Enhanced Learning Through Blended Learning. Educative Innovation at Universitat de València

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Abstract - **Information and communication technologies (ICT) offer new tools for learning activities, extending interaction limited in traditional classes. Universitat de València promotes initiatives to update learning structures according to the Higher Education European Area challenges. Since 2003, Universitat de València experiments innovations and improvements in the learning process, with new learning activities, relations and considerations of student workload as an ECTS experience, being one of the pioneer Spanish universities with actual assessment and feedback based on this transformation. Coordinated groups involve complete courses with innovation projects, combining different learning activities at classrooms and laboratories and other settings with freely scheduled autonomous work. The whole learning process is student-centered and it is enhanced by ICT. This paper describes these experiences and their evaluation after three academic years of campuswide spread, focusing on the most useful resources and activities. Conclusions of this study provide guides to enhance activities with more benefits. Actual blended learning experiences also suggest improvements in the learning management system (LMS) according to the detected pedagogical and methodological requirements. Technical and pedagogical usability of the LMS intend that its use does not suppose an additional effort, thus allowing students and professors to dedicate optimum efforts in the learning process.**

Index Terms – Blended-learning, European Convergence Process, Higher Education System, Educative Innovation, Learning Management System.

INTRODUCTION

The great development of information and communication technologies (ICT) has forced a dynamic of learning changes which has generated a group in expansion of new students different from the traditional ones [1], [2] with its own necessities. In addition, the latest technological developments and accessibility to communication systems have given to students and teachers the possibility to access to a profusion of information and educational material. Multimedia resources and Internet have opened a vast field to education. These changes in students and learning materials and resources have changed the education and learning definition [3]. Some current constructivist authors think that learning process is basically collaborative: students, thanks to interaction among them, with their teacher and with their environment, create knowledge. The pupil, in this way, takes part in its formation. All these changes have forced the creation and development of new methods to obtain an effective formation process.

The actual educational system, immersed in a process of European convergence, has the challenge of forming highly prepared people who have the ability to adapt to changes that ICT are introducing. New technologies offer tools for the accomplishment of activities and almost unlimited and ubiquitous access to contents; and they extend the interaction, which in the traditional classroom often is limited by time and space constraints. The simple provision of ICT infrastructures and tools does not ensure the Higher Education alignment neither with these objectives, nor its fulfilment. It is for that reason that plans and actions must be added to equipment and applications. These plans must be orientated to promote and to improve the Higher Education quality and to generate competences and skills among the students, teachers and staff with regard to an effective ICT use. All these reasons motivated that Universitat de València established a program whose main objective was designed to take advantage of possibilities which ICT offers to students, in order to increase their active role in the learning process. Its goal was to improve the quality and efficiency of the learning process and to complement the formation in new technologies and their use. To accomplish it, it was necessary an adaptation of formative profiles to the new and emergent professional careers. At the same time, the conditions which made professors and rest of staff updating their pedagogical and working methods must be generated, by means of using new technologies in those aspects in which they were more useful.

The present work describes the starting point from which the Universitat de València established the innovation program and selected and implemented an integrated platform to manage the learning and the collaborative work; and the reached situation. Actual blended learning experiences also allow to suggest and to improve the learning management system (LMS) according to the pedagogical and methodological requirements detected in the analysis which has been made. The exposition is completed with the obtained results and their evaluation, which study the LMS technical and pedagogical usability, its specifically

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best valued resources, intend that its use does not suppose an additional effort, thus allowing students and professors to dedicate optimum efforts in the learning process. Finally, conclusions and future work are exposed.

