

ARE NEW TECHNOLOGIES INFLUENCING THE ACADEMIC RESULTS ACHIEVED BY STUDENTS? An exploratory study

Ana GARGALLO-CASTEL
Luisa ESTEBAN-SALVADOR
M. MARZO-NAVARRO
Department of Business Administration
University of Zaragoza,
Teruel, SPAIN

ABSTRACT

The purpose of this study is to analyze the application of Information Communication Technologies (ICTs) within tertiary education in a Spanish University. We analyze the results of a new initiative developed by the University of Zaragoza through an innovative project for a virtual campus called 'Anillo Digital Docente'. Data relating to the degree of WebCT's use is analyzed, as well as the academic results achieved by the students using it. These results are compared with the results achieved by other students studying in a traditional teaching setting. Several conclusions are drawn from this comparison: firstly, on how effective these technologies are within regulated university education; and secondly, on how beneficial the extension of its application would be to other educational areas.

Keywords: ICTs, academic results, development; educational policy; university

INTRODUCTION

A characteristic feature of the new millennium has been the development of new information communication technologies (ICTs), which bring about crucial changes in numerous environments: business, social, economic, cultural, etc. (Osterman, 1986; Lope Peña, 1996; Brynjolfsson and Yang, 1996; Castells, 1998; Ilzkovitz and Mogensen, 1999; Bresnahan, et al. 2001).

Because of the potential benefits that can arise from the use of these technologies (as has been found in recent studies), an empirical study of this area has proved to be of interest. As mentioned previously, this technological revolution does not exclude education; on the contrary, opportunities for growth based on these new technologies are very positive, as indicated in the World Bank report (El-Khawas, et al., 1998). It is not therefore surprising that the European Union Rectors' Conference has considered ICTs as one of the main external factors affecting change in universities (Bricall et al., 2000). Peña (1997) maintains that although in the late seventies the classroom was considered the only medium for the transmission of knowledge, today ICTs offer a wider range of teaching possibilities, but are still underused. The use of ICTs reportedly gives an advantage not only to teachers but also students (Esteban et al., 2003).

Therefore it seems that the adoption of ICTs should be promoted by the universities. Today, implementation of ICTs within the educational context has become a critical factor that already is being applied worldwide (Arif, 2002). However, many of the tools offered by ICTs are not being applied or are being underused; that is to say well under an optimum use level.

In order to make good use of the latest technological advances associated with ICTs, these technologies need to be integrated into teaching practice. This would facilitate the development of innovative modalities that would enable educational institutions to better cater to the needs of the diverse types of students in today's university environment. An area where the potential benefits of ICTs would make a major difference is the area of teaching models designed for students that for several different reasons may not be able to be present in the classroomⁱ, and who are therefore forced to carry out their studies following a non-traditional system. Spanish universities have been experiencing serious difficulties since the late 1990sⁱⁱ - a decrease in the number of students in the lecture theatres as a result of a reduction in the birth-rate (Fram and Camp, 1995; Álvarez and Rodríguez, 1997; García-Montalvo, 2001; Romero et al., 2002). It is expected however, that this tendency may be counteracted in Spain as a result of the increase in the number of students enrolled in lower educational levels, especially in primary education and preschoolsⁱⁱⁱ.

Notwithstanding this possible change in the current trends in Spain, Spanish universities have encouraged as a preventative measure the mobility of tertiary students (Mora, 2003), and are searching for new student profiles as alternatives to traditional ones. It is worth mentioning in relation to this latter point that 18 to 24 year olds are no longer the main target group for university education, other segments of the population are demanding specific training for skills updating and improvement. A number of professionals fall into these student categories that are going back to university to improve their skills and update their knowledge (Tavernier, 1991; Coccari and Javalgi, 1995).

Because of the characteristics of the various segments of potential university 'clients', it seems that the main beneficiaries of the new technologies, especially communication technologies, would be distance learning and web supported students.

One of the major features of Information and Communication Technologies is personal interaction (Bartolomé, 1995), and applied to education it allows teachers and learners to exchange messages. IT nets also free the participants in this teaching process from having to come together in time and in space (Adell, 1997).

Lipsky^{iv} (2000) has developed a new teaching model in which the classroom is conceived as a virtual space. This implies the existence of a more developed model for learning and replaces the presentation of material by the teacher by research and effort on the part of students. The lecturer becomes a mentor and students learn the material by themselves through a web page, which allows them to adapt the material to their personal learning-rhythm.

Adell (1994; 1996) proposes that ICTs be used in various educational environments: the classroom, administration services and the professional development of teaching staff.

Despite the diversity of possibilities that these technologies offer in the field of education, their use has not reached a desirable level and many educational organizations still do not take full advantage of them.

Organization for Economic

Cooperation and Development (OECD, 2001) recently concurred with such ideas through the Centre for Educational Research and Innovation (CERI) who deal with these kinds of issues. Nevertheless, El-Khawas, *et al.* (1998) estimate that the number of institutions that offer distance learning education will increase, together with the number of students enrolled in them.

In this environment, both classical and virtual institutions are beginning to explore e-learning in order to create a more flexible system of education (Szarowski and Mannová, 2002). Some universities also see this situation as an opportunity to place the use of ICTs as a distinguishing element and key factor for innovation and for improving the quality of education (Sangrá, 2002). This study will specifically provide evidence on the use of ICTs in the Web supported teaching modality. The academic results of students using this modality will be compared with those of students in a traditional teaching setting.

