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# Study on the Use of ICT as Teaching Tools by University Instructors

Utilización de las TIC por el profesorado universitario como recurso didáctico

## ABSTRACT

The learning environment at the university stage which is defined by the Bologna Declaration has long indicated the need for major changes, among others, in the teaching methodology and teaching resources used by the university teachers. With this work, we aim to demonstrate some of the results achieved from the implementation of a National Research Project that has been carried out by four Spanish Universities. The objectives of the project aim to describe, through an exploratory study, the methodological situation in which our universities are highlighting their strengths and weaknesses based on the premises of the European Higher Education Area to suggest some strategies in order to facilitate the necessary adaptation. The methodology followed by implementing a questionnaire focused on concrete analysis of the dimension of the Information and Communication Technologies (ICT) reflects the view of university teachers and through the analysis of results allows us to confirm the need for adaptation by the universities for the implementation, with guarantees of the education reform. This article also presents several conclusions and suggestions for educational improvement focused on teaching and methodological training in the use of teaching tools that can promote the suggestions provided by the European Higher Education using ICT, as for example those offered by Web 2.0.

## RESUMEN

El entorno educativo en la etapa universitaria que establece la declaración de Bolonia indica desde hace tiempo la necesidad de cambios importantes, entre otros, en la metodología docente y en los recursos didácticos empleados por parte del profesorado. Con este trabajo, se pretenden mostrar algunos de los resultados logrados a partir de la ejecución de un Proyecto de Investigación (I+D+i) que se ha llevado a cabo por parte de cuatro Universidades españolas. Entre los objetivos del proyecto, se pretende describir, mediante un estudio exploratorio, la situación en materia metodológica en la que se encuentran nuestras Universidades, resaltando sus puntos fuertes y débiles en base a las premisas del Espacio Europeo de Educación Superior (EEES), para proponer algunas estrategias que permitan facilitar el ajuste necesario. El proceso metodológico seguido, en el que se recoge la opinión del profesorado universitario mediante la aplicación de un cuestionario, centrado en el análisis concreto de la dimensión Tecnologías de la Información y la Comunicación (TIC), permite, a partir del análisis de los resultados, constatar la necesidad de adaptación por parte de las Universidades para la ejecución, con garantías, de dicha reforma educativa. Asimismo se presentan una serie de conclusiones y propuestas de mejora centradas en la formación metodológica docente y también en la utilización de herramientas didácticas que pueden favorecer las sugerencias establecidas por el EEES utilizando las TIC, como las que ofrece la Web 2.0.

## KEYWORDS / PALABRAS CLAVE

Higher Education, teaching training, communication technologies, university teaching, institutional changing.

Educación Superior, metodología docente, tecnologías de la comunicación, formación, profesorado universitario, cambio.

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## 1. Introduction

In this article we will draw conclusions from the study «Bases for the improvement of University instruction: teaching methodology» carried out by four Spanish Universities (Cantabria, Oviedo, Leon and Jaen). We will describe and analyze the concerns and views of the faculty of the four universities about their teaching and research duties regarding institutional support and perceived needs for pedagogical training. We highlight strong and weak points, based on the indications of the European Higher Education Area, to propose changes in order to provide the necessary quality within the new university system.

In this article, we present the results of the research process to demonstrate the changes that the majority of universities need to make in order to adequately carry out these educational reforms. The study was divided into a number of dimensions (institutional support, professional development, etc). In this report we will focus on the use of ICT by university instructors.

The use of information and communication technologies (ICT) by university instructors and their training has been studied and analyzed on other occasions in the last few years (Raposo, 2004; Area, 2004; Alba, 2005; Alba & Carballo, 2005; Sánchez & Mayor, 2006; Tejedor, García & Prada, 2009; González & Raposo, 2009; González 2009). We would like to highlight the offerings of some of these studies on the introduction of ICT at universities which we consider to be fundamental for understanding the use of technological tools at universities:

- The use of ICT is necessary and should be included in training, learning and assessment procedures for instructors.

- Knowledge Societies impose innovations resulting from the presence of ICT which in turn lead to a new understanding of the university's role in the transmission of knowledge and the didactic models to be used.

- The use of ICT at universities is aimed at making programs and studies more mobile and international.

- There is a perceived need for a shift in university culture towards formats aimed at recognizing the work and efforts of students, methodological proposals to stimulate self-learning by students, and assessments which encourage lifelong learning.

