



How University Students Use Technologies to Learn: A Survey about PLE in Spain

Cómo los estudiantes universitarios utilizan las tecnologías para aprender: un cuestionario sobre PLE en España

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ABSTRACT

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Personal Learning Environments –or PLEs as they are widely referred to– have aroused significant interest amongst researchers in the last five years and they were the specific subject of study in the project known as CAPPLE. This paper provides a complete overview of the whole project, whose main aim was to carry out an exploratory analysis of the PLEs of final year Spanish university students. The study used a descriptive quantitative method which was applied in the form of a survey. The sample size was 2054, and our main findings show that despite their level of digital competence when learning university students adhere to a more traditional role. For example, they prefer paper to write down things or to study rather than the possibilities offered by specific technological tools. These reasons have enabled us to put forward various institutional recommendations which will open up interesting lines of future research.

RESUMEN

Palabras clave:

Entornos personales de aprendizaje
PLE
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Los Entornos Personales de Aprendizaje –o PLE como se les conoce ampliamente a partir de sus siglas en inglés– han despertado un gran interés entre los investigadores en los últimos cinco años y han sido objeto de estudio específico en el proyecto conocido como CAPPLE. Este trabajo ofrece una visión completa de todo el proyecto, cuyo objetivo principal era realizar un análisis exploratorio de los PLE de los estudiantes universitarios españoles de último curso de Grado. Se utilizó un método cuantitativo de tipo descriptivo, a través de un cuestionario, como método de recogida de información. El tamaño de la muestra fue de 2.054 estudiantes. Nuestros principales resultados muestran que, a pesar de su nivel de competencia digital, cuando los estudiantes aprenden se adhieren a un papel más tradicional. Por ejemplo, prefieren el papel para anotar cosas o para estudiar antes que las posibilidades que les ofrecen ciertas herramientas tecnológicas. Esto nos ha permitido plantear diversas recomendaciones institucionales que abrirán interesantes líneas de investigación para el futuro.

1. Introduction

Studies on how students learn form part of a long tradition in education research, but this line of research has attracted even more interest recently with the appearance of the concept of the PLE, the “personal learning environment”. There are 176 documents in WoS (Web of Science) on personal learning environment for the period 2010-2016. In 2014, Gallego and Chaves made a documentary analysis of the studies on PLE, using WoS, Scopus, ERIC, Dialnet and other repositories of lesser importance. Using search criteria in both English

and Spanish, they reviewed 376 records and found 65 pieces of empirical research into PLE since 2010. They concluded that "The tendencies show that we are experiencing a new and growing concept which is evoking a conceptual discourse that demands more empirical studies" (Gallego & Chaves, 2014, p. 14). Chaves and Trujillo (2015) likewise state that it appears to be necessary to continue research that helps students to understand and enhance the efficiency of their learning processes.

Two approaches are observed in the construction of the PLE concept: one is instrumental and technological, understanding the learning environment as tools and platforms that students use to learn; the other is more psychological and global, understanding that the PLE brings together tools and strategies, and how these are used, and the purpose of their use in learning situations (Adell & Castañeda, 2010; Casquero, Ovelar, Romo & Benito, 2014; Coll & Engel, 2014; Fielder, 2011).

Considering PLE as an environment that is made up of technological tools, Cabero, Barroso and Llorente (2010) argue that its main strengths are the leading role played by the students, who take active control of their training, the friendly and usable environments, the fact that the responsibility for using the contents is handed over to the students, the improved communication via the web and improved social relations, the fact that the environments are conducive to interaction and therefore to connection between formal, non-formal and informal educational actions; finally, they are student-centred. As regards weaknesses, the authors state that more is known about technological developments than education activity models; the users – teachers and students – need technological competence and conceptual training; and, finally, institutional control is more limited.

In our project, we have underpinned the PLE construct according to the second view, that of PLE as set of tools, and the strategies required to use these. Hence, we conceive the PLE as a model that brings together what is formal and informal in learning processes, with the understanding that the tools and resources play a fundamental role but that there are other elements of importance beyond available resources. This coincides with the idea of Fournier and Kop (2011), who, in their study on the factors that affect the design of PLE, determined that there are human factors and attitudes that affect the development of PLE.