The web supported teaching modality combines distance learning education with traditional teaching methods. This combined system corresponds with predictions made by Adell in 1997 in relation to a mixed programme. In this programme students attended some classes and also continued with distance learning using the technological resources offered by ICTs, interacting with teachers and other students when needed. Contact sessions brought, among other things, a reinforcement of the student's interest in learning as a result of having direct contact with other students and teachers. They were able to exchange points of view and participate in other extra curriculum activities, all of which were made possible by a conventional education setting (Cardona, 2002).

A CASE STUDY IN THE APPLICATION OF ICTs IN UNIVERSITY TEACHING

There are a great number of initiatives and tools for distance learning in many institutions in most industrialised countries, as well as many web addresses through which universities offer training courses that are completed, to a greater or lesser extent, via the computer^v. A large number of Spanish universities have virtual campuses available. According to Area et al. (2001), 61% of Spanish public universities had a virtual campus in 2001^{vi}. Most Spanish universities have their own websites, many offer virtual courses, and there are several initiatives for the development of shared virtual campuses. The most important ones refer to Group G-7, recently renamed G-9, comprising of nine Spanish universities^{vii} which offer several course subjects to their students through the Internet; Intercampus^{viii} initiatives for Catalanian universities; and the Ada-Madrid project which comprises six universities from Madrid^{ix}.

This case study fits within the framework of an initiative being developed by the University of Zaragoza through an innovative project for a virtual campus called 'Anillo Digital Docente' (ADD) (Digital Educational Ring), through which a number of university courses are taught. The Labour Sciences Degree was the first degree in the University of Zaragoza that employed almost simultaneously both teaching modalities: traditional teaching methods and web supported methods. Other university courses which previously have been taught following a traditional teaching modality have since embraced this system of teaching.

Web Course Tools (WebCT) was the software selected for developing the virtual campus. This tool is an easy to use web application with convenient software. It facilitates both the environment and the utilities needed for creating the virtual campus, and for achieving a number of educational objectives (Arif, 2002).

WebCT was created in 1997 by Murray Goldberg, a teacher at British Columbia University. Initially, Goldberg was only trying to apply new information and communication technologies in the area of course preparation and to enrich his teaching experience with students.

Since this tool offered so many opportunities, it was developed further and has been exported to a great variety of countries such as South Africa (Arif, 2002), Croatia (Priscan and Tingle, 2002), Brazil (Souza et al., 2002), Canada (Patterson and Yee, 2002) and Spain (Anillo Digital Docente).

In this context, during the academic year of 2001-2002 the Faculty of Social Sciences and Humanities of Teruel introduced WebCT into one of the student groups enrolled in the Labour Sciences Degree. One group followed a traditional teaching modality, where the teacher practiced teaching as usual, through lectures, practical classes, reading and discussion of texts, student assignments, and discussion and presentation of cases, etc. (Yagüe, 1997) with the classroom as the meeting point with students. The other group, in the so called web supported modality, which is a hybrid between traditional teaching and distance learning, alternating direct contact with students (but with a much lower percentage of contact sessions than the traditional or non web supported group) with the use of new technologies. These technologies allow for a constant flow of communication between teacher and student and between students, through the set up of shared virtual work spaces that resemble virtual classrooms for both teachers and students. These virtual classrooms facilitate the group learning process without the need for a physical meeting place. Instead, group learning occurs through the various WebCT tools, such as a contents module, calendar, index, mail, forum and chat-room.

WebCT facilitates a more active learning model that is student centred, in which the student takes on a more creative role, is more self regulated, active and able to learn with more autonomy (Cornélis et al., 1997). The purpose of this study is to analyse the results of students who have chosen the web supported option for their Labour Sciences Degree, and to compare these with the results of students in the traditional modality option for the same degree, and to comment on any differences that may be observed.

SYSTEM FOR MEASURING RESULTS

As described above, the main objective of this study is to detect any differences between the results achieved by each of the student groups described. For this purpose, it is necessary to define some criteria for measuring results achieved by both student samples.

An accepted definition of results indicator has been proposed by Navarro and Flores (1997), as the measure that provides information regarding the effectiveness, efficiency and economy reached by the students in their performance. In order to calculate the ratios achieved, it is necessary to generate data on output, resources used and the conditions under which the teaching activity was carried out.

Certain characteristics need to come together so that these indicators may fulfil their objectives. According to Meunier (1993), at least the features of reliability, validity and operational ability need to be present.

In the area of public management, authors such as Norverto *et al.* (1999) support a system of indicators for their administration, and more specifically, for measuring the quality of universities (Gonzalo *et al.*, 1997; Miguel *et al.*, 2001).

Following a review of the different ratios proposed in various studies, the ratios supported in the Catalogue of the Council of Universities were chosen.

Some of the reasons for selecting these ratios include the fact that they were created unanimously by several major researchers in the field who worked together as a team, as well as the fact that the whole Spanish university community cooperated in the creation of this Catalogue of indicators. This Catalogue is comprised by a list of forty six indicators which are grouped under eight categories: university supply, university demand, human resources, financial resources, physical resources, process, and results.

Since the main objective of this work is to study the results achieved by the two mentioned samples of students during the 2001-2002 academic year, and to analyse the differences that may exist between them, the study has focussed only on the Results Category. This Category is comprised by eleven indicators as shown in Table. 1.

In this study, Performance Rate is defined as the relationship between the number of credits achieved (excluding those that were adapted, validated, recognised, etc.) by students in the first year of the Labour Sciences Degree in the University of Zaragoza, and the total number of credits that those same students had enrolled for. This sample of students was also divided into two sub samples: traditional teaching students and web supported students, and the same ratio was again calculated for each sub sample. Success Rate is defined as the relationship between the number of credits achieved and the total number of credits submitted for examination by students in their first year study of the Labour Sciences Degree in the University of Zaragoza. Both the above ratios have been chosen in view that they complement each other in terms of meaning and level of usefulness, facilitating thereby a comparison of results achieved by students in their exams.

