learning platforms and tools for content creation; and human – lack of training in the area of information and communication technologies (ICT) and lack of training in this type of teaching (Islam, Beer, & Slack, 2015). Lack of time is often pointed out as a limiting factor: teachers see e-learning as an activity that will require a lot of time, overloading, even more, their already overfilled agenda. To this, teachers add the lack of recognition of their work and the fact that it does not have effects for progression in their professional career.

These difficulties might be overcome by implementing measures or approaches of a more or less simple nature. For example, training for teachers in ICT, technical support by specialized teams, accounting as teaching hours the time spent preparing the e-learning courses, financial incentive related to the training expenses, materials and scientific production (Paiva, 2013).

In this context, it is our aim to present a model of a system capable of responding to the training needs identified at UTAD. This model must be able to integrate a multiplatform system, effective, practical, functional and complete, leading to the actual implementation of e-learning at UTAD. This system should contribute to improve the transmission and availability of courses/ trainings, as well as helping bringing students closer together and attract new audiences. This system should also be used to support face-to-face teaching. In summary, the proposed system should: contribute to combat school failure; allow students more flexibility in scheduling their courses and training; cover a wider population of more advanced age groups; attract students from different regions and/ or countries; use more innovative techniques and technological means for the dissemination of knowledge and teaching; promote the collaboration between participants in problem solving, among other. The system should be prepared to integrate tools and able to respond to good practices for the creation of interactive contents.

In the following sections, data related to UTAD and the criteria for choosing each module of the proposed model will also be presented and discussed.

2. E-learning: a brief review and its current implementation at UTAD

Similar experiments in Universities all over the world, of about the same dimension and conditions of UTAD, have been conducted. Additionally, models and frameworks for the evaluation or assessment of the success of these implementations have also been proposed. For example, the critical success factors that influence the acceptance and success of e-learning systems in developing countries have been identified by Bhuasiri et al. (2012). In this study, the authors also compare the relative importance among ICT experts and faculty, by collecting 76 usable responses. The results showed 6 dimensions and 20 critical success factors, and revealed the importance of curriculum design for learning performance. Their findings also revealed that technology awareness, motivation, and changing learners' behavior are prerequisites for successful e-learning implementations. Moreover, the authors presented recommendations to aid the implementation of e-learning systems for developing countries, which have relevance for researchers and practitioners. Additionally, and as stated by Blin & Munro (2008), “The advent of the Internet heralded predictions that e-learning would transform and disrupt teaching practices in higher education. E-learning also promised to expand opportunities for lifelong and flexible learning, and offered a panacea for practical issues such as decreased funding and increasing student numbers”. However, this “anticipated disruption” did not happened. It is a fact that the “technology means” are now common place in most higher education institutions, but there is little or no evidence of significant impact on teaching practices. Blin & Munro (2008) discuss the transformation of teaching practices (which did or did not take place) in the Dublin City University (DCU).

On the other hand, Ozkan & Koseler (2009) proposed a learning management system evaluation model, using six dimensions: system quality, service quality, content quality, learner perspective, instructor attitudes, and supportive issues. They applied a survey to 84 learners (testing for content validity, reliability, and criterion-based predictive validity), from undergraduate and graduate levels, at Brunei University. The results showed that each of the six dimensions of the proposed model had a significant effect on the learners' perceived satisfaction. Motiwalla (2007) proposed a framework for mobile learning evaluation. The used framework “provides the requirements to develop m-learning applications that can be used to complement classroom or distance learning”, and a prototype application was tested for two semesters, with a total of 63 students from undergraduate and graduate university courses. The achieved results helped in better understanding on the role of mobile technology in higher education. Also

related to the attempt of measuring the success of e-learning systems and models for learning, Hassanzadeh, Kanaani & Elahi (2012) have proposed a model for measuring this success in five universities: Amir Kabir University, Tehran University, Shahid Beheshti University, Iran University of Science & Technology and Khaje Nasir Toosi University of Technology. They also analyzed the opinions of 33 experts, assessed their suggestions and the questionnaires completed by 369 instructors, students and alumni, which were e-learning systems users.

Currently, e-learning at UTAD is at a very early stage, with the total number of courses available being very low. From the direct contact with teachers, it may be stated that this is due, among other reasons, to the lack of teacher training, lack of technical support, lack of specific tools and lack of institutional support policies, being this is in line with the reasons enumerated above.

