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Las Tecnologías de la Información y de la Comunicación (TIC) y los nuevos contextos de aprendizaje

ESTUDIOS SOBRE EDUCACIÓN

JUNIO

ESE

REVISTA SEMESTRAL DEL
DEPARTAMENTO DE EDUCACIÓN
FACULTAD DE FILOSOFÍA Y LETRAS

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RECENSIONES / *BOOK REVIEWS*

Youth-culture or student-culture? The internet use intensity divide among university students and the consequences for academic performance[1]

¿Cultura juvenil o cultura estudiantil? La intensidad de uso de Internet entre los estudiantes universitarios y sus consecuencias para el rendimiento académico

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Abstract: The effects of Internet use on the academic performance of university students is usually analyzed from a deterministic perspective that gives this technology an immanently positive or negative role. In this paper we consider the problem from an alternative point of view. We analyze the actual Internet uses the students engage in and the differences in these according to the students' characteristics. We aim to explain when spending more time on the Internet has a positive and a negative effect on academic performance and explain why usually a high usage time of internet is correlated with a lower academic achievement.

Keywords: academic performance, higher education, internet, digital divide.

Resumen: El efecto del uso de Internet en el rendimiento académico de los estudiantes universitarios generalmente ha sido analizado desde una perspectiva determinista que da de forma inmanente a esta tecnología un papel positivo o negativo. En este artículo consideramos el problema de un punto de vista alternativo. Analizamos los usos actuales de Internet que hacen los estudiantes universitarios y las diferencias en estos según sus características. El objetivo es estudiar cuando gastar más tiempo en Internet tiene un efecto positivo y cuando negativo en el rendimiento académico y explicar porque normalmente un uso elevado de Internet está correlacionado con un menor rendimiento académico.

Palabras clave: rendimiento académico, educación superior, Internet, brecha digital.

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Introducción

In order to prepare future generations for the new conditions of the network society (Castells, 1996), educational institutions strive to incorporate the demands of society and the marketplace into their practices and curriculum. Given the central role that ICTs (and the Internet, in particular) play in this regard, universities all over the world struggle to foster the "right uses" and exploitation of the Internet for personal development, vocational training, and learning in general, while limiting the negative effects of the Internet practices of digital natives (Palfrey and Gasser, 2008; Prensky, 2004) in academic work.

This raises the question of why the Internet, with its great capacity for education, is considered an evil when discussion focuses on the reasons for academic failure. Whilst steering clear of dystopian as well as utopian visions of the Internet (Katz and Rice, 2005) and their consequences for education, this paper shows how the amount of time spent using the Internet is, in itself, neither good nor bad when it comes to the results and performance of university students, but that what is important is the purpose to which that use is channelled. In this sense, it will be shown how the socio-cultural characteristics of young people in general prevail over the characteristics of a university student when it comes to deciding how to use the Internet. We argue that for this reason it is said that people claim that time on the Internet has negative consequences on academic performance.

In reaching these conclusions, this paper reports on the state of Internet use in Catalan universities during the 2004/2005 semester. In particular, the study looks at those activities that take up most of the time spent online and what the determining factors are when it comes to spending more time on the Internet and what influence Internet use has on the academic performance of university students. Thus, this paper examines the following three research questions:

- What are the types of Internet use that contribute most to the temporal intensity of Internet use?
- Are there certain student characteristics (personal, socioeconomic status, technical facilities, technical skills and academic context) that increase the likelihood of students showing high temporal intensity use?
- Taking into account why students use the Internet and looking at other characteristics, what influence does the temporal intensity of Internet use have on academic performance?

The answer to these questions will enable us to add to the body of knowledge about the digital divide (Di Maggio, Hargittai, Celeste and Schafer, 2004; Harggittai,

2008; Van Dijck, 2006) amongst university students (Tien and Fu, 2008), a very current issue given the growing introduction of e-learning and blended learning in all campus-based universities[2], which require in-depth knowledge of their students to implement the most suitable and effective teaching methodologies.

Theoretical Background

Study of the determinants and consequences of the digital divide

This paper expands the body of knowledge regarding the digital divide[3]. The term describes a dichotomy between those who have access to the Internet and those who do not. Over the years many authors (e.g. Di Maggio and Hargittai, 2001; Hargittai, 2002; Kling, 1998, Norris, 2001; Van Dijk, 2006) have contributed more nuanced analyzes that go beyond who has and who does not have Internet access. For example, Van Dijk (2006) differentiates four different dimensions: motivational, physical, skills, and usage. Di Maggio *et al.* (2004) define five levels (access, inequality in autonomy of use, ICT ability or skills, variation in social support, and difference in usage patterns).

As with other studies on the digital divide, the relationship between people and the Internet does not take place in a way that is separate from society. Therefore, studies covering the dimension referred to above need to take into account characteristics such as socioeconomic status (education, employment, income, etc.), and the family, institutional and social environment in which users live their lives (and, therefore, access technologies), as well as personal characteristics such as age, gender, ethnic group and health, factors that, without doubt, can determine the type of use a person makes of the Internet (Hargittai, 2008).

However, going a step further, it must be argued that studies covering the dimensions of the digital divide or digital inequality are only worthwhile if the differences identified have some kind of social consequence for the people involved. A number of authors have shown how Internet use has the potential to contribute to social inequality (Harggittai, 2008; Warschauer, 2004). Therefore, it is important to know what use is made of the Internet the consequences this may have.

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[2] In Europe, on account, in particular, of the creation of the European Higher Education Area and the changes it is bringing about in the teaching-learning process that are based more on autonomous learning.

[3] The term digital divide was first officially used in a report issued by the National Telecommunications & Information Administration (NTIA, 1995)

Among young people, inequality in terms of Internet access is minimal in that, as is common in developed countries (see, for example, Fox, 2004, in the US or Instituto Nacional de Estadística [INE], 2007, in Spain), the vast majority have their own computer[4]. Furthermore, the collective (university students) studied in this paper has access to technological facilities from their educational establishment[5]. There are few differences as regards IT skills among university students: only 7.4% of the Catalan students surveyed said they had beginner's or basic ICT knowledge, while 51.6% described their level as high or expert (Duart, Gil, Pujol and Castaño, 2008).