- Didactic and technical training in ICT for instructors is ideal because of its rapid assimilation and, in some cases, complexity.

- The instructors have very positive views of ICT and their didactic possibilities for innovations in educa-

tion, even though the use of ICT is still not widespread.

Given this situation, this is a crucial moment to promote the integration of ICT at universities. As noted in prior studies (Garcia and Gonzalez 2005), the European Higher Education Area is a perfect opportunity to adopt the use of ICT as teaching tools to facilitate teaching, learning, and assessment.

Each year marks an increase in the number of distance, or partially distance, course offerings, using platforms such WebCT, Moodle, etc., because of the benefits of these tools for e-learning methodologies and how they meet student needs. (Hinojo, Aznar & Cáceres. 2009). While structural planning should be done to include ICT, other aspects should also be considered (Benito, 2005):

- Development of adequate strategies for the introduction of ICT, within the planning at each university.

- This should consider the specific traits and objectives of each university. These should be realistic plans which consider the capacities of each university.

- ICT should be considered an opportunity to rethink university education and training.

- The goal should be that ICT become part of daily life at the University.

- A training plan must be developed for the use of ICT by instructors.

Any organizational change should be preceded by the training of its members. When dealing with continuous technological changes and advances, the training must also be continuous. The university is the ideal institution for the education of the community, and therefore should also be responsible for the training of its personnel, using appropriate training plans for such advances. When considering instructor training plans for the adoption of ICT in the university, three fundamental principles must be considered (Anderson, 2005):

- ICT should cross the curriculum in instructor training, and not be limited to specific courses.

- ICT should be taught contextually, as a response to concrete problems found in course subjects.

- Instructors that learn new technologies should experience the innovative properties of the technology in their own learning process: presentations, information searches, teamwork, etc. This means learning with the technology rather than just learning the technology.

The new university model requires the use of ICT by instructional staff for teaching and research duties, and as set forth by De la Cruz (1999), Cebrián (1999), y García (2006), and instructors must have the knowledge and skills necessary for their teaching duties.

This means that universities must make an effort for the training of their instructors in the use of ICT.

Like Gonzalez y Raposo (2009), we believe giving special consideration to the initial and ongoing training of university instructors is absolutely essential.

The new organization of university studies means that these training plans should guarantee a number of competencies for instructors (Benito, 2005; Escandell & Gonzalez, 2007; Rodriguez & Ortega 2005):

- Competencies related to the use and handling of technological tools (skills and abilities, the capacity to simplify procedures, dominance of specific software, etc.).
- Competencies related to the students' learning processes and the instructors teaching (handling of interactions, social and communicative abilities, the ability to direct and guide and to adapt to new conditions or the individual circumstances of each student, etc.).
- Methodological and learning competencies (knowledge of the implications and paradigms of learning based on the activity and collaboration of the student, rapid reaction, interdisciplinary work, ability to adjust and adapt to new situations, up-to-date knowledge of the field, creative capacity, material assessment, selection and dissemination, etc.).

In addition to the above, we think that improvements in the development of instructor training should, as described in other studies (Alba & Carballo, 2005; Devesa, Laguna & Palacios 2009; Gallego & Guerra, 2007; González, 2009; Mahdizadeh, Biemans & Mulder, 2008), include:

- Promoting the figure of a mentor or companion once the instructor attempts to apply their learning while preparing courses using a variety of ICT resources.
- Contextualizing the continuous training of instructors.
- Allowing for access to good practice experiences using these tools.

## 2. Materials and methods

The study was carried out using the descriptive-interpretive *ex post facto* model through the use of questionnaires, interviews and discussion groups. This report presents data resulting from a questionnaire

developed by four research groups at the universities of Cantabria, Oviedo, Jaen, and Leon. The instrument was designed jointly with five internal reviews and a validity review by 10 experts from the same universities. Each of the universities was responsible for analyzing the data from one dimension of the questionnaire. Our study group was responsible for the dimension dealing with information and communication technologies. The data was treated using SPSS.

- Overall objectives: The main goal of this study has been to analyze current educational models and reflect on recommended methodological proposals for adapting university teaching methods to new academic structures. The objective for the research team of the University of Cantabria was to describe current methodological uses in university lecture halls at the four

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universities involved, as they relate to EHEA, and to make proposals for innovative and effective teaching methods.