An exception to this is the existence of a teaching support platform (named SIDE – http://side.utad.pt), developed at UTAD and that has been used systematically over the last decade. All the courses taught at UTAD are registered at SIDE and teachers are required to use it to record the course syllabus, assessment methodology, student attendance, class summaries, marking of assessment tests, registration of classifications, among others. However, SIDE works more like a teaching management platform rather than as a platform for the dissemination and management of online content and courses.

Over the last decade, e-learning at UTAD has been a forgotten teaching modality, not being seen as a modality for distance learning nor as a form to support and complement face-to-face teaching. However, in the last two years, e-learning is being viewed in a more constructive way. There has been an increase in the incentive to teachers, with a dedicated support team and with new platforms and tools for creating and making courses available in a very simple and easy way.

UTAD is organized in 5 Schools: School of Agrarian and Veterinary Sciences (ECVA); School of Human and Social Sciences (ECHS); School of Sciences and Technology (ECT); School of Life and Environmental Sciences (ECAV); School of Health (SH). The learning management system (LMS) that is being used is Moodle. Table 1 shows the number of courses and learning units that were registered in Moodle for the last three years, by school and study cycle. As it can be seen, the total number of learning units and courses is the same for the 2015/16 and 2016/17 academic years. For the academic year of 2017/18 it can be seen an increase both in the number of courses and learning units. From the direct (informal) contact with the teachers, it can be stated that this increase is due to a more personalized support to the teachers. These courses also support face-to-face classes.

	2015/16			2016/17			2017/18		
	1st cycle	2nd cycle	total learning units	1st cycle	2nd cycle	total learning units	1st cycle	2nd cycle	total learning units
ECHS	4	2	16	5	1	16	7	7	33
ECVA	-	3	23	5	2	19	5	3	39
ECVA	2	2	6	4	4	17	6	5	23
ECT	5	1	11	2	5	7	7	5	13
SH	1	1	4	1	-	1	1	-	5
Free curses	3		3	3		3	7	7	7
Total	12	9	63	17	12	63	26	20	120

Table 1 - Number of courses and learning units registered in Moodle for the academic years of 2015/16, 2016/17 and 2017/18.

As it can be seen, although there is still a small number of courses per school, it has been noted (mostly from the direct contact with the teachers) that there is a growing interest to make their courses available in e-learning to support face-to-face teaching. It is hoped that in a very near future the vast majority of the courses will be available. There are about 4,000 participants registered in the platform, of which 55 are teachers.

However, in addition to the degree or diploma conferring courses, others may be available entirely in the e-learning mode. An example of these are the Massive Open Online Course (MOOC) courses currently being prepared.

UTAD has come to recognize that e-learning should be part of its strategy for its training offer and, consequently, is being adopting new policies, namely through the signing of protocols with other institutions with more experience using e-learning, and namely with the Universities of Porto and of Minho. These protocols are offered under the Unorte consortium (Unorte.pt, https://noticias.utad.pt/blog/2014/11/24/consorcio-unorte-pt/, in Portuguese).

3. The proposed model for e-learning at UTAD

To fulfil the aims presented above, the physical module will have the following control and management components: e-learning platform with SIDE interconnection; website with the educational/training offer and e-learning events; media repository; file storage and sharing service; collaborative/cooperative platform; scientific repository; forum; ticket service/helpdesk; customer relationship management (CRM) service; and Learning Analytic system. Additionally, there will be a physical examination (assessment) space (e.g., laboratory), a contents production studio, and a training studio. The policies module includes the institution policies, as well as policies for the creation/ dissemination of courses, implementation of course evaluation strategies and

continuous improvement, training policies, recognition of the merit and effort of teachers, the training in using the system, the policies for the creation of physical spaces equipped with the necessary tools (computers, cameras, video-conferencing, etc.), among other. Figure 1 presents a general view of the proposed model.

