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Internet Use and Academic Success in University Students

Usos de Internet y éxito académico en estudiantes universitarios

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Abstract
The use of technology is changing the way things are done, this includes the work in universities where the teaching and learning process are changing, and it is required to know the effect of technology on student achievement. In this research work, we present the influence of Internet use on academic success of students from five universities in Ecuador. A random sample of 4,697 people was got up and categorized in two groups: the use of Internet in academic activities and entertainment, using factor analysis and cluster analysis; the resulting categories were used as independent variables in multinomial logistic regression model which are seeking to determine if the use of Internet has impacted on academic success. The results show that people, who perform interactive activities with peers and teachers or use a balanced way the different internet tools, tend to have more academic success than who only seeks information. Regarding to the use of Internet in entertainment, a positive impact was found on academic achievement, the students who download audio, video and software; and, students who use all the entertainment possibilities show less likely to fail than who using minimally Internet. In terms of gender, it has different effects for entertainment and academic purposes.

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Resumen
El uso de la tecnología provoca cambios sociales. Esto incluye el trabajo en el ámbito universitario en donde está cambiando tanto la forma de ejercer la docencia como la forma de aprender y se requiere conocer el efecto del uso de la tecnología sobre el rendimiento del alumnado. En este trabajo se investigó la incidencia del uso de Internet sobre el éxito académico del alumnado de cinco universidades de Ecuador. Se levantó una muestra aleatoria de 4.697 personas y se los categorizó en perfiles de uso de Internet para actividades académicas y para entretenimiento, utilizando análisis factorial y análisis clúster. Las categorías resultantes se utilizaron como variables independientes en modelos de regresión logística multinomial que buscaba determinar si el uso de Internet tenía incidencia sobre el éxito académico. Los resultados muestran que quienes realizan actividades interactivas con pares y profesores o quienes utilizan de forma balanceada las distintas herramientas de Internet tienden a un mayor éxito académico que aquellos que solo buscan información. En lo referente al entretenimiento, se encontró una incidencia positiva del uso de Internet sobre el éxito académico. Los estudiantes que realizan descargas de contenido de audio, video y software, y quienes utilizan todas las posibilidades de entretenimiento, presentan menor tendencia a suspender que los estudiantes que utilizan mínimamente Internet. En cuanto al género se presentan diferencias en los usos académicos y de entretenimiento.

Keywords / Palabras clave
University, academic achievement, entertainment, digital divide, interaction, online, assessment, games.
Universidad, éxito académico, entretenimiento, brecha digital, interacción, on-line, evaluación, juegos.

1. Introduction

Academic achievement among students generally equates to the effort expended, and is related to intellectual and environmental factors. Habits acquired at an early age such as an interest in reading, or a lack of resources with which to develop elementary capabilities such as verbal comprehension and production are also an influence (Lucas, 1998).
Academic achievement is multidimensional and shaped by variables that are difficult to systematize within a specific model (Fullana, 1992). Educational success is usually measured by rudimentary testing that fails to take into account basic cognitive dimensions that form part of a systematic process. Variables can be personal, academic or social (Fullana, 1992). In recent years, several approaches have developed around the Bloom taxonomy (Bloom & al., 1956) that more or less coalesces around three psychological domains: cognitive, affective and psychomotor. There has also been a boom in instruction in, and assessment of, competences that insists on the need to develop generic and transversal competences, as well as those skills specific to each study area (Villa & Poblete, 2007), teaching students to «learn how to learn» and to acquire greater capacities in line with today's ever-changing times. Academic achievement can be measured from various perspectives: efficacy, for example, grading the level of success in reaching set objectives in a course program, which provides important information for decision makers in educational institutions. A study by Duart & al. (2008) analyzed universities in Catalonia (Spain) and used as main indicator the relation between the number of subjects passed against the number of subjects students had matriculated for, thus enabling students to be categorized in terms of high, medium and low academic achievement. Other variables included gender, age and socio-economic strata. For gender, women outnumbered men by 10% in the high academic achievement category, and for age, students under 25 got better academic results.
Since then, technology has been added to the traditional indicators of academic achievement, meaning the technological environment at institutional level, access to Internet and how students use it, factors which Duart & al. (2008) define as «new determinants of academic achievement», and which influence students' work on various levels and in different ways. An educational institution's technological environment, if properly established, is an important factor in the development of a culture of technological usage. Although this by no means guarantees academic success, it

