



A STUDY OF THE USE OF UBIQUITOUS MOBILE DIGITAL DEVICES IN INTERCONTINENTAL DISTANCE EDUCATION

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Summary

At today's universities, students' use of mobile digital devices is all-pervasive, and this benefits the development of a ubiquitous context for teaching, learning and social interaction. This study analyses how university students use their mobile phones and laptops to do academic work in various places both inside and outside the university compound. We surveyed 875 European and Latin American university students from 13 institutions. The research methodology was developed by factor analysis and comparing groups using parametric and non-parametric testing. The results show that students mainly use their digital mobile devices on campus, for example in the café, faculty corridors, the library or the lecture hall. To a lesser degree, students use their mobile devices for course work off-campus, on public transport, in entertainment spaces, at home, at work or generally outside.

A new situation in university learning

The reform of universities generated by the implementation of courses structured according to the Bologna Process has resulted in a new, even revolutionary, situation. Mobile devices have transformed the notion of a fixed educational setting meaning that the educational process can now take place anywhere: in the city, on a motorway, in a restaurant, in any local or international setting. On 13 January 2012, the *El Mundo* newspaper published an article entitled *A University Model for the 21st Century*, which read: "We must start deploying technological platforms that enable teachers and students around the world to interact in real time, so that time and distance are no longer an obstacle, and that everybody, regardless of work schedule or location, can become recipients of the new knowledge provided by universities. We must establish low-cost platforms that enable all the wisdom and knowledge acquired by our best teachers to be privately commercialized across the world." The evolution of mobile devices has been rapid and universal, hardly allowing time for reflection on how to systematically integrate them into the educational system for teaching and learning purposes. These resources have multiple applications and open up numerous possibilities for education, as well as being useful social inclusion tools for people with special needs.

We can characterize the transformational processes currently in motion as a change towards a new collaborative, connective and heterarchical learning paradigm. This important paradigm shift requires some profound changes. From the student viewpoint, the key factors in this innovation in education will be the need to acquire new competences, and to accept the notion of mobility in a higher education setting that is now worldwide and unfettered by frontiers. Teachers will see a redefinition of the balance between teaching, learning and research towards the development of innovation and competences. Learning will be reoriented towards the paradigms of collaboration, reflection and interaction.

Academic experts and professionals believe that continuous innovation is the paradigm that most accurately describes the changes that must take place in higher education. Universities must prepare students for a digital future that is already here; technology now enables us to be in different places at the same time. The concept of ubiquity amounts to a deep technological convergence between all types of media, and the coexistence of the real and the virtual; the availability of information at any time, from anywhere via any kind of device. This type of interaction between numerous devices and social media modifies how we experience the world and how we instruct students. The dimensions of ubiquitous learning seem to be continuity in time and contextual interrelationship, which both help to close the time-space divide. There is a revolution taking place in the processes, content, agents, resources and spaces dedicated to teaching and learning. Aspects of this new learning include exploration, discussion, argumentation, collaboration and reflection (Vázquez Cano & Sevillano García, 2015).

Analyses of the ubiquity and deployment of digital mobile devices have mainly centred on the educational use and didactic potential of such devices (Wu et al., 2012; Ahmed, & Parsons, 2013; Cochrane, 2014; Ciampa, 2014; Furió et al., 2014; Ogata et al., 2014; Keengwe, 2015, among others). Likewise, reports published by technological companies have focused on the analysis of patterns of device usage according to variables such as the age and gender of the users, the number and type of apps installed and used, frequency of use and connection time schedules, and the amount of time spent online etc., (UNESCO, 2013; GSMA, 2014).

The implications of the analysis of the locations where university students use their mobile digital devices for study are enormous in terms of understanding the new patterns of usage of such devices for learning; it would enable us to modify and adapt the technological and spatial infrastructure on university campuses, strengthen study group interactivity models, introduce content that is relevant to the location and needs of the students, adapt the format of educational content to the range of devices used and, definitively, provide a better technological response in terms of content and social potential for students who use mobile digital devices as just one more resource for studying and social interaction from various locations. So, the aim of this research is to analyse the spaces and locations where European, mainly Spanish, and Latin American university students use their digital devices for studying, and pinpoint possible differences between patterns and places of usage in these two Hispanic geographical entities.

Ubiquitous learning represents a new educational paradigm made possible thanks mainly to new digital media. Any proposal for ubiquitous learning using mobile tools must consider the three pillars of Information, Communication and Knowledge, related to which are five basic micro-competences: searching, communicating, organizing, producing and disseminating. Ubiquitous education focuses on how to optimize the use of the huge amount of information within everyone's reach, and how to access it anywhere and anytime. The most amazing thing is that students can now study and learn in any situation or context. Some authors hold that virtual tools enable everyone to produce and disseminate information, hence learning can be done at any moment and in any location (Sevillano García & Vázquez Cano, 2015).