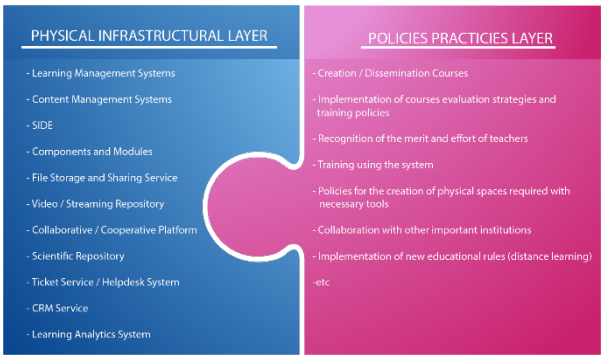

Figure 1 - The two modules of the proposed model for a successful implementation of e-learning at the UTAD.

As can be seen, it is impossible to propose a model where these two modules are not linked to each other. As stated in Reis, Santos & Ferreira (2008), "The installation of infrastructures is a relatively simple process, but using them effectively may require training and a change of habits, which are much slower and gradual processes". There is a need to motivate, train and raise the teachers' awareness of the potential of IT as a pedagogical tool. The success of any proposal for the implementation of any e-learning model can only be achieved if a complete set of policies is implemented. This proposal is based on the literature review and, particularly, in our experience (especially from the informal contacts with teachers). Next, the components of the physical module will be briefly explained.

The "Website with the educational/training offer and e-learning events" component is aimed at:

- Presenting the complete structure on UTAD e-learning;
- Providing the educational and training offer in e-learning modality;
- Searching by category and add to cart;
- Providing proficiency and profile tests;
- Presenting the application forms and access to courses.

The "Email service" is a fundamental element in the communications system of the institution. It promotes:

- Fast sharing of text and multimedia messages;
- Integration with email clients such as Thunderbird, Postbox, Outlook;
- Important for corporate issues and as a marketing tool (e-marketing);
- Customized and signed email of the institution for credibility, security and seriousness in the communication of services and information.

The "Cloud service" has the following main objectives and functions:

- Storing, reading and sharing files in different format types (files always available and accessible in any device, and can be public or private);
- Integration with other services in the cloud: Dropbox, OneDrive, GoogleDrive, Amazon Cloud, etc., multimedia player, text editor, chat, among others;
- Secure and encrypted navigation with LDAP integration;
- Backup system;
- FTP and clients for the different operating systems (Windows, OSX, Linux) and mobile systems (Android and iOS).

The "Collaborative platform service" component promotes collaboration, debate and interaction between users, allows the creation of work groups, has the ability to leverage work, information sharing and self-organizing capacity. It also serves as a facilitator of communication and creation of strategies and tasks, social network-like environment. Also included are the management of the permissions and profile assignments to users, and the creation of spaces dedicated to various themes.

Among the functions and aims of the "Online digital library service" the following ones are included:

- Information storage space in an organized way;
- Function of document conservator, cataloger and information distributor;
- Unique space that brings together all the information that is useful for student study;
- It has advanced search, and follows a catalog structure for the different subjects of study;
- Main fields of search include: title, author, year of publication, subject, ISSN, ISBN, keywords, language, deposit location and file format or content.

The "Forum service" will serve as meeting point in a distance learning model, and promotes asynchronous interaction and collaborative discussion among users. It will also be used to the sharing of information, suggestions and knowledge, and allows the sharing of links and multimedia contents.

The "Tickets/helpdesk service" provides direct support to all users of the institution. Its main features include: storing the records of requests for support, in email format and indexed to different categories; interact and register users via telephone; management of time and conclusion of tickets; possibility of integration of

support via chat; frequently asked questions (FAQ); scheduling system; checking of registrations and new events entries; advanced search system; statistics; module for recording internal notes and a historical record of a particular ticket. It is also a single point-of-contact (SPOC), and a means of interaction between the user and the e-learning technical team for the operationalization of services.

The "CRM/ERP platform service" enables the management and organization of resources and users. It has the ability to integrate key information and institution processes into one location. Its mission is to unify processes and share information flow in a fast and continuous way among the various departments of the institution (ex: academic, administrative, financial), keeping in mind that much information depends on another. The presentation of results and other information in the form of tables and graphs is also an aim, and also preventing communications failures between departments. It also has the possibility of personalized monitoring (e.g., possible student's drop-out, users' history query). Some functionalities also included are: system of events, identification of the state of the processes, messaging service, system of campaigns and business opportunities, cataloging and marketing, document management, reports, etc.