The PLE can be related to the concept of PLN (Personal Learning Network) in that the learning is performed autonomously – with personal use of tools and resources – while at the same time it is constructed thanks to the connections and interrelations that we establish in our face-to-face and virtual social worlds. This vision is reflected in Attwell (2007) or Camacho and Guilana (2011), among others.

The PLE is also supported by the concept of self-regulated learning (Dabbagh & Kitsantas, 2012; Torrano & González, 2004; Zimmerman, 2000), which analyses the degree of control over learning: "what characterizes self-regulated students is their active participation in the learning from the metacognitive, motivational and behavioural perspective" (Torrano & González, 2004, p. 3).

Again, with respect to PLEs there have been analyses comparing them with LMS (Learning Management Systems) or VLE (Virtual Learning Environment) (Wilson et al., 2007). Dabbagh and Kitsantas (2012) and Casquero, Portillo, Ovelar, Romo and Benito (2013) analyse the PLE against the CMS or LMS and consider that the tools based on the PLE concept allow the integration of formal and informal learning through the incorporation of social communication tools into the LMS; there are important problems when you can try to integrate other tools in traditional learning environments (Conde-González, García-Peñalvo, Rodríguez-Conde, Alier, Casany, & Piguillem, 2014). This enables students to develop their own self-regulated learning strategies by incorporating contents, sharing information, participating in the collective generation of knowledge and managing their own personal learning processes.

This line of research has evolved toward the iPLE (Ebner & Taraghi, 2010; Schaffert & Hilzensauer, 2008). Marín, Salinas and De Benito (2014) put the emphasis on the two possibilities that institutions have for developing the iPLE: one is the incorporation of utilities into the architecture of their virtual platforms which are appendix-centred, and the other is the possibility of complementing their platform with web 2.0 social tools. Elsewhere, Pérez (2016) states that "Virtual learning communities supported with technological resources can be easily organized with an iPLE, which is a mixed context that combines the good points of the PLE with institutional resources. The iPLE arises from the combination of LMS and PLE, and aims to create open, flexible and personalized environments where students control and manage their learning and personal development, thus going beyond the formal study stage and giving a long-term approach" (p. 80).

López, Flores and Beas (2012) consider that there are four dimensions of PLE: empowerment, technology, frequency and mastery; increase and diversification of communication; search, management and socialization of information; and, management of learning. Let us look now at how the PLE construct is defined and what its dimensions are within our CAPPLE project, which, it should be highlighted, is the first scientific empirical study to provide data on the PLE of students from all degree courses at Spanish universities.

2. Research on PLE in University Students

Our project was developed from 2013 to 2016 and was financed by Ministry of Economy and Competitiveness of Spain. Thirty-four researchers from six universities participated in the project, apart from the earlier support provided by 10 foreign researchers.

2.1. Aims

The project seeks to ascertain the PLEs of university students and to go in depth into what makes up these environments, their peculiarities, the types of strategies used to build them and which of these are associated to formal education, while also looking for the types of shortcomings they present in cross-disciplinary education.

The project has the following specific aims: to describe the specific strategies and tools most commonly used by final year university degree students on all courses; to analyse the PLE that these students show with respect to possible differences regarding sex or area of study; and to use these data to propose methodological and institutional strategies. In this paper we present the most important data regarding the strategies and tools that they use, as well as to see the existing differences in relation to gender and the areas of knowledge.

2.2. Method

This research is based on a type of exploratory study and a survey based quantitative method. Our starting point was a PLE construct derived from documentary analysis and an ad hoc questionnaire was designed based on this theoretical model.

The exploratory approach means we cannot extrapolate data, but it does at least provide some scientific data about the educational reality in Spain and how our students learn. This, in turn, opens up the possibility of addressing this research topic with reliable data and, in our case, with quite a broad sample that offers enough information for us to be able to draw worthwhile conclusions.

2.3. Stages of the Project

Given the above aims, the project has, over the four years, undergone the following stages:

1. Design and validation of the tool used to collect the information on the PLE from a PLE model and its dimensions.
2. Collection of information on PLEs.
3. Descriptive and comparative analysis of the data.
4. Educational and institutional implications of the findings. Practical, pedagogical and organizational proposals.