The scientific design of the study

Objectives

1. To know, identify and assess the uses, frequency of use, benefits and drawbacks that laptop computers and mobile digital phones represent for students in terms of their potential for ubiquitous mobile university learning.
1. Identify trends among university students who use mobile phones and laptops for learning.

Sample

We conducted an intercontinental survey of 875 university students, distributed as follows:

Table 1:

University	Country	Number of students
Complutense	Spain	26
Vigo	Spain	46
Oviedo	Spain	169
Granada	Spain	77
UNED	Spain	108
Otto-Friedrich-Universität Bamberg, Bamberg	Germany	24
Freie Universität Bozen Brixen	Italy	31
Universidad del Libertador Bernardo O'Higgins, Santiago de Chile	Chile	98
Universidad Nacional Hermilio Valdizán, Huánuco.	Peru	52
Universidad de Cartagena, Fundación Universitaria Tecnológico de Comfenalco	Colombia	110
Universidad Pública de Panamá	Panama	29
Universidad Veracruzana, Xalapa	Mexico	105

Instruments

A questionnaire was designed and validated by a group of experts that included open and closed questions, and whose consistency according to Cronbach's Alpha was measured at .920. The survey was then applied by teachers at the various universities. The research methodology was developed using factor analysis and intergroup comparisons by parametric and non-parametric testing. In terms of the four grades *Never*, *Hardly Ever*, *Often* and *Always*, after analysing all the answers and their frequencies, we decided that the *Often* responses were

the most representative and which best reflected the trend. A contingency analysis of the functions attributed and obtained from the two tools used completed this relation, and enabled us to identify with certainty the trends outlined in the countries studied.

Results and interpretation

Exploratory questions

Table 2: How do you connect to the Internet?

	Laptop	Mobile phone
Spain	14.5	20.4
Italy	33.3	42.9
Germany	21.1	42.1
Chile	13.2	8.8
Peru	19.5	15.4
Colombia	23.9	20.8
Panama	15.4	17.9
Mexico	21.2	19.0

Table 3: Does the cost of connection impede Internet use?

	Laptop	Mobile phone
Spain	6.2	67.0
Italy	3.1	56.0
Germany	2.2	44.0
Chile	7.4	40.7
Peru	18.2	45.5
Colombia	5.7	43.0
Panama	6.7	40.0
Mexico	12.5	70.0

The trend is homogenous except in the case of Chile, where both devices register low usage. Italy has the highest usage in both categories. *Internet connection allows me to search all kinds of sources to quote them in my articles, and to resolve doubts or problems* (Protocol 8). In the contingency table, the *Always* variable figures most prominently for mobile phone use in Chile, at 78%, and in Panama, with 71.4%. For the laptop, *Always* figures highly for all countries, and higher than mobile phone use, with Peru the lowest at 48.8%.

As we can observe, connection costs are an important factor in Peru. In Europe, the cost is not so important for laptops but it is significant for mobile phones, especially in Spain.

Devices for academic use

Table 4: Use of devices for academic work

	Laptop	Mobile phone
Spain	21.3	7.1
Italy	36.8	3.3
Germany	11.1	1.4
Chile	15.3	5.1
Peru	10.5	18.4
Colombia	21.5	11.9
Panama	14.3.	4.2
Mexico	21.4	6.1

Table 5: Use of devices for studying

	Laptop	Mobile phone
Spain	30.2	15.9
Italy	31.6	21.4
Germany	33.3	11.8
Chile	27.1	17.3
Peru	23.1	14.3
Colombia	36.1	22.1
Panama	28.6	21.1
Mexico	38.2	18.2

The laptop is more widely used for academic work. *During class time I use my laptop for practical tasks and exercises for course work* (protocol 341). Italy scores highest with 36.8%. Mobile phone use for academic work is scarce, except in Peru and Colombia where it registers *Often*. Panama stands out with 82.1% for *Always*, and all countries have a similarly high register in this category. Italy is the lowest at 57.9%. With mobile phones, *Always* figures less than for laptops. Spain scores lowest, at 0.04%, and this is related to high connection costs.

Colombia, Italy and Panama are the countries whose students most often use the mobile phone for studying, but with scores that are always below those for laptops, which is *often* used for studying, registering high scores among all those polled, particularly in Mexico, with 38.2%. *When I do my course work, I use the notes and material given out in class and which I have on my laptop and sometimes on my mobile phone, which I often add to by searching for information on Internet in case I have doubts* (Protocol 62). It is significant that German students register 66.6% in *Always* for laptop use when studying. These data give us a frequency of use of between *Often* and *Always* of 100%. *I use my laptop at home to find information that I might need for projects in class, to copy up my notes that I used to write by hand in class until this year* (Protocol 199).