The "Intercommunication with the SIDE platform" component aims at the unification of services and reducing efforts in the sharing of information between the various sectors of the institution. It will allow students to enroll the courses in a simplified way, and by using a simple click on a "synchronization" button, all courses that are assigned to a registered user (teacher) in SIDE are automatically created in the e-learning platform, as well as the registration of all students belonging to the appropriate courses.

As it is becoming standard, the "Learning analytic service" will have the following goals:

- Helping to improve learning outcomes;
- Allowing the realization of decision making;
- Based on students' interaction, it is possible to collect, measure, analyze, guide and disseminate data about student behavior during their educational journey;
- Enabling the knowing of levels of interest in courses and their contents;
- Can help create personalized content for different levels of difficulty found in students;
- Alignment of educational strategies and direct and accurate teacher interventions;
- Data presented as reports (presenting the trajectory of the student in each course);
- It contributes to define actions and improvement of educational structures and contents.

Finally, the "E-learning platform" aims to shorten geographic and temporal distances of users, and allowing to enjoy an improved and personalized teaching. It also allows students to learn at their own pace and manage their study time. It can be used as complement of resources and support for classes in the classroom mode, enabling fast transmission and easy access to content, clean and intuitive design with easy access to the different functionalities. It is open-source, customizable and tailored to the needs. It has a comprehensive set of pedagogical tools for interaction and resources for the development of diversified activities and for the integration with other systems of the institution. It also has modules for the creation of different types of exams, questionnaires and other specific contents, and an anti-plagiarism module. Furthermore, it enables the integration with external services such as O365, Educast, Zoom, among other.

4. Results and discussion

The data presented and discussed in this section were gathered from the "log" files of the system, from informal conversations with the students and the teachers and from a survey applied to the teachers.

A survey with 19 questions, using a 5 intervals Likert scale (from 1—low to 5—high), was applied to the teachers that actually are using the system in a regular basis, and 30 answers have been validated. The questions and the global results are presented in table 4 and figure 2. The questions were grouped in 4 classes: platform, teaching, tests/exams, and global appreciation.

As can be seen, in the platform group, the majority of the teachers (89.4%) have a good impression of the platform, consider it easy to use, are planning to continue to use it in a near future, and would recommend it to other colleagues.

Also, in the teaching group, the majority of the teachers (89.8%) consider that the platform corresponds and adapts to the teaching that is practiced in the institution, it responds to their teaching needs, and that the resources and tools provided in the platform are appropriate to their teaching practices.

As for the tests/ exams group, once again, the majority of the teachers (85.8%) consider that the students have a good reaction when carrying out their tests in the platform, that the creation of a test / exam in the platform is simple and intuitive, that the type of possibilities to create questions suits the subject their teaching, that correcting and verifying students' results automatically adds value to the platform, that answering online in the platform can help them achieve better student results, and that the student's primary enemy in conducting the tests/ exams is their time control. They also consider that

the BYOD policy is effective and a strategic way to perform tests or other type of work on the platform, and that when the students do their tests/ exams using mobile devices they perform better than when using personal computers. As can be seen from the plot in figure 2, 47% of the teachers consider that the assessment results achieved by the students are the same, regardless of the type of the test/ exam used (in the platform or traditional, i.e., pencil and paper), 20% consider that the results are better when using the platform, and 3% consider that results are worst.

In the last group of question, 100% of teachers classify as useful the platform for teaching in the e-learning mode, and the support provided by the e-learning team.

Globally, 90.8% of the teachers consider positive the use of this platform.

The development of the system proposed here for e-learning is being seen as a useful and valuable tool for the different teaching modalities practiced at the UTAD. Since the e-learning modality educational process is still very recent in the institution, teachers try to use the system as a repository of educational content to support the traditional face-to-face modality. Teachers also consider that the system allows to distribute in a simple, fast and effective way the most varied educational contents.