STARTING POINT

Technological and Pedagogical advances in recent years have caused an exponential increase of education based on ICT demand and a revolution in the form to understand the learning process. These changes have forced all the elements involved in the process: students, professors, contents and tools, to adapt to situation; and they have increased the educative panorama complexity. On the other hand, the Higher Education European System is experiencing a deep transformation through the European Convergence Process. Some of the Spanish University strategies to accomplish the UE process objectives in ICT have been: to facilitate all University schools the equipment and facilities to employ ICT; to develop on-line courses; to create laboratories to support research and innovation on ICT; to increase Iberoamerican and European cooperation. Recent reports about ICT in Spanish University [4] do a review of the present situation in university; all considering teaching, research and management matters. The study also contemplates the existing European e-learning program and the USA and UK latest initiatives. The report assures that conventional universities face several challenges: the loss of exclusivity; the ICT research implications, which facilitate interchanges between different universities; and its educational implications (changes in the learning process). On the other hand, the Coordination Council of Universities published its work recently, a work which states that in the Spanish universities present situation, which are mainly changing and renovating its educational methodologies, technological innovation is not the only way, but it represents one of most relevant strategies. The report also gives the successive phases to adequate to future convergence: Impulse (information, motivation, plans design…), teacher's formation and educative innovation (pilot projects, guidelines elaboration…), and diffusion and assessment of best practices and tools.

Universitat de València (UV) (www.uv.es), one of the largest and most varied in Spain, offers classroom and laboratory learning to 50,000 students in 18 centers. Among them, 6,000 courses from 1,500 subjects are developed. Interested in enhancing the learning process by the use of ICT, a Learning Management System (LMS) was selected, implemented and developed to improve the learning and communication processes for the whole University. In 2003, the Universitat de València had an important ICT infrastructure that supported the more habitual tools. All the professors and rest of university staff had computer equipment and Internet access through RedIris. This fact allowed them to use e-mail (all members in the university community could have an account in the University server), to create and host web pages; and also, give them the possibility of accessing and creating forums, and using other telematic tools. On the other hand, the students also have computer classrooms, all of them with Internet access (and

an incipient wireless network). Students could also request an e-mail account or host at the university's server their personal web pages. In addition, the University worked with different academic and administrative management applications: student's enrolment, files, staff and economic management and also had very important research resources: among these resources, it can be mentioned a supercomputer for scientific calculus.

Nevertheless, the use of ICT was not homogeneous in the different areas and degrees, and its utilisation in the educational activity was not generalized. Different educational and research groups from the Universitat de València took part in several educational innovation aspects by means of the ICT use, from a technical and psicopedagogical point of view; but their efforts should be coordinated. At the same time, it was necessary a suitable organisation and institutional support to promote expansion of these experiences to all the University educational activities. On the other hand, the Universitat de València demanded and impelled at different fronts a renovation and modernisation of its structures and processes according to the European convergence process challenges. In fact, Universitat de València was one of Spain pioneers in experimenting and studying on the consequences of this Higher Education transformation. It was for that reason that it was promoted a call for educative innovation pilot projects to experience and to evaluate new styles and systems of teaching-learning. These projects must accomplish the European convergence criteria. Coordination was the professors' responsibility. They looked for new educational systems which contributed to improve the education at university, the study and working methods, and the relations between professors and students.

The pilot project's objective was to fix the bases and to acquire the necessary organizational experience to outline more extensive plans in subsequent courses. The innovation and convergence program towards the European Convergence Project had three interrelated fronts: new technologies implantation in Higher Education; changes in the educational methodologies; and integration of all the university community in the Information Society. For that reason, informatization was not only an aim, nor a procedure which virtualized the activity; but an instrument whose finality was to facilitate and to promote those activities that, by using ICT, really improved the work, communication and interaction between professors and students. In addition, in order to make possible that informatization come to the greatest number of people and activities, it was decided to integrate all the different and dispersed tools which were used until then in an unified learning management, groups and communities system. This LMS (Learning Management System), is described in the following section.

UNIVERSITAT DE VALÈNCIA LMS: AULA VIRTUAL

LMS Selection, Personalisation and Integration

The University Computer Service (SIUV) was required by the university academicians to report on the implantation of an e-learning management system to support all the courses

in the University. First, needed functionalities and minimum requirements to be accomplished by the evaluated platforms were identified. Minimum requirements were: Scalability, Integration, Reliability and Standards. After an exhaustive survey of the available platforms [5], Universitat de València joined the .LRN project [6] because .LRN better met UV requirements for the learning process and also represents an information and communication tool for research and administrative communities.