Table: 1
Indicators in the Results Category of the Spanish University Public System

CATEGORY	INDICATOR
RESULTS	<ul style="list-style-type: none"> • Dropout Rate • Performance Rate • Success Rate • Graduation Rate • Average length of studies • Standardised Progress Rate • Satisfaction with studies • Job satisfaction • Rate of participation in research projects • Proportion of six year periods • Production of doctors

Source: Based on information published in www.mec.es/consejou/indicadores (Council of Universities, 2002).

In order to proceed with the analysis proposed in this study, and taking into account the data available, the second and third ratios in the table above were calculated, i.e. Performance Rate and Success Rate.

METHOD

The case study method has been employed to research the effect of ICTs on student results. As mentioned earlier, the differences between the results of students in a traditional setting and web supported students of the Labour Sciences Degree of the University of Zaragoza were analysed.

The above University offered the first year of the Labour Sciences Degree in both teaching modalities, traditional and web supported, during the 2001-02 academic year. It was an innovative experience to offer the web supported option for this educational institution that has been continued until now^x.

In this educational context, the main objective of this piece of research was to study the effect of the application of the new Information and Communication Technologies on the results achieved by students in the Labour Sciences Degree of the University of Zaragoza. This particular degree pioneered the use of new technologies in the area of teaching in the above mentioned University.

The performance level achieved by students in the first year of study of the above mentioned degree was measured during the years 2001-02 and 2002-03, so as to be able to analyse any differences between both groups and both years that could potentially be attributed to the use of ICTs.

It hasn't been considered necessary to introduce a control variable in view of the fact that the University of Zaragoza teaches this degree in only one centre and the staff who teach the subjects for this degree are the same ones for both teaching modalities.

Data Base

The data analysed was taken from the official certificate of grades for each of the eight core compulsory subjects that were taken during the period studied, for both groups: traditional and web supported students.

The number of subjects in the sample matched the total number of students, i.e. 148 students in the 2001-02 academic year and 236 in 2002-03. Students for both years each had their own grades for each of the subjects that make up the first year of the Degree.

SAMPLE CHARACTERISTICS

The 2001-02 students sample comprised, as indicated in Table: 2, of a similar number of students in each of the groups: traditional group (50.68%) and web supported (49.32%). This distribution changed the following year, 2002-03, with an increase in the number of web supported students to 68.63%, and a decrease in the number of traditional students to 45.78 %.

A preference for the web supported model seems clear, which could have come as a result of the specific features of this Degree or of the particular circumstances of the student population. In most cases, web supported students combined studies with work, and their personal and family situation differed from those of the typical student.

Table: 2
Description of the sample by modality of teaching

COURSE	2001-02		2002-03	
	TOTAL STUDENT	% STUDENT	TOTAL STUDENT	% STUDENT
WEB SUPPORTED	73	49.32%	162	68.63%
TRADITIONAL TEACHING METHODS	75	50.68%	74	45.78%
TOTAL	148	100%	236	

Source: Own elaboration

During the academic year of 2001-02, gender was unevenly distributed across the total number of students. 41.21% students were male and 58.78% were female (see Table: 3).

The following year, although females were still the larger group with 54.23%, the number of males did increase by 4.55% with respect to the previous year.

Table: 3
Description of the sample by gender

COURSE	2001-02		2002-03	
	TOTAL STUDENT	% STUDENT	TOTAL STUDENT	% STUDENT
MAN	61	41.21%	108	45.76%
WOMAN	87	58.78%	128	54.23%
TOTAL	148	100%	236	100%

Source: Own elaboration

Table: 4
Rate of Performance

RATE OF PERFORMANCE	WEB SUPPORTED				TRADITIONAL TEACHING METHODS				Total Sample	
	MEAN	N	STANDARD DEVIATION	MEAN	N	STANDARD DEVIATION	MEAN	N	STANDARD DEVIATION	
2001-02	56.62%	73	0.389	57.00%	75	0.499	56.80%	148	0.447	
2002-03	38.48%	162	0.393	63.91%	74	0.4415	46.45%	236	0.425	

Source: Own elaboration

RESULTS AND ANALYSIS

To carry out the objective of this study, we proceeded with the calculation of the rates defined earlier on: Performance Rate and Success Rate.

These rates were calculated for the whole sample and for each of the sub samples: Traditional teaching methods and web supported.

As shown in Table 4, Performance Rate for the group of web supported students during 2001-02, for all subjects, was 56.62%.

This figure was only just under the rate of 57% for the traditional method group. As can be observed by this indicator, non web supported students showed a very small margin of advantage over web supported students.

For every 100 credits students had enrolled in for each of the modalities, an average of 57 were achieved in the traditional modality, while 56.62 credits were achieved by students in the web supported modality. In the year 2002-03, the Performance Rate for web supported students was 38.48%.

This was a far cry from the value of the previous year, exactly 18.14% below the Performance Rate of the first year in which the Degree was first offered with the two options of traditional and web supported teaching. By contrast, the traditional group saw an increase of almost 4 percentage points over the previous year, bringing the value up to 63.91%.

It is easy to see at first glance that results for the academic year 2001-02 indicate that the differences between the Performance Rate of the traditional group and that of the web supported group were not significant. Data for the following period however, the academic year of 2002-03, point to differences between the groups. T

he differences in performance between traditional and web supported students were mostly due to the greater number of credits achieved by traditional-students, since the average number of credits enrolled for were very similar for both groups, around 31-35% (see Table: 5). There are a number of reasons that could explain this situation.