- Specific objectives: More specifically, we've focused on documenting the level of ICT use by instructors at the universities involved, and made suggestions and proposed alternatives to improve the use of ICT. The following phases were established to meet these goals:

- A look at the state of scientific research on university teaching methods.
- Participation in the design of the «Questionnaire to analyze university instructor support needs for teaching and teacher training» regarding: methodology, didactic resources, information and communication technologies, motivation and assessment, and a pilot study of alternative methodologies appropriate for the EHEA.

### 2.1. Phases

The study was developed using multidisciplinary methods given the interconnection between different areas of the study's objectives: uses and level of ICT use. To illustrate the phases:

- Phase I: Initial study. An inquiry into the materials available for documental research (dictionaries, encyclopedias and thesaurus; databases, journals, manuals, software, websites, web pages, etc.).

- Phase 2: Theoretical base. A look at different macro trends effecting current society which directly or indirectly impact universities, their programs of study, etc.

- Phase III: Empirical research. The initial reviews permit a look into the daily realities of the organization, management, and experiences of instructors at universities and provides a larger number of references through the use of methodological and process analysis.

- Phase 4: Results. Using the information obtained from the analysis, the next phase was to present all of the conclusions. Questions resulting from the conclusions suggested new lines of work, and a Meta assessment of the process allowed for a look at improvements for future research.

### 2.2. Questionnaire

Parting from the stated research objectives, the different dimensions of the questionnaire were established, and a rough draft was developed. The draft was validated and the final questionnaire prepared.

The authors conducted a bibliographical review and participated in several International Congresses on the European Higher Education Area before developing the research tool. Proposals and criteria were used to develop the tool using the following steps: planning and structuring, elaboration, validation and final draft.

The resulting dimensions of the questionnaire were as follows: personal and professional data and information about their position, institutional support, information and communication technologies, motivation and instructor/student relationship, assessment, tutor or orientation activities, impact, satisfaction and product results.

As mentioned above, this article focuses on the information and communication technologies dimension of the study.

### 2.3. Sample population and profile

The study population included 5,017 instructors at the four participating universities. Using a quantitative method, data was collected from a sample of 263 instructors, at the beginning of the data analysis done by the University of Cantabria.

The questionnaire was presented to an expert panel for validation. Suggestions and contributions from the experts were considered when drafting the final questionnaire. The elimination and rewriting of some items allowed us to reduce the number of items from 167 to 141. The split-half method, Cronbach's alpha, was used to determine reliability. The result was 0.922, a high level of reliability meaning a reliable measurement tool. The data in outline form:

Sampling procedure	Proportional stratified sampling	
Reliability	Alpha	0.922
	Cronbach's alpha	Part 1: 0.891
		Part 2: 0.853
		Elements: 64
	Correlation between forms	0.691
	Spearman-Brown coefficient	Equal length
Unequal length		0.818
Guttman's split-half	0.813	
Validity	Expert review: Two expert reviews	
Confidence level	95%; Z=1,96; p=q=0,5	

Chart 1. Sampling procedure.

Basic descriptive statistics were analyzed: mean, average, mode and derivation, as seen in the results. The data resulting from the analysis of the different dimensions and categories of the questionnaire follows.

### 3. Results

The data from the application of the questionnaire allows us to see the profile of the instructors who participated in the study, as well as their uses of ICT and the level of use of a number of common ICT tools. All of these results allow for a close look at current teaching conditions for university instructors. We believe that it is an adequate tool for detecting training needs and determining whether universities need to focus more on instructor training to provide adequate quality within the new programs of study.

The highest percentage of instructor participation in our research was found at the University of Oviedo, followed by Cantabria, Leon and Jaen. The percentage of male respondents was higher than that of women, to be expected given the gender of instructors at these universities. The largest group of instructors was that between 35 and 50 years of age, followed by those over 50, and finally those that are over 50.

The majority of the sample was from instructors at

schools of Social Sciences and Law 42%, Engineering and Architecture 26.4%. Sciences, 13.6%, Arts and Humanities 8.1% and lastly, Health Sciences 7.3%.

An assessment of skill levels with European Union languages indicates that a large percentage of instructors have an average (47%) or high (36%) level of English. The percentages are lower for other languages such as French, Italian, Portuguese and German.