Aula Virtual is the name used for the UV installation and personalization of .LRN. As for the installation, applications available in the Aula Virtual are: documents, calendar, news, forum, email and notifications, evaluation-assessment, chat, Learning Object repository system, Wimpy Point (Web presentations), weblogs, photoalbum and FAQ's. The implementation of Aula Virtual has been developed progressively in several phases. During first phase: the analysis phase, workload tests were guided with all UV courses and users; other experienced members of the OpenACS community were asked for advising, specifically those who had educative systems and figures similar to UV. Users are authenticated by three different authentication authorities: LDAP, LOCAL and EXTERNAL. Figure 1 shows the personal access page to Aula Virtual.
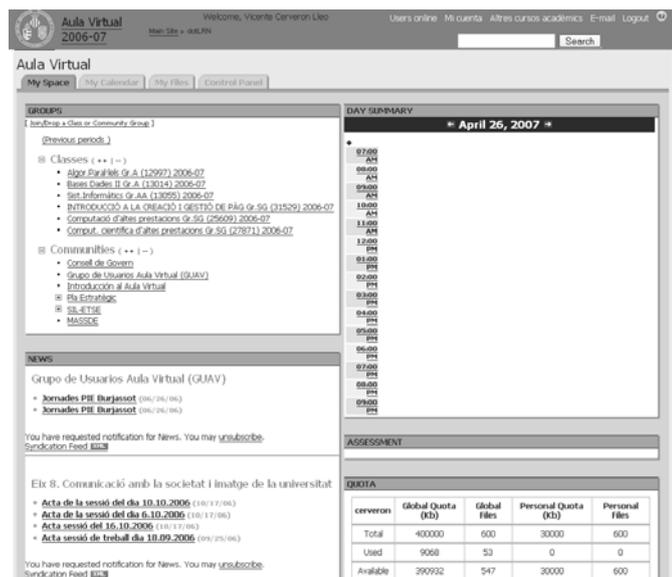
FIGURE 1
AULA VIRTUAL HOME PAGE

Integration with other university applications that show public and private information on the academic courses has been developed using OpenACS packages and .LRN portlets for integration in the courses [7]. Also, batch programs were made, written in Perl, for the insertion of courses, groups and users, when professors requested it. These batch programs return, via "HTTP", the classes teached by a professor and the students registered in their courses, obtaining the information from the academic database. After collecting these data, a package made in OpenACS, named *siuvadmin*, is invoked. This package uses the API for creation of courses and users to connect the platform public side with the UV *Oferta de Curso académico (OCA)* application.

Aula Virtual also is a potent tool to workgroup, and has been used by research communities , integrated by Universitat de València and another universities members. This workgroup functionality has been employed by management and strategical groups as it can be observed in Figure 2, which shows the LMS use in the working axes of the Universitat de València strategical program.

FIGURE 2
AULA VIRTUAL COMMUNITIES

Finally, it must be said, that Aula Virtual constitute the main tool which all Universitat de València community: students, teachers, and personal staff, uses to diffuse news, activities, employment offers, etc., as it can be observed at Figure 3.

FIGURE 3
AULA VIRTUAL COMMUNICATION USE

Own Developments

The users demanded new functionalities and tools, and this fact motivated their development. Among them, we can emphasize the following ones:

- Implementation of the interface translation to the Catalan-Valencian and Spanish languages.
- Technical support for teachers and students (Technical reference manuals and on-line help)

- Development of a space within the .LRN courses where each student has a personal file, replacing classical student cards that professors traditionally asked [8], which was developed from the education Equipment portlet. In this personal file professors can access student data, including his/her photography. The file also allows professors to include comments, private or public, referred to the student.
- OpenACS Chat package integration in the .LRN courses. Chat room are created by the professor where only members of the group are admitted.
- Possibility of mathematical formulation insertion, introducing symbols, in LaTeX or in ASCIIMath (based in MathML).