One reason may be that traditional teaching is a more efficient means for the transmission of knowledge and for student learning.

The alternative modality, which offers the support of ICTs as a replacement for traditional teaching may be less efficient, even though traditional methods have disadvantages.

An example of this is the fact that a pure traditional teaching method imposes on the student what material he or she has to learn, disregarding the strategies or means for learning it (Bernad, 1990).

Table: 5
Total number of credits enrolled for, sat exam for and passed

	TRADITIONAL TEACHI	WEB SUPPORTED
	METHODS	MEDIA
2001-02 TOTAL NUMBER OF CREDITS ENROLLED FOR	35.80	43.48
TOTAL NUMBER SAT EXAM FOR	24.56	26.01
TOTAL NUMBER OF CREDITS PASSED	22.12	24.74
2002-03 TOTAL NUMBER OF CREDITS ENROLLED FOR	31.05	34.91
TOTAL NUMBER SAT EXAM FOR	21.28	15.59
TOTAL NUMBER OF CREDITS PASSED	19.42	13.70

Source: Own elaboration

Non IT user's students in the Labour Sciences Degree had ten hours worth of traditional classes for each credit they had enrolled for. By contrast, web supported students had only 1.3 hours of classes for every ten credits they had enrolled for. This is 87% hours less of traditional teaching methods.

From these figures it could be assumed that these extra 8.7 hours of contact class time were beneficial not only as a means for cutting down time for personal study of the materials, but also for better comprehension of contents and concepts, and for a wider overall vision of all materials.

These factors could have helped traditional students to pass a greater number of subjects.

On the other hand, the specific characteristics of web supported students enrolled for the 2001-02 academic year need to be mentioned. This was the year in which the Labour Sciences Degree was introduced in the University of Zaragoza.

Table: 6
Rate of Success

RATE OF SUCCESS	WEB SUPPORTED				TRADITIONAL TEACHING METHODS				Total Sample	
	MEAN	N	STANDARD DEVIATION		MEAN	N	STANDARD DEVIATION		MEAN	N
2001-02	78.14%	73	0.382		60.00%	75	0.457		69.00%	148
2002-03	55.28%	162	0.4642		72.92%	74	0.4047		60.81%	236

Source: Own elaboration

The novelty factor of this new degree, the shortage of universities that offered this degree, and the use of a more flexible teaching modality, as is the case of web supported teaching, all contributed to attract a particular kind of student.

Academic grades were the selection criteria of students, which mean that students enrolled in the year 2001-02 had good academic records and were highly motivated students.

This could explain the high performance and success ratios achieved by web supported students during this year. In the following year this selection criteria was no longer applied, which meant that practically all students who applied for the web supported option were accepted.

In the case of the Success Rate, the opposite effect was observed for the year 2001-2002: the ratio of 78.14% for web supported students was higher than the 60% ratio for non web supported students. This means that for each credit they had to sit an exam for, web supported students passed 0.78, while non web supported students only passed 0.60. This could be due to several different reasons.

On the one hand it may be possible that web supported students generally act less on chance, i.e. they will not travel to attend an exam, which involves an investment of time, money, time off work, etc., if they do not think they will pass it.

On the other hand, personal circumstances, such as students' age, employment or family responsibilities could mean that they are more mature than younger students, which could also explain the differences found in the Success Rate of both groups.

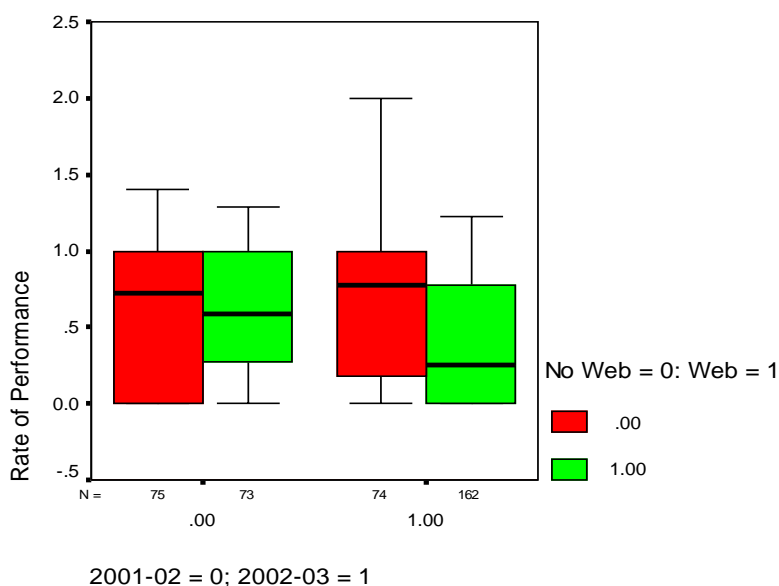
However, there was a change in the Success Rate for the year 2002-2003 from the previous year, which is quite surprising. On the one hand, web supported students passed 0.55 credits from each credit they sat exams on. This means a decrease of 0.23 credits in relation to the previous year. Non web supported students on the other hand passed 0.73 credits from each credit they sat exams on, which means a 0.13 increase from the previous academic year. A reason that could explain these results is in direct opposition to the reasons given earlier on. In the academic year of 2002-03, the Labour Sciences Degree came on offer at several Spanish universities, which meant that students had a wider range of options of universities from which to choose than in the previous year. Also, they could choose a Faculty that was closer to where they lived.