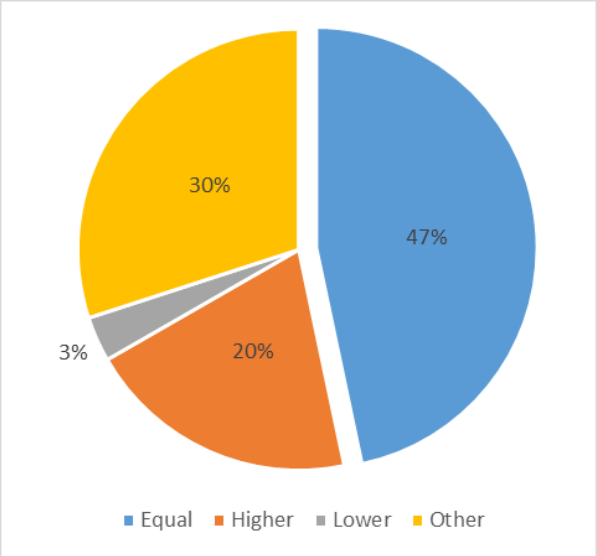

Figure 2 - Answers to the question "When compared to the traditional tests (written tests) the pass rate is:" of the survey applied to the teachers using the system in a regular basis; there were 30 valid answers.

The e-learning system is being mainly used by the teachers and students of the following courses: Veterinary Medicine, Biomedical Engineering, Informatics Engineering, Information and Communication Technologies, Nursing, Sports Sciences, and Tourism.

The activities with greatest use (retrieved form the system's log files) are homework and tests/exams, being also considered by the teachers the most important of the system, because they intervene directly in the evaluation/assessment process. In the synchronous mode, the two most commonly used activities are chat and videoconferencing. As for resources, the most commonly used features in the system are "folder" and "file".

		Scale				
		1	2	3	4	5
Platform	In your user perspective, do you consider the platform easy to use?	0 (0%)	1 (3.3%)	6 (20%)	18 (60%)	5 (16.7%)
	Do you plan to continue using the platform in the near future?	1 (3.3%)	1 (3.3%)	6 (20%)	9 (30%)	13 (43.3%)
	What is your overall impression of the platform?	0 (0%)	0 (0%)	9 (30%)	17 (56.7%)	4 (13.3%)
	How often do you use the platform?	4 (13.3%)	6 (20%)	11 (36.7%)	5 (16.7%)	4 (13.3%)
	Would you recommend the platform to other faculty colleagues?	1 (3.3%)	2 (6.7%)	4 (13.3%)	15 (50%)	8 (26.7%)
	Average	1,2 (4%)	2,0 (6.7%)	7,2 (24%)	12,8 (42.7%)	6,8 (22.7%)
Teaching	Do you consider that the platform corresponds and adapts to the teaching that is practiced in the institution?	1 (3.3%)	3 (10%)	8 (26.7%)	15 (50%)	3 (10%)
	Overall, does the platform respond to your needs in order to teach your courses?	1 (3.3%)	3 (10%)	6 (20%)	15 (50%)	5 (16.7%)
	Overall, do you consider that the resources and tools provided in the platform are appropriate to your teaching practices?	0 (0%)	1 (3.3%)	8 (26.7%)	16 (53.3%)	5 (16.7%)
	Average	0,7 (2.2%)	2,3 (7.8%)	7,3 (24.4%)	15,3 (51.1%)	4,3 (14.3%)
Tests/exams	How do you see the reaction of the students when carrying out the tests in the platform?	6 (20%)	3 (10%)	7 (23.3%)	9 (30%)	5 (16.7%)
	Create a test/exam in the platform is simple and intuitive.	1 (3.3%)	4 (13.3%)	8 (26.7%)	13 (43.3%)	4 (13.3%)
	The type of possibility to create questions suits the subject matter.	3 (10%)	1 (3.3%)	9 (30%)	8 (26.7%)	9 (30%)
	Correcting and verifying students' results automatically adds value to the platform.	1 (3.3%)	1 (3.3%)	4 (13.3%)	11 (36.7%)	13 (43.3%)
	Answering online in the platform can help you achieve better student results.	2 (6.7%)	0 (0%)	14 (46.7%)	12 (40%)	2 (6.7%)
	The student's primary enemy in conducting the test is time control.	3 (10%)	2 (6.7%)	10 (33.3%)	10 (33.3%)	5 (16.7%)
	Do you consider that BYOD (the students working on their own computers) is the most effective and strategic way to perform tests or other type of work on the platform?	3 (10%)	3 (10%)	11 (36.7%)	12 (40%)	1 (3.3%)
	When the students do their tests/exams using mobile devices (like smartphones) they perform better (when compared to the use of personal computers).	0 (0%)	1 (3.3%)	8 (26.7%)	16 (53.3%)	5 (16.7%)
	Average	2,4 (7.9%)	1,9 (6.3%)	8,9 (29.6%)	11,4 (37.9%)	5,5 (18.3%)
Global appreciation	In a global way, classify the usefulness of the platform for teaching in the e-learning mode.	0 (0%)	1 (3.3%)	2 (6.7%)	20 (66.7%)	7 (23.3%)
	Globally, classify the support provided by the e-learning team.	0 (0%)	0 (0%)	2 (6.7%)	8 (26.7%)	20 (66.7%)
	Average	0,0 (0%)	0,5 (1.7%)	2,0 (6.7%)	14,0 (46.7%)	13,5 (45%)
	Total average	1,1 (3.5%)	1,7 (5.6%)	6,4 (21.1%)	13,4 (44.6%)	7,5 (25.1%)