RESULTS

After three years of the LMS use, two of them of generalized use in the whole university [9], [10], in depth analysis of its use has been carried out; whose objectives are to know the more used and useful tools, and which of them must be modified to facilitate user interaction. The Aula Virtual's utilisation study and its relation with educational innovation will determine its degree of implantation and evolution. Likewise, the LMS evaluation and control instruments' efficiency will be observed. The objective is to study the possibility of integrate these instruments with the existing quality , management, and planning applications at Universitat de València.

The analysis is centred on three groups of measurements which have been obtained for each of 18 university schools that constitute the university, during several temporal periods. The information of these 18 existing centres agglutinates the information of all university community. These three groups of measurements refer first to the Aula Virtual utilization generically, and they include the study of the variables: **avprof** (teachers), **aval** (pupils) and **avasig** (subjects); and the use of its tools, whose variables of study are: **doc** (documents), **forum**, **notic** (news), **correo** (mail) and **activ** (activities). On the other hand they are confronted by the set of the educational innovation plans in the study centres, whose analysis measurements are: **IECURS** (educational innovation courses), **IECOORD** (number of coordinators on innovation), **IEPROF** (number of teachers on innovation) and **IEAL** (number of pupils on innovation), and **PIES** (number of educational innovation projects). And thirdly, overall education quality indexes (in Spanish, índices de Financiación Ligada a Objetivos- FLO) are analyzed school by school. The quality indexes which are included in the study are: **TABAN** (abandon rate), **TAD2C** (admissions in the first or second preference rate), **ISADC** (satisfaction of the pupils with the received teaching), **TMEC** (months of students stay in international programs of interchange) and **NSSP2C** (school/centre acceptance).

Once the descriptive study of these variables has been realized, a complex set of summary measurements have been elaborated to contemplate the relevance and influence of the different variables of every group. New summary variables will be those whose psicometric behaviour has been the best. After it, the relation between new variables of the different groups is explored, to obtain useful information about how the three axes of approximation to Higher Education European System (HEES) convergence and learning processes improvement are related.

Descriptive Results

The analysis has been carried out by evaluating two academic years. In the **2004/2005 academic period**, blended learning courses were activated on requests (after explicit expression of interest from the involved professors and lecturers). 600 requests were received which generated the creation of 2,662 courses with 1,890 groups and 35,400 users with a student role. Beside 18 communities (colaborative groups) associated to research projects were opened. Simultaneously connected users' average between 8:00 and 24:00 hours was 40 with peak values of 80 users. For the **2005/2006 academic year** all courses in the Universitat de València were opened for blended and technology enhanced learning, giving a personal account to all students and professors and lecturers. In addition, a utility to import the previous course contents was implemented. Figures from this academic period were: 48,199 students involved, 3,256 professors and lecturers, 8,197 courses, 41 communities (research groups sharing information and communication resources). General activity results indicate that 1,420 professors and 29,553 students had employd to the platform more than 10 times; 871 and 18.604 had done it more than 30 times. This fact represents a utilization of 55% basic users and 33.5% habitual users (There are study centers where the percentage doubled). These data are specially valuable considering that the use of the Aula Virtual is voluntary as much for the teaching staff as for the student, who has alternative ways to follow and pass the matters, courses and activities . In fact, the use of "Aula virtual" is not obligatory but improves traditional teaching [11]. Statistics of use of different modules show that the tool more used is **Documents** and the less used is the one of **Activity-Evaluation**, as it can be observed at Figure 4**.**
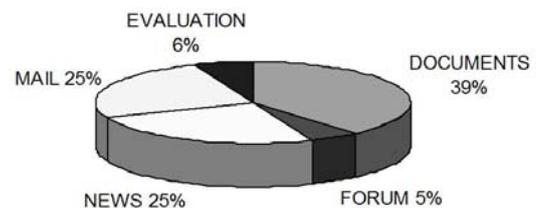

FIGURE 4
COMPARATIVE USE OF TOOLS

Inferential Results: Aula Virtual Measurements Analysis

From the three groups of original variables, the map of relations is studied by Pearson's correlations. The study of these values and statistical associate significance allow fulfilling the sifted first one - necessarily due to the great number of contemplated variables - which annotates the most relevant aspects. At the same time, having treated about linear correlation coefficients, the study of every couple of correlated variables association has been carried out by means of a dispersion graph. From all considered variables that show significant correlation, only two do not show a

linear correlation with the rest: an innovation indicator (**PIES)** and the FLO indicator **TAD2C**.