2.4. Procedure

Following an initial review of the literature and two rounds of expert judgment, it was considered that university students' PLE included the four following dimensions: Self-perception; Management of information; Management of the learning process; Communication. Using this theoretical model, the questionnaire was prepared and was validated according to three procedures.

Once the questionnaire was complete, information was collected from all the Spanish universities. The questionnaire was emailed to direct contacts, with teachers of final year students on all courses and at all universities. To draw up the databases, publicly available information was taken from teaching guides and university websites. Participants were invited to collaborate in getting the questionnaire out to their students.

After two consecutive periods of sending out the questionnaire, we had a sufficiently large participant sample and could proceed to the data analysis stage. Data were analysed with SPSS and after the preliminary reports on the results of the statistical analysis, a round of group discussions with experts from the research group and guests was held. A final project meeting was held prior to the concluding stage.

2.5. Tool

The CAPPLE questionnaire was designed and validated in a multi-stage process which is described in (Prendes, Castañeda, Solano, Roig-Vila, Aguiar & Serrano, 2016): (a) *tool design*: following the theoretical review, a four-dimension PLE model was constructed (Figure 1); (2) *expert judgment*: expert researchers in PLEs were chosen to make the second validation of the questionnaire content; (3) *cognitive interviews*: these used the now modified questionnaire to conduct cognitive interviews with 24 final year degree students from 8 Spanish universities and in 5 different areas of knowledge; (4) *pilot study*: a pilot study was run with 400 final year degree students (268 females and 132 males).

The outcome of this long and complex validation process was a questionnaire of 47 questions and 220 variables. The excessive length of the tool is one of the factors that have caused the greatest problems in terms of both collecting data and their subsequent analysis. The questionnaire is made up of 5 choice Likert and frequency questions, to which the 'don't know/no answer' option was added.

To measure the reliability of the scale, Cronbach's Alpha coefficient was used for all the items of the instrument, obtaining $\alpha = 0,953$. Thus, the questionnaire finally consists of 48 questions. Subsequently, once all the data had been collected, an Exploratory Factorial Analysis was carried out. The mean sample adequacy "KMO", with a value of .90, and Barlett's sphericity test, statistically significant, $\chi^2 (325) = 8301.5$; $p < .01$, confirmed the relevance of performing an EFA. This analysis was carried out following the method of principal axis factoring and rotation VARIMAX. The initial extraction yielded seven factors. The Confirmatory Factorial Analysis confirmed the structure of 7 factors.

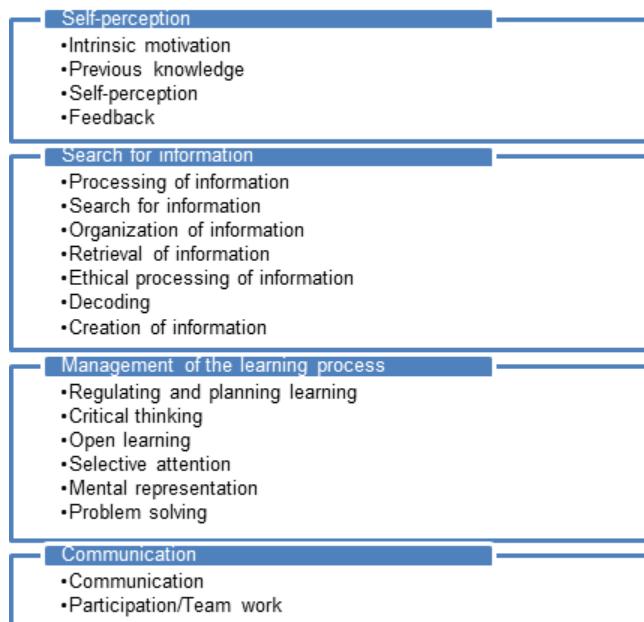


Figure 1. Categories covered by the CAPPLE questionnaire

2.6. Participants

Given the exploratory nature of the study, it has no antecedents in the literature, so we opted for a massive emailing in an attempt to get as high a participation as possible and as many data. We targeted final year degree students as these are understood to be those who might most need an enhanced PLE to develop their self-learning capacities and their life-long education. The data from these students also give a view of what their PLEs are like after their university experience. After discarding those who did not complete the whole questionnaire, we were left with a final sample of 2054. Therefore, considering the sample universe and assuming a 95% confidence interval and 50% heterogeneity, the sampling error is 2.2%. The data producing group was as appears in Table 1. The total comprised 69.67% females and 30.33% males, from 38 Spanish state and private universities (26 and 12 respectively).