does enable the student to develop good practices that can contribute to achieving academic goals. Duart and Lupiáñez-Villanueva (2005) pinpointed three areas in which the university as an institution had undergone changes: technological infrastructure, innovation among teachers and organizational restructuring. As a result, the most relevant factors affecting students on entering university are the level of technology within the educational model and the need to apply it to the development of the curriculum map, and the role of the teacher in directing students in the use of the information and technology available as learning tools and resources.

Various studies have found that Internet use can have positive benefits on educational achievement while others conclude that this outcome is not so obvious (Chen & Fu, 2009; Gil-Flores, 2009; Hunley & al., 2005; Luaran & al., 2011; Raines, 2012; Suhail & Bargees, 2006). The variables used to measure the influence of Internet use on academic success include student online activity for task completion, time spent on the Internet, and access to a computer and Internet connection at home. However, no firm conclusions are drawn on the issue since results from other studies performed under similar conditions have been contradictory (Antonijevic, 2007; Azizi, 2014; Ellore & al., 2014; Junco, 2015). Other studies show that the use of technology has a positive effect on certain cognitive areas such as the development of spatial skills and memory, and improved reading, writing and information processing skills, but this does not necessarily lead to better academic achievement. This fits with the Fullana concept (1992) of multidimensional forms of mediation. Heyam (2014) carried out a meta-analysis of the use of technology, in particular social networks, with regard to student performance, and drew two conclusions: technology and social networks facilitate communication, socialization, coordination, collaboration and entertainment; but they can also cause addiction and lead to time wasting, information overload and physical isolation from society.

Other studies have found relations between the use of technology and factors associated to academic achievement, one such being Gil-Flores (2009) who saw a significant link between computer usage and educational success. This study found that high school students who use a computer at home more often scored higher marks in maths and languages. Although Internet was not a determining factor, it at least establishes a relation between the variables. Another study involving high school students (Ndege & al., 2015) indicates the positive effects of technology in boosting the potential for communication and interaction, as well as the downside, which is that time is often wasted, leading to less time spent on academic activities.

Mishra & al. (2014) carried out a study of university students that analyzed the relation between the average of student scores and the time spent searching on Internet. The results revealed a significant negative relation in that the more time spent online, the lower the average mark. They also found a significant positive relation between the perception of the time students thought they needed to spend on sites with academic information and the average mark. Türel and Toraman (2015) found that men tend to spend more time online than women. They also concluded that as the average mark considered to be a good pass rose, so Internet addiction declined. So, the control should center on students who use Internet more than three hours a day. Lepp & al. (2015) measured the impact of cell phone use on the average marks scored by university students, and found that the greater the cell phone use, the lower the average.

Chen & Fu (2009) concluded that online information searching improved exam results. Other studies in Pakistan found that Internet use had a positive effect on marks, and improved reading, writing and information processing skills (Suhail & Bargees, 2006). Computer resources such as games had a positive effect on spatial skills and memory, as well as developing visual and auditory capacities, thus stimulating overall student development (Subrahmanyam & al., 2001). One recurring element in the studies is the relation between academic achievement and home computer access. On the other hand, no link has been established between academic achievement and computer use at the educational center (Gil-Flores, 2009). Other studies show that students who search out information online get better marks because they have access to more data sources and are thus better informed on the subject (Leung & Lee, 2012). This fits with Kupczynski & al. (2011) who studied the behavior of students in Internet courses, finding that the most active (higher

number of online sessions) had greater educational success. Castaño (2011) highlighted the benefits of student interaction for academic achievement, with the benefits accruing more to online students than to those who physically attended classes.