The indicator values have been gathered in different temporal periods, and they include two or even three courses. For that reason it is interesting to know if there are significant differences between the values depending on the different analyzed times. The objective is to establish whether improvement between courses has been relevant in statistical terms and it not has been produced randomly. This analysis phase has been made with the SPSS 14 Linear General Model Module of repeated measurements ANOVA. Moreover, the Huyhn and Feldt correction verifies the necessary suppositions to use the statistical tests as there may exist homogeneity problems in the variable variance. Besides, also measurements of the effect size have been gathered. This fact reflects a practice quantification of the different variables importance, apart from its statistical significance or the sample size.

In short, in a global analysis, statistical calculations demonstrate in a quantitative way the practical importance and therefore the comparative capability independently of the sample size in measurements which belong to the three groups. The measurements with statistical significance have been in the Aula Virtual use group: **aval** (pupils) and **avprof** (teachers) of generically utilization group; **doc** (documents) and **notice** (news), referring to its tools use group. In the set of the educational innovation plans measurements group the variables which have demonstrated its practical importance through the years have been: **IECURS** (educational innovation courses), **IEAL** (number of pupils on innovation) and **PIES** (number of educational innovation projects). Finally, in the FLO indexes measurements group, only the **ISADC** (satisfaction of the pupils with the received teaching index) one, which is a measurement obtained from the evaluation surveys by pupils, presents a statistical comparable reliability. Therefore, the observed improvements through the courses in the analyzed period which have been gathered by these indicators are, really, relevant in statistical terms.

Inferential Results: Compact Variables Creation by Grouping Indicators

Another statistical analysis task is directed to create compact variables for summary purposes. They will be based on those original variables which have demonstrated to be more predictive and / or more discriminative. These new variables will give summarized information of the three thematic areas: Aula Virtual use, educative innovation, and overal quality indexes, in a more efficient manner. To obtain this goal, the first step is to study the original composition of variables, and its possible grouping in one or more by each group, by means of the Principal Components Analysis. This kind of study forces a factor and studies the explained variance percentage, and also uses the sedimentation graph. The results which have been obtained indicate a totally different behaviour for each of three variables groups.

The Aula Virtual use variables have been assigned to two components. The first component is named **Platform Implantation**: it is explained in a 46.42 % in the 2005 course and in a 33.74 % in the 2006 course. In both courses

this component includes the variables **avprof** (teachers), **aval** (pupils) and **activ** (activities), but in 2006 **avasig** (subjects) is added to the factorial solution. The second component of this factorial solution with orthogonal components (varimax rotation) is named **Tools**: it is explained in a 25.41 % in the 2005 course and in a 30.08 % in the 2006 course; it is formed by contributions of the variables **doc** (documents), **forum**, **notic** (news) and **correo** (mail); but in the 2006 solution the variable **forum** is not included.

The educative innovation variables offer a very clear one-factor solution, which is explained in a 94.03 % in the 2006 course and in an 89.8 % in the 2005 course. In both cases the new variable is formed by the variables **IECURS** (educational innovation courses), **IECOORD** (number of coordinators on innovation), **IEPROF** (number of teachers on innovation) and **IEAL** (number of pupils on innovation), that is to say all educational innovation indicators less **PIES**, which has been those discarded previously because of its not linear behaviour.

The third group of variables, those belonging to overal education quality indexes, has not offered any factorial solution consistent across the different courses. There is no solution with considerable explanation percentages nor interpretable. For this reason its use is kept as indicators and it is not proposed a summary global indicator.