Area of knowledge	Total number of students in Spain	Project sample
Social and Legal Sciences	153952	879
Engineering and Architecture	78265	277
Arts and Humanities	19966	308
Health Sciences	29844	352
Sciences	16044	238
Total	295067	2054

Table 1. Population of final year degree students in Spain (official data from the Spanish Ministry of Education) and the sample producing data in the project.

2.7. Data Analysis

Due to the exploratory nature of the study, a descriptive analysis was carried out using frequency tables as categorical variables. Contingency tables and Pearson's Chi-Square were used for the differences in the variables relating to gender and areas of knowledge. The SPSS 22.0 statistical program was used.

3. Results

Drawing on the responses from the whole sample of 2054, we now present the most important data from each of the four dimensions in the questionnaire. We will present these in relation to the descriptive statistics and will then give a brief account of the results in terms of the variables for sex and area of knowledge.

3.1. Results from the CAPPLE Questionnaire: Four Dimensions of the PLE.

a) Self-perception

This dimension covers motivation and perceived effort. It is significant that 77.34% of students stated that their most valuable motivation resource when learning was face-to-face classes. Furthermore, 63.24% said that they preferred to read printed documents rather than online. Almost half (45.8%) the students were not interested in attending talks or lectures that complement their normal classes.

As for academic tasks that are linked to official education, a large majority (85.49%) indicated that having clear task objectives was very important for them to understand what they were expected to achieve and to judge how much effort was required. In other words, they seem more motivated to learn when the uncertainty is lower, and they are clear about what they have to do and have the necessary resources available. This is of interest on account of its implications not only in face-to-face teaching but also in online teaching models.

b) Management of Learning

This dimension includes items on self-perception and learning process planning, critical thinking, flexibility, attention and problem solving. The responses also revealed information of interest. Only 19% of the students said that they used technological tools to manage their work processes, so the implication is that 81% do not. As tools in this category we included online calendars, time management tools, knowledge management tools and collaborative tools. In conclusion, most students continue to use paper and show no interest in incorporating telematic tools in performing tasks linked to managing their knowledge.

As in the previous category, we find a clear preference for face-to-face classes again although to a lesser extent (50.93%). Students are aware of online training modalities like MOOCs, but in general show little interest in them. Neither do they show much interest in social networks, open resources or collaborative virtual spaces. Students opt to make little use of these tools and limit them to personal contacts and social relations.

Regarding digital information, students indicated that they value clarity of information (44.65%) and aesthetic design aspect in presentations (31.63%).

c) Management of information

This part of the questionnaire asked about how they processed information - search strategies, management, organization, retrieval and creation, as well as aspects to do with the ethical use of resources and information.

In terms of searches, 98.29% replied that they search for information on the Internet. However, it should be noted that 60% use only general search engines (Google) and make no use of other tools or strategies. Over 60% stated that they do not use the Internet as their main source of information. When asked about their preferred source of information on the Internet, 55% replied that it was Wikipedia, which coincides with the generalist nature of their digital sources, as borne out by the responses to the search engines used. These data also coincide with those shown for the use of social networks. It should be noted here that almost a quarter of the sample stated that they never published information online.

The majority prefer documents with contents of a traditionally academic nature rather than hypertext or multimedia information (94.7%). Likewise, the preference is for paper versions when studying and taking notes, as well as for printing off interesting information found online (over 60%). Even when working with audio-visual/multimedia information, students continue to take down notes on paper.

Another indication of the traditional profile these students have is their unwillingness to use the cloud to store digital information, with a mere 15.3% using this option. The preference is for physical units – their own computer, external discs or USB devices.