The majority of instructors dedicate the majority of their time to instruction. The majority teach three (48.1%) or more classes (22.7%). The numbers drop quickly for those teaching two classes (14%), none (7.8%) or one (3.9%).

As is to be expected, the majority have doctorates, though more than 16% have only Bachelor's degrees and a lower percentage have only certificates. Very few of the instructors in the sample have completed a master's degree. Instructors in Business Management and Administration as well as Financial and Fiscal Law were most likely to have studied a master. More members of the sample have completed postgraduate classes (16%), mainly associated with doctoral programs, to obtain a certificate of Research Sufficiency.

The professional categories included professors at all levels. The majority of instructors are full professors (48.4%), followed by associate professors (11.2%), and in decreasing order, temporary lecturers (8.4%), lecturers (non-doctorate) (7.8%), assistant professors (7.5%), and lastly, Deans (5.5%).

As stated above, this article includes the results from the Information and Communication Technologies (ICT) dimension of the questionnaire, which was divided in two categories: ICT uses and the level of use of different ICT.

Both categories were analyzed using different indicators to obtain the following information about the use of these technologies:

In the category of ICT uses, we wanted to know how the instructors in the study really use ICT in different areas of their professional activities. A Likert scale (0-6) was used to obtain the responses, and the responses have been grouped in three categories in order to make the results easier to interpret: Very important (VI), Somewhat important (SI), Not impor-

tant (NI), as is shown in the following table, along with the standard derivation (SD) and the Average (Ave).

From this data we could see that half of the university instructors considered the use of ICT to be very important for their teaching duties. However, the results show that they are less important for other duties. The data leads us to reflect upon the use of ICT for instruction. We consider ICT to be a fundamental teaching resource in adapting to the European Higher Education Area and therefore improving the quality of university education in aspects such as coordination between instructors, between students, and between instructors and students, management activities, the development of continuous formative assessment, the implementation of cooperative projects and activities, etc. Alba and Carballo (2005) state that although ICT are an integral part of the university system, their pedagogical use has «been left aside».

Nonetheless, in the «research» category we see that the percentage of instructors assigning the highest importance to the use of ICT in this area reaches 61%. The importance that instructors assigned to the use of ICT for the publication of research is interesting because of their direct relationship with research. We also see a high percentage of instructors, 44.5%, who rely on ICT for their publications, a positive result given the recent digitalization of scientific journals.

47.8% of the instructors considered the use of ICT as very important for contact with students, another large group of the sample did not assign it much importance and we assume that they must use other methods of contact with students. The use of ICT for the preparation and simulation of cases is not very common among university instructors. We don't know whether this is due to a lack of awareness or if the instructors simply have not found viable pedagogical uses.

Analyzing the data in function of the differences in the profiles of the sample, we can see that the use of ICT for instruction is considered of less importance at the University of Jaen ( $p=.035$ ), while the University of Oviedo stands out for the quality of interactions with students using these tools. ( $p=.011$ ). Oviedo and Cantabria both depend more on ICT for publishing ( $p=.004$ ).

According to age, younger instructors assign more importance to their use of ICT for research ( $p=.012$ ) and for connecting with students ( $p=.028$ ). According to education level, instructors with a doctorate assign the most importan-

ICT	SD <sup>(1)</sup>	Ave <sup>(2)</sup>	NI <sup>(3)(4)</sup>	SI <sup>(3)(4)</sup>	VI <sup>(3)(4)</sup>
Rate your use of ICTs for:					
Instruction	4.31	4.00	08.30	42.40	49.30
Research	4.50	5.00	11.60	27.10	61.40
Contact with students	4.24	4.00	08.60	43.50	47.80
Preparation and simulation	3.79	4.00	19.20	42.90	38.00
Publication	4.03	4.00	17.50	37.90	44.50

Chart 2. ICT uses.

ce to the use of ICT for research ( $p=.000$ ). With regards to the schools in which they instruct, we find the professors of Engineering and Architecture are those that most often use ICT as method of contact with students. As a function of the number of classes they instruct, we see that ICT are used more frequently for instruction by instructors giving three or more classes ( $p=.018$ ). It appears that the ratio between instructors and students impacts the use of ICT because of their capability to facilitate communication and the management of results and/or products, allowing the instructor to reach more students with an optimal use of resources.