This situation led to more competition between universities and as a result access grades for the Labour Sciences Degree at the University of Zaragoza were lowered, which in turn led to the enrolment of students with much lower academic records than in the previous year. Besides, it could also have been the case that the more motivated students had already enrolled in the previous year.

A COMPARATIVE ANALYSIS BETWEEN THE TRADITIONAL TEACHING MODEL VERSUS THE WEB SUPPORTED TEACHING MODEL

Following an initial descriptive analysis of the results achieved by each student group on each of the two academic years, we looked at whether the differences between results were statistically significant. Whether the results achieved for each of the Ratios proposed in the Catalogue of Indicators of the Spanish University System were significantly different between the non web supported group and the web supported group.

A Box-Plot analysis was performed to statistically test the results obtained. This was followed by a means differences test. Both tests were carried out using the SPSS programme, version 11.0. Graphic 1 shows differences between each student group for the 2001-02 and 2002-03 academic years.



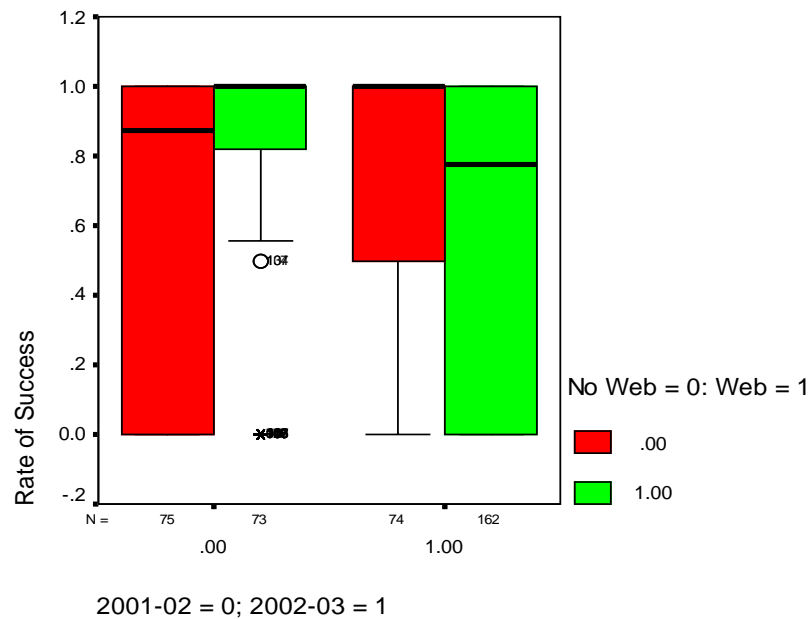
Graph: 1
Box Plot, Rate of Performance course 01-02 and 02-03
 Source: Own elaboration

As can be observed, test results are consistent with the initial analysis. For the year 2001-02, there were minimal differences in the Performance Ratio calculated for the non web supported and web supported groups, with a slightly lower ratio for the group.

However, larger differences were observed between groups in the year 2002-03, with a much higher Performance Ratio for the non web supported student group.

Tests on the Success Rate followed the Performance Rate tests. As shown in Graph 2, there were considerable differences in the Success Rate of each group, with a higher rate for web supported students. These results also match the initial analysis given above. Similarly, the 2002-03 year experienced a change in the results of each student group, just as observed in the initial analysis. There was a remarkable increase in the Success Rate of non web supported students, while students experienced the opposite effect.

Although students with low success rates were outliers in the year 2001-02, this effect became more widespread in the following year. However, what is clear is that this group still had the larger number of students with good success ratios.



Graph: 2
Box Plot, Rate of Success course 01-02 and 02-03
 Source: Own elaboration

To statistically test the results of the initial exploratory analysis, a means difference test was performed, i.e. a t-test for Equality of Means Independent Samples Test, as shown in Table: 7.

Table: 7
t-test for Equality of Means 2001-2002 (Independent Samples Test)

	t	Significance level
Performance F	-0.057	0.955
Success Rate	2.613	0.010

*p<0.05; **p<0.01; ***p<0.001 Source: Own elaboration

Results for the year 2001-02 confirmed results found in the initial analysis.

The differences in the Rate of Success between the non web supported and web supported group were statistically significant, with a p-value of 0.05. For the Rate of Performance, however, we cannot detect a difference between the means of the two groups at the 0.05 significance level.

For the year 2002-03 (Table 8) non web supported students reached higher values for both Performance and Success Rates and the differences were statistically significant.

Table.8
t-test for Equality of Means 2002-2003 (Independent Samples Test)

	t	Significance level
Performance Rate	4.43	0.001
Success Rate	2.81	0.010

*p<0.05; **p<0.01; ***p<0.001 Source: Own elaboration

What transpires from these results is that despite the benefits received from the new technologies, students in the web supported modality did not achieve better Performance Rates. Nevertheless, these same students not attending classes were not in an inferior position during the year 2001-02. It could therefore be argued that although ICTs generate a positive effect on student performance (resulting from the time saved for students, from an improvement in communication between student and teacher and between fellow students, and from the elimination of geographical barriers, among others), this effect was neutralised by the absence of contact time and the positive effects it brings about. As maintained by Cardona (2002), a good teacher with good communication abilities has a positive effect over the transmission of knowledge.

From the results for the year 2002-03, it can be observed that although initially it was thought that the contributions made by ICTs would bring about even higher results than those achieved by students in the traditional modality, this effect was biased because of the specific characteristics of the students in the first year. As mentioned earlier, these students had excellent academic records. It is worth mentioning that a large number of people from all around Spain had applied for the 150 places available in the course, so that several hundred were not able to enrol that year. Also, the top 75 applications chose, for personal and professional reasons, the web supported teaching modality. In this context, ICTs enabled students to achieve a level of performance at least on a par with the performance level of non web supported students.