Inferential Results: Compact Variables Analysis

The last phase of analysis raises new Pearson's correlation mould with these summary variables. The correlation tries to offer a more interpretable and direct information oriented to have good decisions in the Aula Virtual environment. The Pearson's linear correlations mould studies the association between the new key indicators, relating them for couples.

High and positive relations have been obtained in every measurement in the successive years; but the Aula Virtual component **Tools** is excluded because it presents a very low correlation (0.072) in successive years. This fact can be explained because the different Universitat de València study centres have applied different politicies to spread the new available modules as much as its improvements. As for the interfamily correlations (measurements belonging to different families in successive courses): in general, the Aula Virtual implantation is related to the educative innovation projects and the student success index also can be related to the Aula Virtual implantation. As for specific relations, it is necessary to emphasize that **TMEC** (months of students' stay in international programs of interchange) in the 2005 course it predicts the 2006 course educative innovation in almost 40 %; or that the 2004 course's **TABAN** (abandon rate) can predict the 2005 course variable **Tools** in 25 %.

Finally, linear predictive regressions of the Aula Virtual use during last courses have been realized. The results offer significant regressions to predict the platform implantation, but not to predict the component **Tools**. This last aspect can be more linked to the educational peculiarities of every centre. For that reason, technical work must be centred on improving the different tools, by maintaining a close contact and communication with those centres/schools with highest use of those tools. On the other hand, the implantation criteria must be guided by general actuation programs,

centred on University's decisions; because implantation has resulted related to innovation, and to overall education quality indexes.

CONCLUSIONS AND FUTURE WORK

Universitat de València is the largest in Spain adopting an open source platform linked to educative innovation for blended learning. The evaluation process shows a high degree of use of Aula Virtual, even being voluntary. This fact evidences clearly that both, professors and students, have found real utility and new possibilities using the LMS. The Aula Virtual use helps to establish methodologies and parameters to plan and to evaluate the on-line learning incorporation in learning processes, always according to the European convergence process criteria; and also promotes the technological and pedagogic collaboration. This collaboration is based on transference and reutilization of educational materials and formative resources among all universities in Higher Education European Area or in the rest of the world.

There are two Aula Virtual modules which are being improved in short term to be used in educative innovation. They are the less and the most used tools: Assessment-Activity, and Documents, respectively. The improvement of these modules can help to its generalized use at all the university, and to its use related to innovation future analysis that must be made in the near future to continue helping the new learning-teaching processes.

Activities and assessment modules permit the distribution of tasks between homework, practices and exams, the weighted distribution in the final evaluation note of each one of these tasks, etc.; but some defects which were detected. It is clear that many different situations are presented. The current work in progress tries to gather all the possibilities to reach that assessment-activity application can be used by all professors who want to manage students evaluation by using Aula Virtual. There are two phases in the programmed work. In first phase, all possible forms of evaluation that can occur in the different university courses must be compiled and an algorithm which takes into account all of them must be defined. The algorithm will reach the solution using a logical sequential flow. In the second phase, a module whose start point is the existing Aula Virtual' tools will be developed. This software module will have to be able to implement the algorithm which has been defined on the first step. The result will be a new module which gathers all the evaluation styles of a subject and it will finish with its final grade. Finally, necessities to export results to other university applications will be identified; and also these applications will be integrated with the new module.

As for the Aula Virtual Documents tool improvement, the Universitat de València LMS has not the possibility of dynamic content creation, which could be visualized, and edited at the platform. At present, an active collaboration between University of Galileo and Universitat de València is maintained http://openacs.org/xowiki/Simple_Content_development_tool, in order to create a content creation tool for Learning Objects, related to the .LRN LORS package. The use of this package will allow to create adaptative and collaborative learning models, and, on the other hand, to create re-usable contents; not only in different courses and groups of one institution, but also in other LMS. This interoperability will be guaranteed by using standards in contents creation.

Finally, the generalization in use of the blended learning and ICT in the teaching activity will depend decisively on the pedagogical work. This means that it must be developed new courses and activities to instruct in the use of the tool; and also to inform the university community about ICT use and LMS environment didactical potentialities.

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