The differences found regarding professional category indicate that, in general, full professors make more use of ICT for instruction ( $p=.000$ ), research ( $p=.002$ ), simulations ( $p=.000$ ) and publications ( $p=.000$ ). This last item had negative indicators for lecturers. With regards to working hours at the university, we find that instructors with at least 12 credits use ICT less for publication ( $p=.035$ ). We believe this should be kept in mind when preparing training and supervision courses for instructors according to their

ICT	SD <sup>(1)</sup>	Ave <sup>(2)</sup>	NI <sup>(3)(4)</sup>	SI <sup>(3)(4)</sup>	VI <sup>(3)(4)</sup>
The following ICTs were evaluated:					
Image (TV, video and video camera, DVD, etc.)	3.26	3.00	31.50	42.80	25.60
Internet and telecommunication systems (multimedia presentations...)	4.50	5.00	08.50	31.30	60.01
Virtual platforms (Web CT, Moodle, etc.)	3.48	3.00	33.00	29.90	37.10
Subject specific software	3.30	3.00	33.50	36.10	30.40

Chart 3. Level of ICT use.

category and position.

The second category of the ICT dimension of the study was to take a look at the level of use of a number of ICT or «tools» by university instructors for a variety of professional activities. The responses appear in the following table, with the same groupings as the other category: Very Important (VI), Somewhat Important (SI) and Not Important (NI), as well as the standard derivation (SD) and the Average (Ave):

The use of images as a teaching tool is not considered important, and as many as 31% of the instructors rated images as not important. However, the use and application of internet products and telecommunications systems on screen is much more frequent among the sample. They are considered important tools by more than 60% of instructors, a sign of the importance instructors give to audiovisuals as a means of communication with their students.

Virtual platforms and Web publications such as Open Courseware (OCW), WebCT or Moodle

have barely any use. We also find that the majority do not use any subject specific software, although 30% use them frequently. We believe that knowledge of good practice experiences which demonstrate the functions, offerings and advantages of these tools in each subject area would facilitate the decision to use ICT in classes.

We also compared significant differences in use levels across the study sample according to the university. We found that at the universities of Cantabria and Oviedo internet and telecommunications systems were used more frequently ( $p=.008$ ) and at Oviedo they more frequently use virtual platforms ( $p=.000$ ) and specific software ( $p=.000$ ).

We also found that men tend to use internet and telecommunications systems less frequently than women ( $p=.006$ ). If we look at the data according to age, we see that younger instructors make more frequent use of Internet, telecommunication systems ( $p=.028$ ), subject specific software ( $p=.017$ ) and virtual platforms ( $p=.000$ ) Virtual platforms have little or no use among instructors over 50 ( $p=.000$ ).

As far as the education level, instructors with doctorates use virtual platforms less frequently ( $p=.021$ ) than those without a doctorate. And according to the school in which they work, instructors of Engineering and Architecture more frequently use virtual platforms ( $p=.003$ ) and subject specific software ( $p=.005$ ).

#### 4. Discussion and conclusions

The results from the study provide an interesting look at the different methodological styles of ICT use by university instructors and allow us to offer methodological alternatives and suggestions which we feel would be important when introducing the teaching methodologies of the EHEA.

After describing the research resulting from a study by various universities and observing a need for more methodological alternatives for university instructors to improve the introduction of EHEA, we would like to make several proposals for the training and implementation of ICT use. These would allow for more collaborative work amongst the university community and at the same time offer opportunities for acquiring ICT competencies such as: more use and adoption of other tools such as those offered by Web 2.0 (wikis, on-line collaborative tools, blogs, forums, social networks and markers).

Given that a tool can be used in many ways and to many ends, the selection of a tool also implies that the instructor must make decisions about the methods to be used. We believe that the methodologies to be used should have the goal of improving competencies with the use of ICT and the handling of information and communications. Of all the possible methods we would like to highlight cooperative learning, problem-based learning, project-based learning, case studies, e-portfolio, etc. We also suggest that for the appropriate use of 2.0 tools and teaching methods, if at the beginning training focuses on technology and tools, it should also consider a number of other issues:

- Supervision for instructors when they attempt to use their training to prepare a class or research project using ICT.
- The contextualization of the continuous training of the instructor, to meet the real and practical needs of the professional profiles in each area.
- The sharing of good practice experiences between instructors both nationally and internationally.

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