The second analysis undertaken also confirms the findings of the earlier analysis i.e. that in the first academic year the Success Rate for the web supported group was higher than that of the non web supported group. This difference could be the result of the opportunities offered by the new technologies, which may have helped web supported students to achieve better results.

Web supported students' age and their high level of motivation are factors that need to be taken into consideration when drawing conclusions. As Croy (1998) maintains, for distance learning students to be successful they require a high level of motivation and self-regulation.

CONCLUSIONS

The purpose of this study was to illustrate how the use of Information and Communication Technologies has an effect on results achieved by students under two different teaching modalities: a traditional teaching modality and a web supported modality. To measure differences between groups two of the indicators proposed by the Council of Universities were used, i.e. Performance Rate and Success Rate. These had been created within the framework of quality analysis of university education.

From the tests carried out it can be observed that in terms of the Success Rate, results achieved by students in the web supported modality during the 2001-02 academic years were higher than those in the non web supported modality. This finding could be explained by other factors other than ICTs. Students had been demanding for some time the introduction of the Labour Sciences Degree, and had also participated in creating a petition in which they justified the need for this degree.

This point is to the fact that this student population was highly motivated. Besides, students with the highest academic records chose the web supported teaching option.

For the following year however, results for the Success Rate changed. Students in the traditional teaching modality achieved higher results than those in the web supported modality, and the differences were statistically significant. This finding may be explained by the fact that demand for this course had decreased at the Faculty in question since the degree had become widely available in other Spanish universities. Access grades for the course were therefore lowered which meant students with average academic records were accepted into the course. There were no statistical differences between modalities in the first year for the Performance Rate, although it may be concluded that ICTs helped overcome some of the deficiencies resulting from a lack contact class time in the traditional sense. They enabled better use of time and adequate contact with the teacher and the other students. The positive contribution of ICTs was reinforced with a small number of contact time sessions, approximately two per month. For the 2002-03 academic year, non web supported students achieved higher values in Performance Rate than web supported students, and the differences were statistically significant. This finding supports the opinion of the traditional model being the ideal teaching model for the transmission of knowledge, where there is a direct relationship between teacher and student.

In view of these results, it can be concluded that ICTs may be useful to help overcome some of the disadvantages experienced by this new student segment, such as the physical distance of the teacher, the lack of daily classes and direct contact with other students, etc. ICTs can play an important role if universities wish to offer a quality service to this new student segment which demands a different type of teaching. It must also be noted that when a new degree is introduced which has been in high demand by society, it is to be expected that entrants may be those with the highest academic records, given that grades tend to be the commonly used access criteria. These students tend to be highly motivated, which generally translates into higher than usual Performance Rates, once studies have been consolidated. These results are especially interesting for those universities which in the future may be considering the introduction of the web supported teaching modality for any of their degrees.

This study has measured the effectiveness of ICTs on student learning based on two results indicators, Performance Rate and Success Rate. Other studies however, contend that ICTs have a positive effect on learning, but their cost effectiveness is not yet clear^{xi}. This could be an interesting question for future research.

Financial Support: The authors would like to express their thanks for the financial support received under the Research Project, Teaching Innovation number 267-92 entitled "Calidad y TIC en la enseñanza semipresencial: Ciencias del Trabajo" University of Zaragoza.

BIODATA and CONTACT ADDRESSES of AUTHORS



Dr. Luisa ESTEBAN-SALVADOR is Associate Professor at the Department of Accounting and Finance, University of Zaragoza, Spain. Currently she is the Dean of the Social Sciences and Humanities Faculty from the same University. She received her Ph.D in the area of gender and corporate governance studies. Her Research interests are the use of ICTs in education and gender analysis in which she researches and writes. During her academic life she has attended many seminars, symposia, and conferences in home and abroad, and visited many countries of the world on such occasions. He has publications in recognized and reputed journals.

Luisa ESTEBAN-SALVADOR
Department of Business Administration
University of Zaragoza, C/ Ciudad Escolar, s/n
44003 TERUEL, SPAIN
Phone: 00 34 978 61 81 01
Fax 00 34 978 61 81 03
Email: luisaes@unizar.es



Ana GARGALLO-CASTEL has been granted a scholarship at the Spain Department of Science and Technology and she is teacher assistant at the Department of Business Administration, University of Zaragoza (Spain). Her research interests include Information Technologies, Organizational Design and Human Resources Management. She has presented several papers at national and international conferences. She has published several articles in national and international journals, *Quality Management Journal*, *Issues in Information Systems*, *International Journal of Information Technology and Management*, *Journal of Information Technology Impact*, etc.

Ana GARGALLO-CASTEL
Department of Business Administration
University of Zaragoza, C/ Ciudad Escolar, s/n
44003 TERUEL, SPAIN
Phone: 00 34 978 61 81 01, Fax 00 34 978 61 81 03
Email: gargallo@unizar.es



Dr. Mercedes MARZO-NAVARRO is Assistant Professor, in the Department of Economics and Business Management at the Faculty of Economics and Business Sciences, University of Zaragoza. She has written numerous articles on relationship marketing, quality in higher education and services marketing. She has publications in the *Journal of Fashion Marketing & Management*, *International Journal of Educational Management*, *International Journal of Contemporary Hospitality Management*, *Journal of Travel & Tourism Marketing* and *Journal of Relationship Marketing* among others.