Sciences in general and certain subjects in particular vary in the approach required for studying them, and technology can make a positive or negative contribution to learning. A study by Antonijevic (2007) found that computer use proved very valuable for science students but had the opposite effect on maths students. The use of technology in learning directly affects academic achievement. This is evident in a study by Wittwer and Senkbeil (2008) who discovered no link between computer access and performance in maths. However, using a computer to solve problems had a positive effect on students.

When it comes to entertainment, there is a marked difference in gender, as young women tend towards social networks while young men prefer online gaming (Fernández, Peñalba, & Irazabal, 2015). Young people who present an addiction to Internet usage also have lower academic achievement (Frangos, Frangos, & Kiohos, 2010). The trend is for students to score lower marks the more time they spend on online gaming (Ip, Jacobs & Watkins, 2008). Pepe (2011) found similar results in primary school students. Results tend to show that the time spent searching for information on Internet helps to raise marks and improve socialization whereas time spent online gaming has the opposite effect (Chen & Fu, 2009). Hunley & al. (2005) showed that the amount of time spent on the Internet had limited effect on high school students' academic achievement, yet GPA test scores show no relation to specific online activities such as information search, use of email and videogames. This contradiction in the results of various studies reveals the need for deeper investigation in order to probe systematically the true nature of academic achievement and its determinants. This could shed light on the beneficial uses of technology on academic work, and inform teachers on how best to instruct students in the use of technology.

2. Material and methods

Two hypotheses were posed, which stated that the use of technology for both academic and entertainment purposes had a positive effect on academic achievement.

2.1. Population and sample

The sample was selected from students attending five universities in Ecuador between February and May 2015. A total of 4,697 students were surveyed at random, of whom 48.5% were men and 51.5% were women.

2.2. Data-gathering instruments

A tool was developed based on questionnaires used in the Proyecto Internet Cataluña (UOC, 2003) and the Digital Literacy in Higher Education Project (DLINHE, 2011), and adapted to the requirements of this research. The questionnaire did not require students to state which degree course they were studying. It was divided in two parts, the first containing 13 questions on the use of technology for performing academic activities; the variables are presented in table 1.

Table 1. Variables for the use of technology in performing academic activities

Variables	Factors	Explained Variance
• Read and write on blogs dedicated to coursework. • Read and write on wikis related to coursework. • Use social markers (e.g.: http://del.icio.us). • Write emails regarding coursework. • Chat on forums dedicated to academic issues.	Communication	27.53%

• Consult a teacher. • Consult colleagues. • Post and comment on social networks. • Participate in online forums. • Access the university's online platform. • Download educational material and resources. • Watch videos related to coursework.	Participation	27%
• Search for coursework information on Internet.	Information Search	12.73%

The second part of the questionnaire extracted information on the use of technology for entertainment by means of 10 variables, presented in table 2. It also gathered socio-demographic information using the variables of age, gender and income, the latter measured on a five-level scale. Information on academic achievement was obtained from two variables that asked the students how many subjects were taking and how many they had failed in the last semester.