Table 4 - Questions and results of the survey applied to the teachers using the system in a regular basis, there were 30 valid answers. A Likert scale of 5 intervals was used, where the value 1 corresponds to a low agreement, and 5 to a high agreement.

In the English course, chat is a very useful activity for practicing written conversation between the students and the teacher. As for videoconferencing, it is also a widely used practice that favors dialogue among students, with moderation by the teacher. Videoconferencing has also been used by students who, due to illness, cannot attend classes directly in the physical space of the institution, and in classes shared with European institutions.

In the course of Veterinary Medicine there is a need to use images for the study of blades (photomicrographs), which can occupy 1 GByte of space. This problem has been solved with the integration of the cloud service.

Regarding the tests/exams, they were performed in two different modalities: controlled environment mode (face-to-face, institution room), and distance mode. Here, due to the lack of available data, it will be

presented and discussed only the results obtained in the first mode.

Both teachers and students were pleasantly surprised by the simplicity of making tests available, performing and correcting, and they highlight the speed and the possibility of checking the classification just after the tests/ exams were completed. The students also highlighted the commitment that the institution is making to introduce new evaluation/ assessment methodologies.

Another equally striking aspect, expressed by teachers, was the flexibility and diversity in the design of the tests/ exams. Table 5 lists the courses that used exams to assess student performance. It is observed, in total, 49 exams were implemented and 1698 students were evaluated (79% of students were approved). The most prevalent questions in the exams are Multiple Choice, True & False, Correspondence, (greater use in the Computational Logic unit of Computer Engineering and Information and Communication Technologies), Development (greater use in the unit of Bioinformatics and Molecular Analysis in Veterinary Medicine and Biomedical Engineering), Missing Word Selection, Short Answer, and Drag n'Drop. Veterinary Medicine is the area with the highest number of exams and students.

It should be noted that 17 courses used the platform to present homework, and in total about 150 homework was requested. The same courses also used the platform to carry out examinations to the students and their respective evaluation.

The biggest problem pointed out by the students, which was even pointed out as the great disadvantage of the platform for conducting the online tests/ exams, is time. Students are familiarized to the face-to-face mode, where time is controlled by the teacher, but on the platform time is automatically controlled (to the second) and when it reaches the limit the test/ exam is closed, allowing no further answers. On the other hand, the use of technology, ease of testing, null costs (savings in the purchase of answer sheets), greater concentration on test and convenience were positive points attributed by the students.

From the point of view of teachers, they also consider very useful the use the platform to perform their tests/ exams, where the possibility of automatic correction is indicated as a great saving of time, implying a lower workload and the possibility of dedicating themselves to other tasks. Flexibility, ease of creation, configuration and evaluation are keywords identified as advantages by teachers.

The BYOD was used to perform the examination in the controlled environment (face-to-face) mode. One point that is emphasized in using this practice is that the student works on a system with which he/she is familiar. All devices are checked and controlled and with network restrictions so that only the exam can be accessed.

Regarding the type of preferred device, 99% of the students used their laptop computers and 1% opted for their smartphones. The teachers were asked to compare the results of the assessment process using the platform presented here with the traditional assessment methods. They concluded that the overall evaluation results obtained by the students are very similar, regardless of whether they use the platform presented here or the traditional face-to-face mode.