It is important to point out that university students are at an advantage when it comes to Internet use due to their high level of education and youth. This advantage has been described in several studies such as Katz and Rice (2005) who found more intense usage amongst university students, or Prensky (2004) and Pedró (2006) who found university students to be more innovative than average.

However, in terms of the time spent using the Internet, there is no such equality (see Table 4). Furthermore, time spent on the Internet is clearly related to the specific activities done online (Howard, Rainie and Jones, 2002). These activities are not randomly distributed (Harggitai, 2008) nor, therefore, is the time spent surfing the Internet.

Following the theoretical framework presented in this paper, the decision was made to research the relationship between time spent online by Catalan university students and the type of activity carried out on the Internet, and also to look at the determining factors to temporal intensity in order to explain the reasons behind the influence of time spent using the Internet on a specific social outcome or consequence: academic performance.

The Internet and academic performance

In terms of the output studied, taking into consideration the studies that examine the influence of different Internet uses on academic performance, we can see how there are certain uses that the studies present as mainly negative[6] and that it is these that have been of most interest to researchers. These uses include leisure, in par-

[4] Duart *et al.* (2008) also show that 91% of the students and 96% of the lecturers in Catalan universities own a personal computer with an Internet connection.

[5] In 2000 there were 24 students for one computer; by 2003 this ratio had been halved to 12 students per computer (OCDE, 2005).

[6] Although study conclusions differ, depending on how use and performance are measured, some studies show no influence of the end use of the Internet on the academic performance of university students.

ticular those that focus on online games (Gentile, Lynchb, RuhLinderc and Walsh, 2004; Hauge and Gentile, 2003) and synchronous communication (Kubey, Lavin and Barrows, 2001). However, some authors have raised if the relationship with low academic performance is an effect of internet usage per se or rather a bad use of the Internet. These authors reject a more deterministic approach to the technology (Kubey *et al.*, 2001) based on their assessment that the addiction arises from psychological characteristics (such a loneliness, social isolation) of individuals who subsequently make excessive use of the Internet.

Nevertheless some authors also put forth a different scenario. For example Brown and Thomas (2006 and 2008) argue that online gamers develop collaboration and other knowledge worker skills that are mainly absent from today's standard educational canon because they are very difficult to teach in traditional educational institutions. This approach certainly concurs with studies of Internet use determinants. Despite the fact that we did not have access to psychological variables in preparing this paper, we will endeavour to discover whether there are socio-cultural variables that condition use and, therefore, the time spent online by university students.

With regard to academic usage, a positive relationship was observed in terms of Internet usage that is integrated into the teaching-learning system and communicative usage aimed at building social relationships among students and between students and lecturers (Castaño-Muñoz and Duart, 2008), thus approaching a more autonomous learning dynamic similar to e-learning 2.0 (Downes, 2005). In Catalonia, however, it has been demonstrated that attempts to study following an Internet-based study approach can also result in lower academic performance if the academic institution does not support such a teaching methodology (Duart *et al.*, 2008), with students seen to be in the middle of a contradiction between their learning styles and those of the educational establishment and teaching staff (Pedrò, 2006; Prensky, 2001).

Methodology

Data sources

Fuelled by the developments in transportation and in Information and Communication Technologies (ICT), the global society is transforming into what Castells (1996) called the "network society". A first large-scale investigation (*Project Internet Catalonia – PIC*: http://www.uoc.edu/in3/pic/eng/) into the transformation of

Catalan society towards the network society was conducted between 2003-2005 (Castells, Tubella, Sancho and Roca, 2007). The PIC study was set up as a holistic endeavour to gather and analyze data in order to understand and better steer the process of integrating Catalonia into the global network society. It spans all realms of society, from hospitals and the health care system to business practices, government and the education system. This paper is based on an analysis of the data from the second round of the PIC initiative, and particularly the research on the higher education system led by Duart *et al.* (2008), which took place in 2006 and 2007. The PIC university study investigated the exploitation of the Internet in the eight Catalan public universities: University of Barcelona (UB), Autonomous University of Barcelona (UAB), Catalan Technical University (UPC), Pompeu Fabra University (UPF), University of Gerona (UdG), Open University of Catalonia (UOC)[7], University Rovira and Virgili (URV), University of Lleida (UdL)[8].

The data for the analysis was obtained through an online questionnaire, which all students in Catalan public universities were invited (via email) to fill out. This kind of survey forms part of a category of online surveys that can be considered to be scientifically valid and that, given their randomised nature and the extensive penetration of the Internet amongst the target population, can be used for statistical inference. Following the typology of online surveys proposed by Couper (2000), ours was a probability-based survey (a kind of survey that can be used for statistical inference and that, therefore, can be extrapolated to the population). More specifically, the survey fits within a category known as "list-based samples of high coverage populations", of which the author states the usefulness as an information collection method in populations such as students, where Internet coverage is very high, and in educational research. There is an increasing preference for this kind of survey covering university students given the fact that they form a group for which there is a list of email addresses and where, as has been said, there are no problems of non-coverage.

The results reported here only consider a specific subset of the questionnaire, which produced a rich dataset with more then 120 variables profiling the university students. In this context, it is also important to mention that the dataset used for the analysis was derived from the PIC questionnaire and from statistical data about the same students available from the Catalan government (www10.gencat.net/dursi/AppJava/home.jsp?idioma=2). The merging of the datasets was also made possible by the email-based approach to data collection, which allowed us to use the

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7 Because UOC offers only Internet based courses it has been omitted from the analysis in this paper.

8 See Duart *et al.* (2008) for a more in-depth description of the Spanish and Catalan university system.

students' email addresses to join the two data sets.