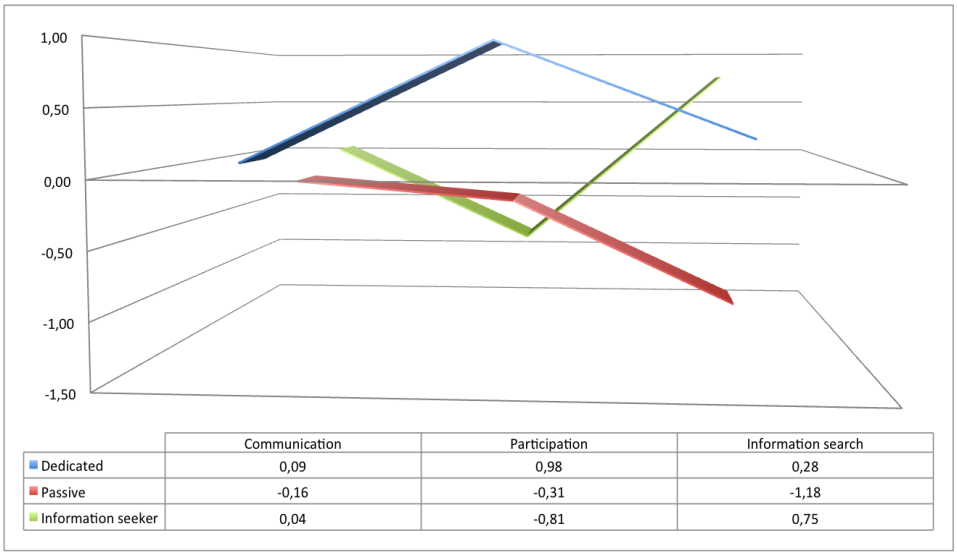
Table 2. Variables for the use of technology for entertainment purposes

Variables	Factors	Explained Variance
• Post comments on social network profile. • Make comments and contact friends on social networks. • Chat online. • Upload videos and photos.	Socialization	30.58%
• Download programs. • Download music or films. • Watch television or listen to the radio.	Downloads	21.78%
• Purchasing. • Selling. • Online gaming.	Transactions and games	20.71%

2.2. Procedure

We created a variable to represent Internet use for academic activities and another for Internet use for entertainment, so students were classified according to the use of technology for coursework or for entertainment. To construct the «academic uses» variable, we presented 13 questions to measure the use of various technological instruments in academic activities (table 1), and a factor analysis was performed to reduce the number of variables and group them in factors. The factors were Communication, Participation and Information Search, and they were subject to a k-means clustering analysis. To guarantee the consistency of the classifications, groups were created by first calculating the centroids from a subsample and then using them to generate the groups. The students were classified in 2, 3, 4 and 5 groups, from which one was selected that presented the greatest accuracy and best ease of interpretation of the groups' structure, following a discriminant function analysis. This analysis was carried out using the group number generated by the cluster analysis as a dependent variable, and the factors from the factor analysis as independent variables (Cea, 2005; Díaz-De-Rada, 1998; Shunglu & Sarkar, 1995). This enabled us to determine the percentage of elements correctly assigned to each classification. We then divided the classification into three groups, as the easiest way to interpret them, and the three groups' centroids for each variable are shown in figure 1.

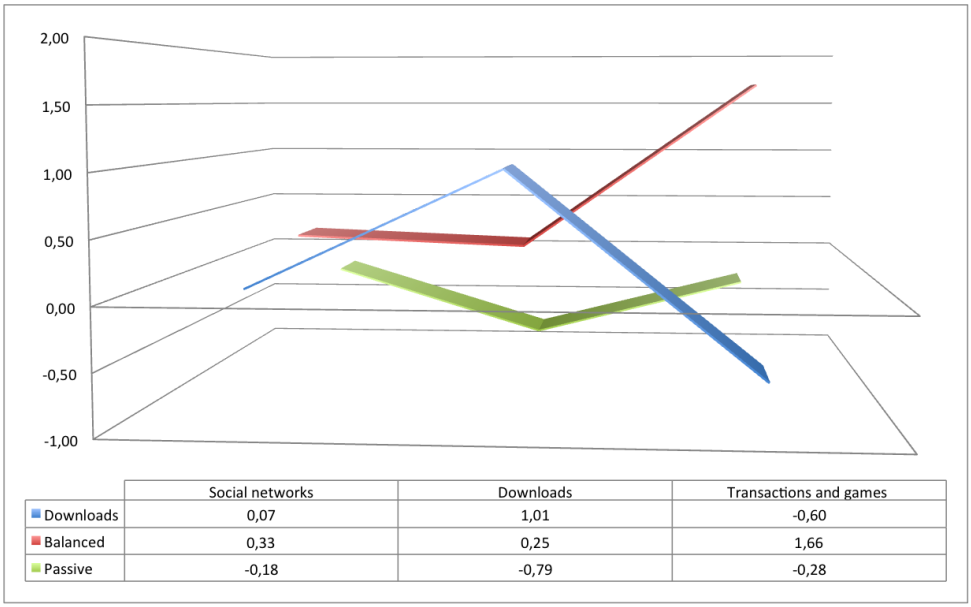
Figure 1. Groups according to use of technology for academic activities