Dr. Mercedes MARZO-NAVARRO
Department of Business Administration
University of Zaragoza, C/ Ciudad Escolar, s/n
44003 TERUEL, SPAIN
Phone: 00 34 978 61 81 01, Fax 00 34 978 61 81 03
Email: mmarzo@unizar.es

REFERENCES

Adell Segura, J. (1996). La navegación hipertextual en el World Wide Web: implicaciones para el diseño de materiales educativos. Several authors. Proceedings of Edutec 95: Redes de comunicación, redes de aprendizaje. University of Las Islas Baleares, Palma (Spain).

Adell Segura, J. (1994). World Wide Web: Un sistema hipermedia distribuido para la docencia universitaria. Proceedings of the I Congreso sobre Nuevas Tecnologías de la Educación, Badajoz, diciembre de 1993 (published in Blázquez, F; Cabero, J. y Loscertales, F. (Coord.), *Nuevas tecnologías de la información y la comunicación para la educación*, Ediciones Alfar. Sevilla, 114-121).

Álvarez, M. & Rodríguez, S. (1997) La calidad total en la universidad: ¿Podemos hablar de clientes?. *Boletín de Estudios Económicos*, LII (161), 333-352.

Area, M. (2001) La oferta de educación superior a través de Internet. Análisis de los campus virtuales de las universidades españolas. Dirección General de Universidades, Ministerio de Educación, Cultura y Deportes, available at <http://www.edulab.ull.es/html/proyectos/campusvirtuales>

Arif, A. A. (2002). Comparing Students Perception of Web-Based-Education. *Proceedings of ICTE2002, International Conference on ICT's in Education*. November, 13-16, Badajoz, 315-319.

Bartolomé, A. (1995). Medios y recursos interactivos. Rodríguez Domínguez, J. L. and Saénz Barrio (Ed.), *Tecnología educativa. Nuevas tecnologías aplicadas a la educación* (291-299). Alcoy: Marfil.

Bernad, J. A. (1990). *Estrategias de enseñanza-aprendizaje en la Universidad*. Instituto de Ciencias de la Educación, Educación Abierta, 89. Universidad de Zaragoza.

Bresnahan, T., Brynjolfsson, E. & Hitt, L. (2001). Information technology, work organisational and the demand for skilled labor: firm-level evidence. *Quarterly Journal of Economics*, 117 (1), February, 2002, 339-376.

Bricall, J. M., Baró, E., Hermoso, J., Lapiedra, R., Michavilla, F., Oroval, E., Quintanilla, M. A., Rivero, T., Roig, J., San Segundo, M. J., Solá, F. & Tejerina, F. (2000). Informe Universidad 2000, Conferencia de Rectores de las Universidades Españolas (CRUE), retrieved on 12th January 2009, available at <http://www.crue.upm.es>

Brynjolfsson, E. & Yang, S. (1996). Information technology and productivity: A review of the literature. *Advances in computers*. Academic Press, 43, 179-214.

Cardona, G. (2002) Tendencias educativas para el siglo XXI. Educación virtual, online y @learning Elementos para la discusión. *Revista Electrónica de Tecnología Educativa*, (Edutec), (15), May.

Castells, M. (1998). Retos educativos en la era de la información. *Cuadernos de Pedagogía*, 271, 81-85.

Coccarri, R. & Javalgi, R. (1995). Analysis of students' needs in selecting a collage or university in a changing environment. *Journal of Marketing for Higher Education*, 6 (2), 27-39.

COUNCIL OF UNIVERSITIES (2002). Catálogo de indicadores del sistema universitario público español, retrieved on 5th april 2009, available at <http://www.mec.es/consejou/indicadores/index.html>, 10 of September.

Cornélis, f., Cochinaux, P., Garady, D., Ferrant, C. & Webb M. (1997). Investing in knowledge: the integration of technology in European education, European Round Table of Industrialists, Brussels.

El-Khawas, E., DePietro-Jurand, R. & Holm-Nielsen, L. (1998). *El control de calidad en la educación superior: avances recientes y dificultades por superar*. Informe del Banco Mundial.

Esteban, L.; Gargallo, A.; Marín, A. y Marzo, M. (2003). *Percepciones sobre las utilidades de las nuevas tecnologías en la educación*. Journal of Digital Contents, Vol.1 Issue 1, Special issue on: INFORMATION SOCIETY AND EDUCATION, 2003.

Fram, E. & Camp, R. (1995). Finding and implementing best practices in higher education. *Quality Progress*, February, 69-73.

García-Montalvo, J. (2001). Características socio-demográficas de los jóvenes graduados de enseñanza superior. *Capital Humano*, noviembre, (14), 1-8.

Gonzalo, J., Pina, V. & Torres, L. (1997). Aplicaciones del análisis envolvente de datos a la medición de la eficiencia de las entidades públicas: Utilidad para la gestión. *Actualidad Financiera*, MONOGRÁFICO, II (2), 91-103.

Izkovitz, F. & Mogensen, V. (1999). Tecnologías de la información y de las comunicaciones en Europa. Problemas y desafíos. *Papeles de Economía Española*, (81), 21-33.

Lipsky, D. B. (2000). La experiencia en los Estados Unidos. *Proceedings of Jornadas Mundiales sobre Enseñando y aprendiendo relaciones laborales en la sociedad digital*. Las Palmas de Gran Canaria, February.

Lope Peña, A. (1996). *Innovación tecnológica y cualificación. La polarización de las cualificaciones en la empresa*. Colección Estudios. Consejo Económico y Social.

Meunier, B. (1993). *La gerencia de las organizaciones no comerciales*. Ministerio de las Administraciones Públicas, Madrid.