The survey achieved a 15% response rate among the students, a figure that allowed a sufficiently high number so as to provide an overlap among the population studied and the sample in terms of percentages in the main sociodemographic characteristics and university of origin.

Analysis overview: stages, delimitation of the sample and analysis techniques

As noted, the survey was sent to all students. This provided responses from students from all courses. Merging these with the databases mentioned above gave us valid data for a total of 14,936 students to analyze.

This group of nearly 15,000 students formed the basis of the first stage of the analysis, which looked at what kind of engagement with the Internet was likely to lead to intensive usage patterns. This question was answered by means of OLS regression analysis of the different uses measured over temporal intensity of Internet use.

However, because the aim of this paper is to explore the relationship between Internet usage and academic performance, the sample used for the subsequent analysis was restricted to students in their first two years of higher education. This subgroup was selected because the indicator for academic performance is constructed by seeing how many of the courses that a student enrolled in were passed. This indicator naturally results in a highly skewed distribution as most students pass their courses (see Table 1). By selecting only students in their first and second years, the distribution improved significantly because university tend to weed out non-competitive students[9] in the first two years, so pass rates are somewhat lower. As can be observed in Table 1, the distribution of academic performance becomes much more skewed towards better performance beginning with the third year. This reduced sample of first –and second–year students resulted in 6,906 valid observations.

[9] Non-competitive students are understood to be those who, for various reasons, have greater difficulties in succeeding in the higher education system. Hence, the term is not limited to intellectual and academic capacity, but includes constraints based on students' social and economic circumstances. Therefore, it is important to note that the established educational system has evolved to accommodate specific social groups (Conwell, 1997) and the reproduction of their cultural capital (Bourdieu, 1988; Bourdieu and Passeron, 1990).

Table 1. Student Course Passing Rates (in %), by Year of Study, 2004-2005

		Low[1]	Medium[2]	High[3]	
First Year	Student Count				3605
		22.3	23.4	54.3	
	% of total				24.3
Second Year	Student Count				3301
		20	26.8	53.2	
	% of total				22.2
Thrid Year	Student Count				3511
		17.5	23.4	59	
	% of total				23.6
Forth Year	Student Count				2511
		13.2	22.9	64	
	% of total				17,0
Fifth Year	Student Count				1401
		13.3	19.6	67.2	
	% of total				9.5
Sixth Year	Student Count				522
		14.0	16.3	69.7	
	% of total				3.5
	Student Count	2705	3498	8733	14851
	% of total	18	23.4	58.6	100.0

Notes:
1 Low indicates that the coefficient of enrolled courses by passed courses is less than 0.5
2 Medium is between 0.5 and 0.8
3 High is 0.8 or higher.

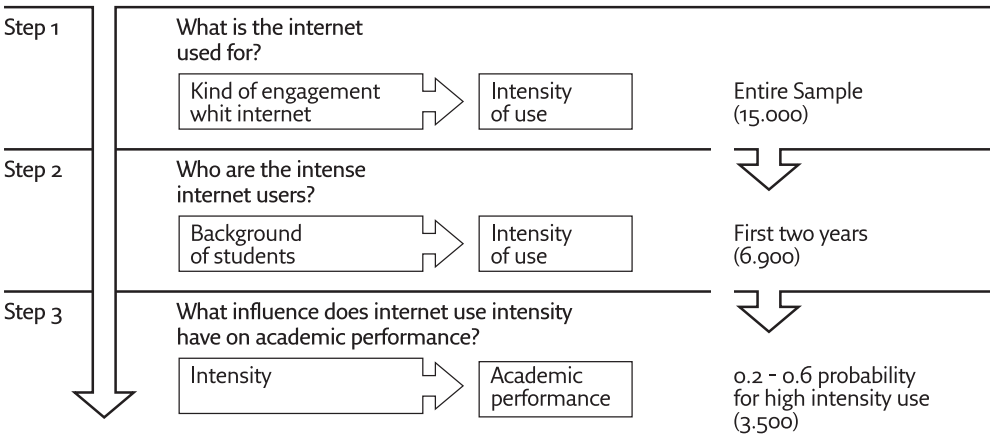
In the second stage of our research we looked at who the intensive users were. In order to do this, as mentioned above, we narrowed the sample down to the students in their first two years because we were concentrating on an analysis of academic performance. Binary logistic regression was used to analyze the data and find out which variables have a significant influence on the probability that a student has a high temporal intensity in terms of Internet use.

This second step allowed us to select our sample of 3,519 students who shared the same probability of being intensive Internet users to pursue our core research question in stage three. Despite working with observational data, the central objective of this paper is to study, in an isolated manner, the effect of temporal intensity of Internet use in academic performance –i.e. we were faced with the methodological problem of estimating causal effects using observational data. From among the possible solutions put forward by various authors (Schneider, Carnoy, Kilpatrick, Schmidt and Shavelson, 2007) the decision was taken to carry out a score matching (PSM) analysis (Rosenbaum and Rubin, 1983; Schneider *et al.*, 2007). In the specific case of this analysis, the PSM allowed us to identify those students with similar characteristics but with different intensities in terms of Internet usage (treatment), in a way that made it possible to isolate the effects that Internet usage intensity has on academic performance from the influence of the other variables, including variables observed in the questionnaire and those that were not observed.

PSM tends to compare students with a similar probability of being intensive Internet users, some of whom are, in fact, intensive users and others who are not. We decided ultimately to perform our analysis on students who have a similar average propensity for Internet usage. Thus, we eliminated the groups most likely to show extreme behaviour regarding Internet usage. Specifically, the sample for the calculations using an OLS regression to investigate the influence of Internet use intensity on academic performance consists of the 3519 students who have a propensity score of 0.2 to 0.6 with regard to high Internet usage intensity (see following section for an overview of the process).

Figure 1 gives an overview of the different steps we performed in order to investigate the research questions.

Figure 1. Research Process Overview



Descriptives and construction of the variables

Tables 2 and 3 show the distributions for the independent variables used in our analysis. One set of variables describes the social background and academic environment of the students (Table 2). The second describes self-reported Internet access and Internet skills (Table 3).