	Communication	Participation	Information search
Dedicated	0,09	0,98	0,28
Passive	-0,16	-0,31	-1,18
Information seeker	0,04	-0,81	0,75

A similar procedure was applied to develop classification based on the use of Internet for entertainment. The variables used and the resulting factors from the factor analysis are shown in table 2. The final categories of this classification are shown in figure 2.

Figure 2. Groups according to use of technology for academic activities



	Social networks	Downloads	Transactions and games
Downloads	0,07	1,01	-0,60
Balanced	0,33	0,25	1,66
Passive	-0,18	-0,79	-0,28

We also created a variable to represent academic achievement, so students were categorized in four groups according to the number of subjects failed. This was obtained by subtracting the number of subjects passed from the number of subjects taken (subjects failed = subjects taken, subjects passed). This gave us four categories: no subject failed, one failed, two failed, more than two failed. The correlations established are: the uses of the Internet for academic activities and academic achievement, and, the uses of the Internet for entertainment and academic achievement. The correlations were obtained using multinomial logistic regression models.

3. Results

3.1. Categorization of the students

Classification based on the uses of the Internet for academic activities divides the students into three groups (figure 1) or profiles: the dedicated academic profile scores high in all factors, especially in Participation, which is its distinctive element and refers to interactive activities and work carried out using educational material. The homogeneity in the values for this profile demonstrates a balanced use of Itools. In the Communication factor, there is a similarity between the information seeker academic profile and the dedicated profile. The information seeker academic profile presents the lowest values in the Participation factor and the highest in Information Search. Its main characteristic contains a contradiction in that it has a high level of information search and a low level of interactive activities and work with educational material, which indicates an imbalance in the use of Internet tools. Finally, the passive academic profile has its lowest levels of intensity in information search and the use of social network tools; and the intensity levels are low for interactive activities and work with educational material, yet they are higher than those for the information seeker profile.

Classification of students based on the uses of Internet for entertainment activities divides them into three groups (figure 2). The first is the download entertainment profile and is composed of 32.4% of the students surveyed; it has the highest level of downloads of programs, music, films and radio and television content. Men are in a majority in this group, at 57.2%. Group 2 is the balanced entertainment profile so-called because the components' usage of all forms of entertainment is more or less homogenous; it numbers 19.8% of the students and most are men, 58.3%. Its distinctive feature is the high level of buying and selling that takes place, as well as the preference for online gaming. Group 3 is the passive entertainment profile which accounts for 47.8% of students, and these have the lowest level of Internet use for entertainment. They tend to be the oldest in the sample and are mainly women, 61.5%. The low level of technology use for entertainment points to a student who does not deem online entertainment to be important, or who has restricted access to technology or no time to use it.

3.2. Educational uses of the Internet and academic achievement

One of the hypotheses tested in this research is that Internet use for doing coursework has a positive effect on academic achievement. The use of technology for carrying out educational tasks is grouped according to profile denomination that reveals the differences between them. The main divergence is between the dedicated profile and information seeker profile, which is apparent in the level of interaction activities and the work carried out with educational material; this is high in the dedicated profile and very low in the information seeker profile.