Table 6: Searching for academic information

	Laptop	Mobile phone
Spain	34.3	6.9
Italy	38.9	8.3
Germany	23.5	11.8
Chile	28.2	18.5
Peru	25.0	25.7
Colombia	28.3	33.8
Panama	36.0	20.0
Mexico	33.3	21.7

Table 7: Swapping class notes

	Laptop	Mobile phone
Spain	32.7	4.7
Italy	31.6	6.5
Germany	17.6	5.9
Chile	37.8	13.8
Peru	15.4	23.7
Colombia	26.5	18.4
Panama	8.3	27.3
Mexico	28.7	11.2

Table 8: Carrying out group tasks

	Laptop	Mobile phone
Spain	17.9	1.5
Italy	50.0	3.0
Germany	27.8	2.1
Chile	21.3	3.0
Peru	13.5	8.1
Colombia	19.0	9.0
Panama	16.7	18.2
Mexico	23.8	5.4

Searching for academic information refers to enquiries about grants, qualifications, exam results and course notes, and students frequently use their laptops or mobile phones for this task. *When doing course work, I often use my mobile phone to compile data quickly, because it is fast, and I also use my apps in these tasks too* (Protocol 92). Italy, with 38.9, and Spain with 34.3, score highest in laptop use for academic information searches, while students in Colombia and Peru, at 33.8 and 25.7 respectively, prefer using their mobile phones for such tasks. Chile, at 52.4 and Colombia, with 40.6, registered *Always* as the majority choice for mobile phone use in this section, and also scored high for laptop use when carrying out academic information searches. *Never* or *Hardly Ever* scored very highly in all countries for mobile phone use in academic searches, except in Germany (11.8) for mobile and laptop, and for mobiles in Peru (47.3), Italy (42.8) and Spain (35.5).

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The laptop was most frequently used for swapping class notes in Chile, Spain and Italy. In contrast, mobile phones were used for the same task to a significant degree in Panama, 27.3, more than the laptop, at 8.3. *When I get home, I use my laptop as it is more comfortable than my mobile, and I can do tasks and read better on it when I need to look for information* (Protocol 146). *Never or Hardly Ever* figure highly in all countries, particularly in Peru, with 45.9 in both categories, and Spain, 43.5. *I use my mobile phone to arrange to meet my class mates to do work together and to swap notes* (Protocol 80). *My laptop allows me to move around from one place to another, collect class notes from colleagues and do group work together instead of being stuck in one single place. I use it to read the press, and copy up class notes posted on the university website, the virtual campus* (Protocol 3).

Mobile phone use for swapping notes scores significantly higher in Panama, 27.3, than for the laptop, 8.3. *I use my mobile phone to read class notes and swap with my colleagues, or I get them from my teacher. I use it for any emergency that I might have, related to university work. I always have it switched on and although I put it on silence I am always aware in case something occurs regarding university work* (Protocol 100). Likewise in Peru, at 23.7 for mobile phone use and 15.4 for the laptop. *Always* for laptop use scores highest in Chile, 42.7, and Colombia, 39.2. *Never or Hardly Ever* for notes-swapping via mobile phones is very high in Germany, 94.1, Italy, 92.3 and Spain, 83.3. Perhaps competitiveness among students leads many to avoid swapping notes with fellow classmates.

Working in collaboration with other students has become an enriching and socializing dimension of academic work in recent times, but this is not reflected in laptop or mobile phone use for such tasks. The only exceptions are Italy, 50.0, and Germany 27.8.

Question 19 of the questionnaire was a closed question which asked students about the uses and functions of their mobile phones (results shown in the following table). The communication function followed by use of mobile phone for entertainment, at 629 and 566 absolute impacts respectively, score the highest across all countries. It is the education function, with 155 impacts, that scores the lowest in all countries.