Our sample of first –and second– year students was drawn from a larger sample of students who answered an Internet-based questionnaire, hence all of the students in our sample were, therefore, inherently a self-selecting group capable of using the Internet to answer a questionnaire.

Table 2 shows the descriptive data for the first and second year of our sample. Whenever possible, census data on the total Catalan university students (taking into account all the courses) has been added in the last column. This last column is the only available indicator of the adjustment of the sample to the universe, but as for all courses it should serve only as an indication and does not allow an accurate analysis of the two first courses' sample adjustment. When analyzing the data we see how self-selection has biased the sample (even though not excessively) to underrepresent men versus women, as well as students of the more technical University of the system (UPC) and students in engineering and science social. By contrast, women, students from the largest university of the system (UB) and students of humanities, natural sciences and biomedicine are slightly overrepresented in our sample when compared to the real distribution.

Table 2. Distribution for Personal and Academic Background and Average Age of First and Second Year Students (N=6906), Catalán Universities, 2004-2005

Variable	Mean	%	Census (All courses)
Gender			
Male		34%	46%
Female		66%	54%
Age	21.4		
Father's education			
Primary		40%	
Secondary		21%	
Higher		23%	
Other		16%	
Mother's education			
Primary		40%	
Secondary		21%	
Higher		23%	
Other		16%	
Father's Occupation			
Manager or similar		19%	
Skilled worker		69%	
Unskilled worker		3%	
Other		9%	

Variable	%	Census (All courses)
Mother's Occupation		
Manager or similar	14%	
Skilled worker	66%	
Unskilled worker	9%	
Other	11%	
University Attended		
UAB	22%	22%
UB	43%	34%
UDG	8%	7%
UDL	5%	5%
UPC	10%	19%
UPF	6%	6%
URV	7%	8%
University Department		
Biomedicine	11%	7%
Exact and natural sciences	12%	7%
Social sciences	38%	47%
Engineering	19%	27%
Humanities	19%	12%

Table 3. Distribution for Computer Access and Skills of First and Second Year Students (N=6906), Catalán Universities, 2004-2005

Variable	%
Internet access	
Computer with a basic telephone line connection	9%
Computer with ADSL connection	66%
Computer with cabel connection	8%
Laptop with a basic telefon line connection	3%
Laptop with an ADSL connection	20%
Laptop with cabel connection	5%
Laptop with wireless connection	24%
Computer or laptop without Internet connection	2%
No own a computer	

Variable	%
Computer knowledge	
Beginner	0%
Basic	11%
Normal	46%
Advanced	37%
Expert	5%
Internet knowledge	
Beginner	1%
Basic	10%
Normal	41%
Advanced	42%
Expert	7%

Regarding table 3, it is important to note that all our Internet usage data is self-reported unless otherwise stated. In addition, given the self-selection bias, it is not surprising that a very high percentage of the sample reported very good access to the Internet and that these students also reported comparatively high confidence in their abilities. About 42% felt they had expert or very good knowledge, 46% good knowledge, and only 12% reported having basic or beginner-level skills. The same overall positive picture is observed when looking at how students feel about their Internet knowledge. The majority of students reported expert, very good and good knowledge (7%, 42% and 41% respectively) and only a minority reported low-level skills (11%).

This study is particularly interested in the intensity of Internet usage and in academic performance as dependent variables. It is important to note in the context that both Internet intensity as well as academic performance of these students were measured by a composite indicator.

As explained in the preceding point, academic performance is an indicator built by calculating how many of the courses a student enrolled in were passed (see Table 1 for a distribution of this variable).

However, Internet use intensity is based on a combination of the students' reported average connection time per session and how often per week they connect to the Internet. Before looking at Internet usage intensity (see below), we need to explain the components and construction of the variable: two variables, duration of average Internet session (DAIS) and online session times per week (OSTW), were combined to build a new variable for overall usage intensity, thus avoiding multicollinearity. We assigned a value from 0.5 to 7 to each scale of the DAIS variable ("0-1 hour" to "5 or more hours") and multiplied the respondent's OSTW value ("once per week or less" = 0.5, "two, three or four days per week"=3, and "five or more times per week"=6). The distribution of the resulting variable can be seen in Table 4. To make the analysis of the intensive Internet use determinants (point 5.2) it has been decided to transform the resulting continuous variable in a categorical one. Hence, three categories were generated according to the percentage of individuals who are part of each one, aiming to make 3 categories with similar numbers of students. In this way, the low intensity category consist in the 33.5% individuals with less intensity, average intensity has 30.2%, and high intensity contains the 36.4% individuals exhibiting the most intensive use.

Table 4. Intensity of Internet Usage Among First and Second Year Catalan University Students, 2004-2005

Intensity Scale		Number	Percentage	Accumulated Percentage
	.25	58	.8	.8
	.75	68	1.0	1.8
	1.25	13	.2	2.0
	1.50	409	5.9	7.9
	1.75	2	.0	8.0
	2.25	1	.0	8.0
	3.00	708	10.3	18.2
	3.50	1	.0	18.2
	4.50	775	11.2	29.5
	7.50	277	4.0	33.5
Total Low Intensity (0.25—7.5)		2312	33.5	33.5
	9.00	2083	30.2	63.6
Total Medium Intensity (7.5—9.0)		2083	30.2	
	10.50	53	.8	64.4
	13.50	22	.3	64.7
	15.00	1229	17.8	82.5
	21.00	615	8.9	91.4
	27.00	257	3.7	95.1
	42.00	335	4.9	100.0
Total High Intensity (10.5—42.0)		2511	36.4	
Grand Total		6906	100.0	

Findings and Discussion

This section reports on the findings of the research. First, we estimate the influence of the different uses on usage intensity, then we show the influence of different aspects of personal and academic background as determinants of high temporal intensity and, lastly, we explore the influence of Internet use intensity on academic performance.

How do university students spend their online time?