Table 3. Regression model coefficients

Failed subjects[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Failed 1	Intercept	-.670	.060	123.550	1	.000			
	[cluster 3 academic=1]	-.427	.086	24.738	1	.000	.653	.552	.772
	[cluster 3 academic=2]	.319	.088	13.146	1	.000	1.376	1.158	1.635
	[cluster 3 academic=3]	0[b]	.	.	0	.	.	.	.
Failed 2	Intercept	-1.294	.076	292.825	1	.000			
	[cluster 3 academic=1]	-.375	.108	12.155	1	.000	.687	.556	.848
	[cluster 3 academic=2]	.393	.108	13.336	1	.000	1.482	1.200	1.830
	[cluster 3 academic=3]	0[b]	.	.	0	.	.	.	.
Failed 3 or more	Intercept	-2.019	.102	388.468	1	.000			
	[cluster 3 academic=1]	-.286	.144	3.935	1	.047	.751	.566	.997
	[cluster 3 academic=2]	.698	.136	26.260	1	.000	2.010	1.539	2.625
	[cluster 3 academic=3]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Failed 0.
b. This parameter is set to zero because it is redundant.

The likelihood ratio of failing one subject as opposed to failing none diminishes 1.53 (1/0.65) times when the student belongs to the dedicated student profile in relation to the information seeker academic profile. The likelihood ratio of failing one subject as opposed to failing none increases 1.37 times when the student belongs to the passive academic profile in relation to the information seeker academic profile. The likelihood ratio of failing two subjects against failing none is 1.45 (1/0.68) times less when the student belongs to the dedicated academic profile in relation to the information seeker academic profile, and is 1.48 times greater when the student belongs to the passive academic profile in relation to the information seeker academic profile. The likelihood ratio of failing three or more subjects against failing none is 1.33 (1/0.75) times less when the student belongs to the dedicated academic profile in relation to the information seeker academic profile, and is 2.01 times greater when the student belongs to the passive academic profile in relation to the information seeker academic profile.

3.3. Entertainment and academic achievement

The second hypothesis sustains that the use of Internet for entertainment activities influences students' academic performance. An important finding in our study is that students who use Internet for entertainment purposes less tend to fail more often (table 4). The likelihood of failing one subject as opposed to failing none is 1.78 (1/0.55) times less when a student belongs to the download entertainment profile in relation to the passive profile; and is 1.29 (1/0.77) times less when the student belongs to the balanced entertainment profile in relation to the passive profile.

Table 4. Regression model coefficients

Failed subjects[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Failed 1	Intercept	-.493	.050	95.963	1	.000			
	[cluster 3 entertainment=1]	-.587	.082	50.665	1	.000	.556	.473	.654
	[cluster 3 entertainment=2]	-.261	.093	7.820	1	.005	.771	.642	.925
	[cluster 3 entertainment=3]	0[b]	.	.	0	.	.	.	.
Failed 2	Intercept	-1.072	.061	304.806	1	.000			
	[cluster 3 entertainment=1]	-.495	.100	24.428	1	.000	.610	.501	.742
	[cluster 3 entertainment=2]	-.414	.120	11.845	1	.001	.661	.523	.837
	[cluster 3 entertainment=3]	0[b]	.	.	0	.	.	.	.
Failed 3 or more	Intercept	-1.586	.075	444.524	1	.000			
	[cluster 3 entertainment=1]	-.722	.133	29.633	1	.000	.486	.374	.630
	[cluster 3 entertainment=2]	-.440	.150	8.589	1	.003	.644	.480	.864
	[cluster 3 entertainment=3]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Failed 0.
b. This parameter is set to zero because it is redundant.

Something similar occurs when we analyze students who failed two subjects. The probability of failing two subjects in relation to failing none is 1.64 times less when the student belongs to the download entertainment profile in relation to the passive profile; and is 1.51 times less when the student belongs to the complete entertainment profile in relation to the passive profile.