Course	Tests	Students	Approved	Average grade	Minimun garde	Maximum grade	Type of questions
Geotourism	1	12	12	19	18	20	Multiple choice Drag n' Drop
Horticultural Fruit Processing	2	19 18	19 18	19 18 18	15 18 18	20 20 20	Short answer True and false
Animal Reproduction	2	80 82	72 34	13 10	6 7	15	Development Short answer Correspondence Drag n 'Drop
Medical Semiology II	7	91 92 92 92 91 93 90	91 33 91 91 50 90 66	15 8 16 19 10 12 10	10 0 8 8 3 8 2	20 19 19 19 18 15 15	True & false Multiple choice Short answer Correspondence Missing Word Selection
Reproductive Medicine I	2	81 81	66 76	13 11	9 8	17 15	Multiple choice True & false
New Reproductive Technologies	1	17	16	13	9	13	Multiple choice True & false Correspondence Drag n' Drop
External Geodynamics	4	12 12 4 12	4 9 3 10	8 11 10 13	0 5 4 6	13 18 16 14	True & false Correspondence Drag n' Drop
Training Methodology and Control	1	103	103	14	11	16	Multiple choice
Computer Networks II	2	11 16	2 9	7 10	2 5	14 15	Multiple choice True & false Development
Computational Logic (Inf.)	6	9 36 48 25 26 48	5 30 45 20 18 32	10 11 11 10 11 10	6 7 7 4 5 2	15 16 17 20 20 20	Multiple choice Correspondence True & false Development Missing word selection
Computational Logic (ICT)	6	26 8 16 18 15 15	18 2 9 3 7 8	10 8 9 5 10 10	5 6 4 2 1 2	14 12 17 11 20 20	Multiple choice Correspondence True & false Development Missing word selection
Instrumentation and Sensors	7	13 13 12 12 12 14 15	13 7 12 12 12 14 15	19 10 18 12 19 18 19	16 1 17 10 18 11 15	20 19 20 20 20 20 20	Multiple choice Correspondence True & false Development Missing word selection Short answere Drag n' Drop
Bioinformatics and Molecular Analysis (Bio.)	3	17 5 5	17 1 0	15 7 1	10 4 0	19 10 3	Development
Psychology of Children and Adolescents	1	15	15	18	15	20	True & false
Bioinformatics and Molecular Analysis (Gen.)	4	14 15 19 26	13 15 19 15	13 17 15 12	0 10 12 6	18 20 20 19	Development
Total	49	1698	1342				

Table 5 - Listing of courses that have used tests/exams and the type of questions used.

In our opinion, the efforts made at the UTAD in the implementation of the e-learning system presented here and the support provided to the teachers have proven effective and very positive in this short period of time. It should be remembered here that the first courses were created on the platform presented here in 2015 only, being this platform only used as a mere repository, and that only in 2017 the platform was used to assess the students' knowledge (the first tests/ exams were created).

However, in spite of the progress made over the past three years, in particular the evolution in the number of courses presented in Table 1 and the results presented throughout this section, none of the available courses

effectively use the full potential and advantages of e-learning.

As can be seen, the results presented here and their main conclusions agree with the ones presented in the international revised literature, presented in section 2.

5. Conclusions

It was presented a brief review of the "state of the art" of e-learning at the UTAD. In other published articles, a study was carried out comparing the most used and most recently available LMS. Based on these, it was proposed a model for the implementation of e-learning at the UTAD. This model has two modules: the physical/ infrastructural module and the policies/ practices module.

As referred in section 2.2, it was noted, mostly from the informal direct contact with the teachers, that there is a growing interest to make their courses available in e-learning to support face-to-face teaching. It is hoped that in a very near future the vast majority of the courses will be available. In addition to the courses already offered, a set of MOOC courses are currently being prepared.

It is believed that this model will undoubtedly contribute to the successful implementation of e-learning at UTAD.

On the other hand, the evaluation results obtained by the students are very similar to the traditional evaluation, raised some questions: does the student prepare him/herself adequately for the evaluation or does it looks like a game in which the evaluation process is more facilitative using the technology?

In our opinion, the results presented here show that the e-learning system and the support provided to the teachers has proved to be effective in this short period of time. Moreover, future work should also try to demonstrate that the proposed system is also applicable to other small size universities with some context tweaks.

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