Table 5 shows the distribution of uses from the total universe of Catalan university students.

Table 5. Distribution of Various Uses of the Internet, Catalan University Students, 2004-2005

General Internet use	(1) % Very much	(2) % Much	(3) % Normal	(4) % Little	(5) % Never	Mean
To use email	73,1	18,8	6,4	1,1	0,7	1,37
To search information	66,2	25,2	6,8	0,8	0,9	1,45
To use instant messaging systems	42,1	21	15,9	11,5	9,5	2,25
To work	30,7	23,8	19,8	9,4	16,4	2,57
To download music and/or movies	24,1	20,4	19,6	16,7	19,3	2,87
To access audio and video content	14,4	20,7	26,3	20,8	17,8	3,07
To download software	13,4	19,7	28,3	22,2	16,4	3,08
To follow periodicals	12,4	18,3	26,1	23,4	19,8	3,2
To search for work	11,1	16,2	23,3	22,9	26,5	3,37
To follow educational courses	13,4	12,5	17,5	21,2	35,4	3,53
To do administrative tasks	7,9	13,5	24,7	24,7	29,1	3,54
To relieve information (RSS-Feeds)	8,4	11,5	20,4	20,1	39,6	3,71
To chat	9,1	10	15,8	23	42,2	3,79
To visit weblogs	5,5	9,6	20	26,7	38,2	3,83
To upload information	4,4	8,2	16,8	27	43,7	3,97
To listen radio	3,9	8,5	15,7	24,5	47,4	4,03
To play	3,7	7,1	15,5	27,3	46,4	4,06
To buy	1,6	6,4	18	32,1	41,9	4,06
To access pages with adult content	1,3	2,6	9,1	18,2	68,8	4,51
To do phone calls	1,9	3,7	5,9	13,1	75,3	4,56
To get to know people or to flirt	0,9	2,3	7,6	19	70,2	4,55
To watch TV	0,9	2,2	5,8	14,6	76,6	4,64
To sell	0,7	1,4	3,7	10,4	83,9	4,75
Internet Use When Studying for a Course			% Yes			% No
To communicate with my professor			74%			26%
To communicate with my peers			53,6%			46,4%

Note: This table is based on the analysis of the whole PIC sample

Out of the above uses set out in this paper, seven have been selected. These seven have been shown to be good indicators of the main points of debate in the literature about the influence of the Internet on academic performance. Three types of leisure uses have been selected: firstly *games*, secondly *relationships* (chat, instant messaging and getting to know people and/or dating), and thirdly *accessing audiovisual content* either by downloading content or via direct Internet access. However, there was also a wish to introduce into the analysis *uses not related to leisure* such as working and *educational use* of the Internet (taking courses). Added to educational uses is information about two uses that fall between relationships and educational uses (communicating with lecturers and fellow students).

The objective of this selection of uses was to find out what type of uses out of those put forward accounted for most of the students' time on a daily basis and to help interpret, in the following point, the relationship between the intensity of Internet use and academic performance. In other words, in this particular point we wanted to identify the uses that are most time-intensive by estimating a regression for temporal intensity of use as a function of different uses (Table 6). Each use represents the student's response to a question about the reported frequency of Internet use for that activity on a scale of 1 to 5 (1 being very frequently). All the selected uses show a significant influence on Internet usage intensity. Gaming has the largest coefficient (0.974), showing that if a student reports using the Internet frequently for gaming, s/he increases Internet usage more than in other activities. This comes as no surprise, because modern online games are an activity that requires to dedicate a lot of time as many become part of social groups that meet regularly for sessions lasting several hours.

Other activities where reported frequent use contributes more strongly to usage intensity are instant messaging (0.940) and chatting and getting to know people (0.767). Thus, the three largest contributors to Internet intensity are primarily social activities. The next most influential use –accessing video and audio content– means using the Internet more as a replacement of old media, like television and radio, to consume entertainment. Using the Internet for work and for study appear, in many cases, to consume less time than as a source of social interaction or entertainment.

Educational uses were observed to take up little of students' online time, with the sole exception of communicating with friends, which is also a social use and may not necessarily be for educational purposes. Therefore, it appears that university students use the Internet for purposes unrelated to their status as students and as a result do not form part of a specific group of users, but rather follow the same dynamic as the group of young people as a whole in Catalonia (Castells *et al.*, 2007). To a large extent, this phenomenon is due to the low implementation and use by educational institutions of Internet tools in the teaching-learning process (Duart *et al.*, 2008).

Table 6. Estimated Intensity of Use as a Function of Various Uses1 of the Internet (OLS Regression), Catalan University Students, 2004-2005

Variable	Regression Coefficient	Standard Error of Coefficient
Internet Use		
To download music and/or movies	0.29**	0.09
To access audio and video content	0.63**	0.01
To chat	0.21*	0.09
To use instant messaging systems (e.g. Messenger, Yahoo, etc.)	0.94**	0.1
To play video games	0.97**	0.1
To get to know people or to flirt	0.77**	0.14
To work	0.59**	0.07
To follow educational courses	0.46**	0.09
Internet Use When Studying for a Course2		
To communicate with my professor	-0.03	0.23
To communicate with my peers	1.93**	0.22
Constant	2.11	0.37
Adjusted R2	0.13	

Notes:
1 The uses looked at here have been selected because they showed a significant correlation with academic performance
2 The following two variables were asked as yes/no questions rather than as frequency of use, so coefficients are not comparable with those above.
* statistically significant at a 5 percent level of significance;
** statistically significant at a 1 percent level of significance.

Which students are intensive users of the Internet?

To determine which students were more likely to be intensive users of the Internet, we estimated a Logit equation (highly intensive user = 1; low or medium intensive user = 0). Areas covered included personal characteristics, university attended, enrolled courses, reported computer and Internet skills, Internet uses, and other computer use-related questions. Table 7 reports the estimated regression coefficients rather than the odds ratios. This model has a quasi R^2 of 0.24. It therefore gives a good explanation of the influence of individual social and academic backgrounds, as well as the influence that computer and Internet use variables have with regard to predicting a student's usage intensity.