Finally, we would add here that in terms of ethics the clear majority (over 83%) responded that they provide references and that they respect copyright and avoid plagiarism (over 67%), which, while high, means that over 30% do not consider possible plagiarism when preparing a document, something which gives cause for concern considering that these are final year students.

d) Communication

Lastly under this dimension there are aspects to do with interaction with others and aspects of groupwork dynamics. A high percentage (almost 80%) said they made frequent use of social networks, although, as we saw with learning, they make scarce use of these as an academic tool. Messaging services are preferred for collaborating and interacting (40.87%), followed by email (27.99%), while videoconferencing or chat stand at below 6%.

The tool used most for group projects is Google Doc/Google Drive, with 65.9%. Social network tools (Twitter, Facebook...) are used to a lesser extent but still have solid support (22.27%). None of the three other tools students were asked about received more than 10% support: virtual environments like Moodle, Sakay, etc., received 8.01%, followed by wikis (2.67%) and, last of all, blogs (1.86%) Moodle, Sakay, etc.

When asked about their priority aspects when working in teams, “building together” came first with 57.75%, followed by “interacting with others (53.65%) and, finally, “resource sharing” (48.74%). When valuing contributions and criticisms from other users, 66.68% said they took these into account.

3.2. Results Regarding Sociodemographic Variables

Figure 2 shows some of the differential characteristics of males and females in some aspects of their PLEs.

Women (95.5%) access the Internet more than men (87.7%) to communicate, $\chi^2(3, N = 2039) = 14.61, p = .002$, as well as to interact with each other (84.5% women and 69.3% men), $\chi^2(3, N = 2040) = 75.62, p < .001$. This is consistent with the fact that men (68.7%) are less likely to use social networks and WhatsApp than women (78.5%), $\chi^2(3, N = 2054) = 27.02, p < .001$. In fact, more women (24%) than men (15.7%) go to social networks when they want to learn something new, $\chi^2(3, N = 2054) = 37.84, p < .001$.

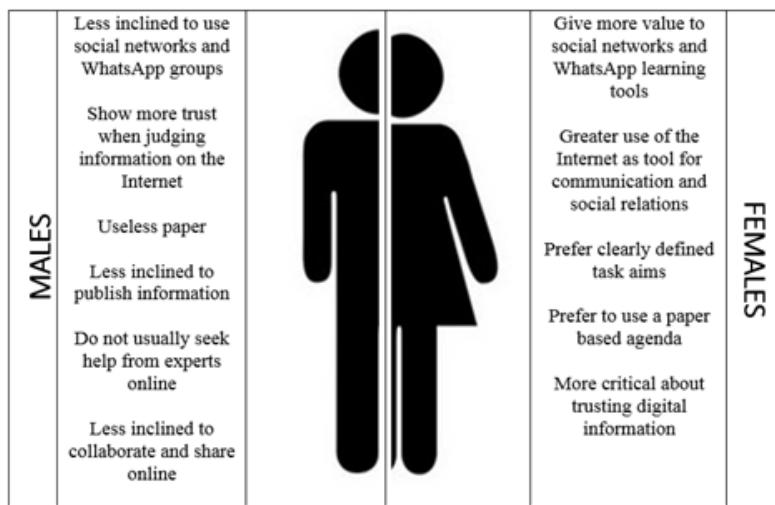


Figure 2. Differences in Spanish students' PLEs according to sex.

More women (82.7%) than men (78.2%) prefer the objectives defined in the tasks they perform, but the difference was not significant, $\chi^2(3, N = 2054) = 7.41, p = .06$. Women (44.7%, 24.9% men) also prefer to reflect what they are doing on paper, $\chi^2(3, N = 2054) = 88.1, p < .001$. They also prefer to plan their study in a traditional agenda (73.2% for women and 37.9% for men), $\chi^2(3, N = 2054) = 261.04, p < .001$.

Women are more critical to the reliability of digital information. For example, it comes from social networks (women 75.3% and men 70.7%), $\chi^2(3, N = 2054) = 33.59, p < .001$, or video tutorials (women 37.4% and men 32.1%), $\chi^2(3, N = 2054) = 12.22, p < .01$. However, it is the men (16.4% and 11.8% women) who most question the information they receive from experts, $\chi^2(3, N = 2054) = 20.38, p < .001$.