Miguel, J. M. de; Caïs, J. & Vaquero, E. (2001). *Excelencia. Calidad de las Universidades Españolas*. Centro de Investigaciones Sicológicas, Madrid.

Mora, J. G. (2003). La inserción laboral de los titulados universitarios como criterio de evaluación de las titulaciones. *Proceedings of Seminario Métodos de análisis de la inserción laboral de los universitarios*. León, June, 9-11.

Navarro, A. & Flores, M. R. (1997). Los indicadores de gestión de las administraciones públicas: técnica de cuantificación en el análisis regional. *Proceedings of I Congreso de Ciencia Regional de Andalucía: Andalucía en el Umbral del siglo XXI*. April, 23-25.

Norverto, M.C., Campos, M., Muñoz, C. I. & Zornoza, J. (1999). Los indicadores para la gestión pública. *Serie Investigaciones*, Instituto de Estudios Fiscales, Madrid.

Organisation for Economic Co-operation and Development –OECD- (2001) Políticas, estrategias y experiencias en el ámbito de la enseñanza Universitaria y de Adultos. *Proceedings of I Seminario Internacional de la Lengua Española*, September, 24, Santander.

Osterman, P. (1986). The impact of computers on the employment of clerks and managers. *Industrial and Labor Relations Review*, 39, 175-186.

Patterson, D. & Yee, D. (2002). Lessons Learned: Collaborative Creation of a WebCT Prototype for Undergraduate Special Education Courses. *Proceedings of ICTE2002, International Conference on ICT's in Education*. November, 13-16, Badajoz, 1418-1421.

Peña, D. (1997). La mejora de la calidad en la educación. *Boletín de Estudios Económicos*. Agosto, LII (161), 207-226.

Priscan, S. & Tingle, J. (2002). Experience with CARNet's "Training the Trainers" on-line pre-course. *Proceedings of ICTE2002, International Conference on ICT's in Education*, November, 13-16, Badajoz, 619-628.

Romero Cadaval, E., Carmona Fernández, D., González Romera, E. & Alvarez

Moreno, J.A. (2002). Elmer: The concretion of Project About Virtual University Education. *Proceedings of ICTE2002, International Conference on ICT's in Education*, November, 13-16, Badajoz, 582-585.

Sangrá, A. (2002). Educación a distancia, educación presencial y usos de la tecnología: una tríada para el progreso educativo. *Revista Electrónica de Tecnología Educativa (Eduotec)*, (15), May.

Souza, N.R., Vargas, V.L., Munarski, J., Andrade, A. F. & Figueiό, R.M. (2002). E-Learning in a organization chemistry course using integrated collaborative tools. *Proceedings of ICTE2002, International Conference on ICT's in Education*, November, 13-16 Badajoz, 1592-1596.

Szarowski, R. & Mannová, B. (2002). A Distance Learning Using the Teaching Web Toolkit. *Proceedings of ICTE2002, International Conference on ICT's in Education*, November, 13-16, Badajoz, 23-26.

Tavernier, T. (1991). Strategic evaluation in university management. *Higher Education Management*, 3(3), 257-268.

Yagüe, M. J. (1997). *Proyecto docente e Investigador*. Universidad Autónoma de Madrid.

Footnotes

- ¹ They are generally students whose main activity is other than being a student; they have employment or family occupation and are improving their training with a degree, a diploma, a masters or doctorate courses. In the case of the Labour Sciences Degree, it is an advanced degree.
- ² According to the statistics from the Ministry of Education, Culture and Sports, Spanish Universities have experienced a decrease of 30.054 students in the 2003-2004 academic

years with respect to the previous year. In the University of Zaragoza, enrolments in the campuses of Zaragoza and Huesca have gone down while there's been an increase of students by 2% in the campus of Teruel. Numbers for the University of Zaragoza as a whole are negative however, with a 5% decrease for 2003-2004.

³ According to the Ministry of Education, Culture and Sport, the number of students enrolled in primary education increased from 2.508.137 in 2002-2003 to 2.515.422 in 2003-2004, and preschool went up from 1.277.407 children in 2002-2003 to 1.336.562 children in 2003-2004. This is an increase of 7,285 students in primary education and 62,155 in preschool with respect to the previous year. This increase was mainly due to the increase of immigrant population. Polytechnic training saw an increase of 4.678 students, while in compulsory secondary education and higher secondary education the decrease was of 19.740 and 537 respectively.

⁴ Paper titled 'The American experience', given by David B. Lipsky, Professor in labour Relations at Cornell University, New York, USA, for the World Symposium on "Teaching and Learning Labour Relations in a Digital Society" (Objectives for the new Labour Sciences Degree) held in Las Palmas on 23, 24 and 25 February 2000.

⁵ See following address for links to American on line universities, retrieved on 15th July 2009 <http://www.geteducated.com/dlsites.htm>

⁶ According to Area et al. (2001) a 'virtual campus' may be defined in a wide sense as a presence in the Internet of a university through an institutional website. In a more restricted sense, a virtual campus may be understood as the creation of an online and distance training system alternative to presential teaching. These authors however, use an in between definition and conceive a virtual campus as a space in the WWW created by a university with the purpose of developing training activities either to support conventional teaching or to offer virtual courses.

⁷ <http://www.uni-g9.net> retrieved on 15th July 2009

⁸ <http://www.catcampus.org> retrieved on 15th July 2009

⁹ <http://moodle.upm.es/adamadrid/> retrieved on 15th July 2009

¹⁰ However, due to the new data protection policy we have not been able to replicate the study as it would have been desirable.

¹¹ National Science Foundation, Science and Engineering Indicator, 2000, vol. 1, 1-2.