There are several interesting observations to be made regarding the results of this estimate. Firstly, in a rather traditionalist Catholic country like Spain, it is likely that the occupation of the father (but not the mother) and the education of the mother (but not the father) has an influence on Internet adoption. Even though Spanish society has undergone some fundamental transformations in the past generation, our data supports the notion that the majority of Catalan families still function in a mode where the father is responsible for earning the income and the mother devotes time to raising the children. In this sense, if the father has a good job and/or the mother has studied at a higher level, the student will spend less time on the Internet and more time in other activities. This fact is understood better if we consider that time spent by students using the Internet is mainly spent on leisure activities; it would, therefore, appear that students from families whose parents have a good job and more education level spend less time on this kind of leisure activity and more of their online time doing other things.

The equipment used by students also influences the usage time. As would be expected, those with equipment of a higher category than the base (computer + ADSL) spend more time using the Internet, while those who do not have their own computer or Internet connection spend less time on the Internet since they have inferior facilities, as well as less autonomy and flexibility in terms of time.

As regards the place where students connect to the Internet, the only point to highlight is the fact that students whose work requires them to use the Internet spend more time online, not necessarily for leisure purposes.

The skills in computer and Internet use seem to have a significant influence on usage intensity, corroborating the results obtained in the literature in this study (Harggitai, 2008). So we can see how those who have skills that are lower than the base in terms of usage naturally use the Internet less, since they have fewer skills that they can apply to different uses. Also, the use of open-source software seems to be a good indicator of the likelihood of a student being a high-intensity user. This is most likely due to the fact that the use of open-source programs requires a certain competence beyond simple usage, as the individual needs to be able to choose, install and run the software as well as have at least a basic understanding of the political, legal and business implications of using open-source software.

Controlling other variables, age is not significantly correlated with Internet usage (this is not surprising as the vast majority of students in years one and two are approximately the same age), but male students tend to show comparatively higher usage intensity (however, the coefficient is only significant at a 10 percent level of significance).

It is surprising to see the lower probability of higher Internet usage intensity for students in the exact sciences and the bio-sciences compared with social sci-

ences, an observation that contradicts one of the stereotypes that associates science with Internet use. Engineering students do not appear to be more intensive users when their other characteristics are taken into consideration. (In this respect, it should be noted that the majority (73%) of these students are men).

Judging from our data, the different arrangements of the universities for providing access to, and offering services on, the Internet do not seem to make a difference. Given that most students have Internet access at home, this result is not surprising.

As regards the university entrance mark, there is a significant influence on higher Internet use but it is so minimal that it cannot be considered relevant.

The final point to make is that, naturally, all usage significantly increases time spent online, with the exception of "taking courses on the Internet", where no significant relationship was observed. This is better understood if we note how, as shown in the previous point, that those who take these courses for social reasons (youth and their relationship with leisure uses) or institutional reasons (scarcity of online courses at campus-based universities) are in the minority.

Table 7. Logit Estimate of High Intensity Internet Use, Catalan University Students, 2004-2005[1]

Variable	Regression Coefficient	Standard Error of Regression Coefficient
Age	0.01	0.01
Female	-0.13	0.07
High Occupation Mother	0.05	0.11
Low Occupation Mother	-0.07	0.11
Other Occupation Mother	0.12	0.15
High Occupation Father	-0.23	0.09
Low Occupation Father	-0.12	0.18
Other Occupation Father	-0.12	0.19
Mother with Secondary Education	-0.13	0.09
Father with Secondary Education	0.14	0.08
Mother with University Degree	-0.36	0.11
Father with University Degree	0.05	0.10
Other Education Mother	0.05	0.15
Other Education Father	0.14	0.14

Variable	Regression Coefficient	Standard Error of Regression Coefficient
How do you assess your skills regarding the use of computers? (Reference: intermediate)		
Beginner	-10.25	10.13
Basic	-0.42	0.14
Advanced	0.16	0.08
Expert	0.28	0.19
How do you assess your skills regarding the use of the internet? (Reference: advanced)		
Beginner	-0.55	0.90
Basic	-0.43	0.16
Intermediate	-0.36	0.08
Expert	0.18	0.16
Do you use free software (GNU/Linuxo. Firefoxo. Apacheo. etc)? (Reference: Little)		
Very much	0.40	0.11
Much	0.35	0.11
Normal	0.26	0.11
Never	0.00	0.09
Disciplines (Reference: Social Sciences)		
Biomedicine	-0.36	0.11
Exact and Natural Sciences	-0.26	0.10
Engineering	0.11	0.12
Humanities	0.02	0.09
Others	-0.65	0.61
University (Reference: UB)		
UAB	-0.13	0.08
UDG	-0.09	0.12
UDL	-0.08	0.17
UPC	-0.14	0.14
UPF	0.07	0.13
URV	0.08	0.13

Variable	Regression Coefficient	Standard Error of Regression Coefficient
For what do you usually use the Internet		
To download music & films	0.03	0.03
To access audio video content	0.08	0.03
To chat	0.06	0.02
To communicate with the instant messenger	0.28	0.03
To play	0.20	0.03
To get to know people and to flirt	0.14	0.04
To work	0.09	0.02
To follow courses	0.00	0.03
University Access Grade	-0.00	0.04
Course Repetition Score	0.05	0.30
Do you own a computer with Internet connection? (Reference: computer with ADSL)		
Computer with a basic telephone line connection	-0.13	0.12
Computer with cable connection	0.23	0.11
Laptop with a basic telephone line connection	0.28	0.21
Laptop with an ADSL connection	0.23	0.08
Laptop with cable connection	-0.21	0.17
Laptop with wireless connection	0.12	0.07
I own a computer or laptop without Internet connection	-0.70	0.16
No. I don't own a computer	-10.43	0.49
From where do you usually connect to the internet? (Reference: Home)		
University	-0.08	0.07
Internet Cafes	0.12	0.21
Libraries	-0.08	0.08
Other public centers	0.04	0.25
Work place	0.37	0.10
Other	-0.18	0.13
Has not uploaded information to the internet	-0.38	0.08
For what do you usually use the Internet in the study of a course ?		
Do you use the internet to communicate with the professor	-0.12	0.07
Do you use it to communicate with your peers (about the class)	0.40	0.06
Constant	-20.53	0.46