Table 9:

Mobile phone functions	Spain	Italy	Colombia	Panama	Germany	Peru	Mexico	Chile
1. Entertainment	17.2%	27.3%	16.4%	20.0%	18.6%	18.6%	16.5%	17.8%
2. Expression	12.5%	9.1%	11.9%	12.2%	9.3%	12.2%	12.9%	10.2%
3. Motivation	7.2%	4.5%	9.4%	9.6%	.0%	8.3%	7.4%	6.8%
4. Information	13.5%	13.6%	11.0%	8.7%	9.3%	11.5%	12.5%	13.1%
5. Education	4.3%	.0%	6.7%	4.3%	2.3%	8.3%	3.2%	5.6%
6. Collaboration	7.6%	9.1%	9.6%	9.6%	14.0%	8.3%	8.9%	7.8%
7. Communication	20.2%	36.4%	15.3%	14.8%	39.5%	17.9%	19.0%	19.5%
8. Illustration	7.3%	.0%	7.8%	10.4%	.0%	4.5%	6.6%	7.1%
9. Innovation	10.3%	.0%	11.9%	10.4%	7.0%	10.3%	13.1%	12.2%

Question 19 of the questionnaire was also a closed question which asked students about their personal usage habits and functions of their laptops, and the results are shown in the table below. The highest scores were for the information function, closely linked to education, with 647 out of a possible 875, followed by education at 535. These two functions scored highly across all nations, the total being 4121 impacts over 3255 for mobile phones.

Table 10:

Laptop functions	Spain	Italy	Colombia	Panama	Germany	Peru	Mexico	Chile
1. Entertainment	12.6%	11.8%	10.5%	6.4%	11.3%	8.6%	10.4%	13.1%
2. Expression	9.1%	4.4%	9.4%	5.7%	4.1%	11.4%	8.0%	7.4%
3. Motivation	8.2%	2.9%	8.7%	5.0%	3.1%	7.9%	7.1%	7.2%
4. Information	15.4%	25.0%	15.8%	17.7%	17.5%	17.1%	15.6%	14.2%
5. Education	12.6%	16.2%	13.9%	17.0%	18.6%	10.7%	11.7%	13.1%
6. Collaboration	10.9%	13.2%	10.9%	12.8%	14.4%	11.4%	12.0%	11.4%
7. Communication	12.9%	14.7%	12.1%	11.3%	14.4%	12.1%	13.6%	13.1%
8. Illustration	10.7%	7.4%	9.5%	15.6%	11.3%	10.0%	11.7%	10.8%
9. Innovation	7.7%	4.4%	9.2%	8.5%	5.2%	10.7%	9.9%	9.5%

Discussion and conclusions

This designed, implemented and verified research work represents an innovation that is of social, family, academic, methodological and didactic interest. The results show that the trend is more or less homogenous in all the countries surveyed, with some variations. These include economic factors, which are significant in Peru, which often makes it difficult to use the mobile phone to connect to the Internet due to relatively steep online connection costs. Other cases include Spain, where prolonged journeys on public transport means that students can use their mobile phones to do academic work, among other things. Columbia is paradigmatic in that students often use corridor spaces at the faculty to connect to Internet and do course work, either by laptop or mobile phone.

Empirical evidence shows that there is a duality between competences seen as necessary and which are later put into practice. We find new digital natives who understand intuitively how to operate these devices and who later, with time and practice, go on to acquire and apply such skills.

The results reveal that there are three important tasks ahead: first, telecoms companies should help close the digital divide and promote the teaching and learning functions of the modern ubiquitous mobile technologies by lowering online connection costs for students, especially in those countries where such technologies are virtually the only tools available for accessing knowledge as books are costly and in short supply. The leap forward into the digital universe has been made but full access is still limited due to the high costs of connection, usage and maintenance. Another drawback is low battery life; technology needs to develop longer-lasting batteries to increase autonomy.

Secondly, the growing and increasingly frequent use of mobile connected devices by students requires university teachers to post more curricular content on the faculty networks, not just course information. Although the online swapping of course notes and collaborative works is

useful and frequently done by students, it would be equally useful to provide more instruction about the availability of digital resources that cover other areas of knowledge, so that students can access such data from their mobile phones. In this new digital age, we cannot have vast repositories of knowledge lying dormant for lack of knowledge of their existence, or the time, training and professional interest to make them known. For example, the Erasmus organization, which consist of some 4,000 institutions, is designing a huge multilingual portal for the dissemination of massive open online courses with the aim of connecting knowledge, research and results transference among universities, and the ubiquitous mobile audiovisual format will be one of its priorities (Vázquez Cano, 2013; p.90).

Thirdly, the results of our research lead us to focus on the students themselves. Just as a critical, analytical attitude and way of working was developed in students in the interpretation of the messages and content transmitted by text books, audiovisual material and newspapers, thereby cultivating a specific methodology, we now clearly understand that it is time to design a system of analysis for the production and exploitation of resources that can be accessed by mobile devices such as phones or laptops, since these are unstoppably and increasingly present in everyday life and the academic world of students, teachers, and at higher education centres and universities. These new media enable and should encourage us to develop a way to organize, represent and codify reality. We need to develop new elements of critical analysis and educate our students so that they can use the information available to them in a suitable and beneficial way (Sevillano García, 2014; p.297).

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