4. Discussion and conclusions

Although the use of technology to perform academic activities determines only 3% of academic performance its effect is visible, depending on the type of usage. Students who tend to interact more and use educational material (dedicated profile) are less likely to fail than students whose main academic activity is to search for information (information seeker profile). These findings differ from those of Chen & Fu (2009) who sustained that searching for information on Internet enhanced academic achievement. The differences between the dedicated and information seeker profiles and their effect on academic achievement coincide with hypotheses that state that the digi-

tal divide is not solely due to Internet connection or access to technology (Warschauer, 2002; Zillien & Hargittai, 2009) but also to good use of technology and resources, as is the case of the dedicated profilers who present habits that are considered proper and balanced.

The passive profile has the lowest levels of technological use, which presumes that the student is conditioned by restrictions (income, knowledge, access to a connection); and the negative effect on academic achievement is clear since those whose use of the Internet tools for coursework is minimal (passive profile) tend to fail more subjects than those whose output is based on online information searching (information seeker profile). The lack of access to the Internet has an even greater negative impact than bad practices or habits in technology use. It also emphasizes the disadvantage suffered by those with fewer economic resources, thereby reinforcing the knowledge gap theory (Tichenor, Donohue, & Olien, 1970).

This study shows that students have greater academic success when they make a balanced use of Internet tools for their coursework; they more often get involved in interactive academic activities and make greater use of educational material, which fits with Castaño (2011) who showed the positive effects of interaction. On the other hand, students whose use of the Internet is categorized as passive score lower in testing.

Our study found that the influence of Internet use on academic achievement was significant, in line with Mishra & al. (2014) and Türel and Toraman (2015). Further research needs to focus on the time spent on the Internet for academic purposes in order to measure the true extent of this relation, so it should look to the most influential variables from our study, such as those related to interaction and working with educational material.

A significant percentage (30%) of students use Internet only for information searching and not for interacting with teachers or colleagues or using course material. This seems to be a strange behavior and further research is needed to determine whether it is an inappropriate practice or a new ad hoc methodology that is becoming a dynamic structure in students' technological practices. The use of the Internet for academic work is not influenced by gender, as both men and women present the same patterns for technology use.

In terms of entertainment-related activities, we found that the Internet use for entertainment had a positive influence on academic achievement, contrary to Ip & al. (2008). The reason is unclear so more data is needed on the time students spend on each entertainment activity. In general, students who download files and use the Internet extensively for entertainment purposes tend to fail fewer subjects than those who do not use the Internet, or rarely use it, for entertainment.

Regardless of whether students fail one, two or more subjects, the download profilers make more extensive use of the Internet for entertainment purposes. These students are less likely to fail than those who belong to the complete profile, whose level of technology use for entertainment is high and balanced. Although data on this finding are not abundantly clear, analysis of the similarities and differences between the two profiles reveals that the biggest divergence relates to the extent of buying and selling activities, and online gaming, with the latter perhaps being the most significant (Ip & al., 2008), which is why we extracted the percentage of students who play online in each profile, with download profilers playing less online (53.3%) than the complete profilers (87.7%). This could explain why the complete profile students have lower academic achievement. Although this finding is interesting, it requires more conclusive evidence. Future research needs to work on more variables, one such being the time students spend on online gaming.

Our finding, that students who use technology for entertainment generally tend to score higher in tests, runs contrary to several studies (Frangos & al., 2010; Ip & al., 2008; Mishra & al., 2014; Pepe, 2011; Türel & Toraman, 2015). Data supporting this finding is mininal, other than the fact that the level of influence of entertainment on academic achievement is 1.9% of the explained variance.

When comparing students who perform a wide range of online entertainment activities (balanced profile) to those whose use is limited (passive profile), women are twice as likely to belong to the latter group. In other words, women tend to make less use of technology for entertainment. On the other hand, comparing balanced profilers to downloaders, both men and women are equally repre-

sented and no clear trend is visible. We can conclude that in terms of entertainment women prefer to download information than play games online.

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