Note: 1 The quasi R^2 of this Logit is 0.24

Internet usage intensity and academic performance

A potentially serious problem in estimating the impact of Internet use on academic performance is the possibility that students who are high-intensity Internet users have unobserved characteristics that also make them more successful academically. That is, it is possible that there is something about those students we have not observed that makes them high-intensity Internet users and successful academically. Some of these features might be the ones noted in the literature as very predictive variables of the academic performance. For these no information was available in this study. Distinguishing between the time students spend studying (which a priori has a negative relation to the time spent on the Internet for pleasure) or the motivation of students. Therefore it is very important in our study to control for their possible effects.

This phenomenon is called selection bias. Thus, the estimated relationship between Internet use and academic performance could well be biased unless we correct for this possibility.

Therefore, to test the hypothesis that the intensity of Internet use has an effect on academic performance, we used propensity score matching to estimate the effect of higher Internet use among students with similar probabilities of such high use. We estimated the probability with a logistic regression (see Table 8). The objective was to group students with similar characteristics into two categories: those who have a high rate of Internet use and those who do not. We then estimated the average treatment effect of high Internet use by matching students one-on-one based on the probability. To have a more accurate match, we set a tolerance level of 0.0001 and restricted the matching to the region of common support.

We also did two sets of analysis, one with the nearest neighbour matching for the whole sample, and for the other we pooled only students with a probability within 0.2 and 0.6. The estimates for both methods were very similar and there seems to be a very small correlation between high Internet use and performance.

Table 8 shows the regression estimate of academic performance for a subset of students based on their probability of showing high Internet usage intensity between 0.2 and 0.6 and, hence, thereby eliminating all the observations that have a very high likelihood of being high intensity users as well as the ones with a low likelihood of being high intensity users, because these extreme cases do not have good matches. Nevertheless the selection bias that we attempted to correct seemed to have been relatively light, as the results are only slightly different from the same regression performed on the non –PSM– corrected group.

We can see that Internet usage intensity has a significant but not very strong negative influence on academic performance controlling for the student's parents' education and occupation, age, gender, and academic enrolment characteristics. The result is not surprising, since we have shown that the type of activities that most contribute to high-intensity use are associated with game playing, social interaction, and entertainment rather than academic activities.

As was true for the prediction of Internet use intensity when the mother completed higher education, we observe a positive correlation with academic performance, while the education of the father has no significant correlation.

An unexpected result is that we observed a significant lower academic performance for students where the father has a good job. One interpretation could be that the students from households where the father has already accomplished a relatively high social status are not as determined to succeed, and hence put less emphasis on academic performance.

As has been repeatedly found, gender and age are significant determinants when thinking about academic performance. Young students and female students are more likely to have better grades.

Compared with social science students (38% in the two first years sample and 47% in the whole population), exact science and engineering students have an increased probability of having slightly lower grades. Another interesting result is that, compared with the performance of students from the University of Barcelona (who are the most with 43% of the total in the two first years sample and 34% in the whole population), students from almost all universities (UAB, UDG, UDL, UPF, URV) have a significant chance of receiving better grades.

Furthermore, the student's entrance grades into university have a significant influence on the probability of performing well in university, which shows a continuity between the results of students' performance in secondary and higher education.

Lastly we can see that using the Internet to communicate with peers and with lecturers has a positive effect on academic performance. This can be interpreted as evidence that the so-called web 2.0, with its increased potential for communication and collaboration, will have a more positive effect on learning and academic performance as demonstrated previously (Castaño-Muñoz and Duart, 2008).

Table 8. Estimated Effect (OLS Regression) of Internet Usage Intensity on Academic Performance (PSM-corrected and non-corrected), Catalan University Students, 2004-2005

	Non-PSM corrected			PSM 0.2 - 0.6 sample		
	B	Beta	Sig	B	Beta	Sig
(Constant)	.48		.00	.45		.00
Intensity	.00	-.07	.00**	.00	-.05	.00**
Mother secondary education	.00	.00	.92	.00	.00	.86
Father secondary education	.01	.02	.25	.02	.03	.16
Mother higher education	.04	.05	.00**	.04	.05	.03*
Father higher education	.01	.01	.69	.02	.03	.15
Mother other education	.01	.01	.67	-.02	-.02	.47
Father other education	.00	.00	.91	.02	.03	.28
Mother high occupation	.02	.02	.14	.02	.02	.39
Mother unskilled worker	.02	.02	.19	.01	.01	.71
Mother other/no occupation	.02	.01	.39	.03	.02	.23
Father high occupation	-.03	-.05	.00**	-.05	-.07	.00**
Father unskilled worker	.04	.02	.06	.03	.02	.31
Father other/no occupation	-.03	-.02	.25	.00	.00	.90
Age	-.01	-.08	.00**	-.01	-.08	.00**
Gender	-.04	-.07	.00**	-.03	-.05	.00**
Biomedicine	-.02	-.02	.09	-.03	-.03	.13
Exact & Natural Sciences	-.02	-.03	.05	-.03	-.04	.04*
Engineering	-.11	-.14	.00**	-.11	-.15	.00**
Humanities	.02	.02	.09	.02	.03	.09
Other disciplines	.08	.02	.24	-.02	.00	.81
UAB	.04	.06	.00**	.06	.08	.00**
UDG	.07	.07	.00**	.06	.06	.00**
UDL	.13	.08	.00**	.10	.06	.00**
UPC	.02	.02	.34	.02	.02	.30
UPF	.11	.09	.00**	.10	.09	.00**
URV	.12	.10	.00**	.11	.09	.00**
University access grade	.06	.18	.00**	.06	.20	.00**
Uses the internet to communicate with the professor	.03	.01	.00**	.03	.04	.01**
Uses the internet to communicate with peer students	.01	.06	.00**	.04	.07	.00**

Notes: * Adjusted R^2 is 0,121. ** Adjusted R^2 is 0,122

Nevertheless, the negative effect of Internet usage intensity on academic performance is small. An increase in intensity of Internet use causes a decrease in academic performance of about 0.01 points on the performance indicator. Considering that the mean academic performance is 0.28, this can hardly be interpreted as a strong influence.

In this context it seems important to highlight that one would need to delve deeper into exploring what kind of personality-related (non–technology–related) aspects of the student are important in determining their probable academic performance. It is in this light that we see that it is the objective of uses, like communicating with lecturers and peers about the subject of the course (last two variables), that makes the true difference when it comes to learning and academic performance. For example, Kubey *et al.* (2001) highlighted the negative effects of Internet usage on academic performance in which they describe how synchronous Internet activities seem to have a more negative effect than asynchronous uses. Potentially this is because synchronous uses are more distracting and cause higher social pressure to spend time in it.

Conclusion

This study shows a number of interesting results concerning Internet use in a large sample of Catalan university students[10].

Firstly, we found that there is apparently no digital divide among university students when it comes to Internet access and technological skills. Deeper analysis, however, showed that there are differences in *for what and how much* the Internet is used. In other words, we did find a second-level digital divide (Di Maggio *et al.*, 2004).

In response to the first of the questions put forward, it has been shown that university students, in line with the dynamic of young people as a whole, use the time they spend online mainly for leisure (games, social relationships and replacing old media), dedicating little time to educational uses associated with their courses, owing to the low use of the Internet by educational institutions and lecturers in the teaching-learning process. Thus, it would appear that using the Internet as a form of leisure is a good determinant in spending lengthy periods of time online and, therefore, a key factor in explaining the intensity divide.

However, besides spending time on leisure activities, what other characteristics of students influence the fact that they use the Internet for many hours a day?

[10] We note at the outset that this is a particularly high Internet-using group in Catalan society.

With regard to the second of the research questions, the data shows how several characteristics have a significant influence on the probability that a student has high-intensity Internet usage patterns. Confirming the results of the literature about the social divide (Di Maggio *et al.*, *2004*; Harggittai, 2008; Van Dijck, 2006) we see how the *social position of the family*, measured by looking at the profession and education of the parents, influences the type of uses students make of the Internet. A good job and further-education qualifications reduce the probability that their children spend time using the Internet for leisure, therefore reducing the time spent on the Internet. Indirectly, this helps improve academic performance. On the other hand, in terms of the *variables directly related to technology*, our study also reinforces the theories that show that the better the facilities and IT skills, the more time is spent online, given that better facilities are available and, therefore, as Duart *et al.* (2008) showed, use is diversified. Our model, however, is not able to provide an answer to another determinant that is typical of heavy usage: autonomy of use measured as place of connecting, since most students go online at home, so there is hardly any variation. Finally, with regard to *academic characteristics*, it can be seen how the university to which the student belongs has no influence on the time spent using the Internet, i.e. uses promoted by the university are equally low in all universities studied, although there is a significant relationship between the study area and usage time. However, the behaviour of students taking exact science and natural science courses runs contrary to the belief that science students generally make more use of the Internet.

The final objective of this paper is to understand whether intensity of Internet use *per se* has an effect on academic performance as a social consequence of its use. In this respect, after controlling for the possible selection bias and the failure to provide information on important variables like time spent on academic activities offline or the motivation of the students we found that there is a significant negative relationship between high Internet use intensity and academic performance. However, taking into consideration other variables, the influence is relatively weak, and considering that the main student activities on the Internet are gaming, social and entertainment uses, it is surprising that the negative influence of Internet usage on academic performance is not greater. This last observation is also supported by the results of Tien and Fu (2008) who carried out a similar study examining the ICT usage of Taiwanese university undergraduates. They did not find a clear relationship between Internet use and academic performance despite reporting a much higher use of computers for university-related academic activities.

It would appear that, while the time spent online by students is dedicated to leisure activities (in line with the dynamic of uses among young people as a whole),

this fact only leads to a very small decline in academic performance, given the fact that other factors play a more important role in this phenomenon. Furthermore, the data shows some uses become more positive the more they are carried out: those students who use the Internet for academic purposes and to communicate with fellow students and lecturers get better marks. Therefore, we can say that an excessive use of the Internet is not a cause of lower performance. What produces lower performance is the way in which students use the technology (for leisure, mainly) which is influenced by their personal, cultural (mainly by virtue of the fact that they are young), social, and economic (see *supra*) characteristics but also by the institutional characteristics of the university system, since it would be difficult for a student to use the Internet for academic purposes if the university did not promote such use. It is, hence, a matter of providing online learning opportunities that serve as a scaffolding to guide the informal learning preferred by modern students (Senges, Brown and Rheingold, 2008) in that, as demonstrated elsewhere (Castaño-Muñoz and Duart, 2008), the small number of students who use the Internet autonomously, following a dynamic related to e-learning 2.0 (Downes, 2005), are those who obtain better academic results due to the fact that their interest is higher (and, for this reason, they find more information) but also due to the improvement in knowledge they obtain from the information and from the habit of looking for it.

In conclusion, the data demonstrates how the fact that as there is no culture specific to university students as regards using the Internet means that Internet use has a negative, albeit slight, effect. We can see how it is possible for Internet usage as part of such a culture to have a positive effect on performance. For this reason, universities should promote its use.

In this regard, future analysis could emphasize on finding out how institutions can create an academic student culture by encouraging student Internet uses that enhance academic performance and to what extent the development of this culture would reduce the digital divide that results from the differences between different uses. Thereby helping all students to achieve a similar advantage from the Internet in their academic activities.

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