When dealing with differences according to areas of knowledge we will use the following abbreviations: Arts and Humanities (AH), Social and Legal Sciences (SLS), Health Sciences (HS), Sciences (Sc), Engineering and Architecture (EA). In the *information management dimension*, we find certain differences in the use of tools for learning (Table 2).

	AH	SLS	Sc	HS	EA	χ^2
	n (%)					
Social networking	77 (25)	236 (26.8)	35 (14.7)	60 (17)	34 (12.3)	87.37***
Blogs or webs	220 (71.4)	669 (76.1)	151 (63.4)	238 (67.6)	201 (72.6)	24.01*
Forums	65 (21.1)	219 (24.9)	53 (22.3)	57 (16.2)	113 (40.8)	79.58***

Note: * $p < .5$, *** $p < .001$

Table 2. Differences in some tools in the
"When I want to learn something new I go to" item

Also, when asked about the tools used when learning something new, 43.4% of EA students use Twitter, while the lowest use was made by students of SLS, with 30.6%, $\chi^2(12, N = 2022) = 28.03, p = .005$.

Another aspect in which there are differences in this dimension is related to the type of information they prefer (Table 3). Note that HS students prefer iconic information the most. In relation to the audio format, Sc and EA students are the least preferred.

	AH	SLS	Sc	HS	EA	χ^2
	n (%)					
Iconic	233 (75.6)	632 (71.9)	184 (77.3)	297 (84.4)	207 (74.7)	42.64***
Video	198 (64.3)	602 (68.5)	136 (57.1)	240 (68.2)	178 (64.3)	23.55*
Audio	101 (32.8)	288 (32.8)	42 (17.6)	85 (24.1)	46 (16.6)	85.76***
Multimedia	188 (61)	545 (62)	110 (46.2)	194 (55.1)	151 (54.5)	38.81***

Note: * $p < .5$, *** $p < .001$

Table 3. Differences in the “When I work with information, I prefer it to be...” item

When creating digital contents there is a difference in the creation of videos to share online. SLS students are the most frequent creators here (26.1%) while Sc students are the least frequent (9.7%), $\chi^2(12, N=2054) = 58.12, p <.001$. However, when it comes to creating iconic contents the range is now from AH students (42.5%) and EA students (30.3%), $\chi^2(12, N=2054) = 32.95, p = .001$.

Science students appear as the most critical of the trustworthiness of digital information (73%), while the most trusting is found in SLS (58%), $\chi^2(12, N=2054) = 26.82, p < .01$. It is worth noting that the majority of students' overall question online information and give greater trust to traditional book sources. Science students again top the list of how much attention is paid to how updated online information is (90%), while AH students are those who pay least attention to this aspect (73.4%), $\chi^2(12, N=2054) = 41.51, p < .001$.

In the *communication* dimension, similar data were found for social networks, with SLS students making most use of them (79.5%), versus EA students (63%), $\chi^2(12, N=2054) = 41.54, p < .001$. SLS students (39.8%) who make most use of social networks when publishing new information, and EA students do so least (24%), $\chi^2(12, N=2054) = 47.78, p < .001$. However, it is noteworthy that it is the same EA students who most value and consider contributions from other users (68.9%).

In the *self-perception* dimension, regarding why students access the Internet, the only differences found between areas of knowledge were for reasons of organization (SLS 52.8% and Sc 40.9%), $\chi^2(12, N=2013) = 37.95, p < .001$, and social relations (SLS 83.6% and EA (71.6%), $\chi^2(12, N=2040) = 34.94, p < .001$.

Differences were also found in the *learning process management* dimension. SLS are those who in the main continue to use pen and paper to organize their ideas and tasks, while the figure drops to 40% for EA students (Table 4).

	AH	SLS	Sc	HS	EA	χ^2
	n (%)					
Task manager (Evernote)	23 (7.5)	79 (9)	13 (5.5)	28 (8)	27 (9.7)	33.79***
Sheet, notebook or diary	202 (65.6)	631 (71.8)	125 (52.5)	214 (60.8)	111 (40.1)	126.7***
Online calendar	43 (14)	158 (18)	39 (16.4)	61 (17.3)	71 (25.6)	22.4*

Note: * $p < .5$, *** $p < .001$

Table 4. Differences in “When planning and organizing my studio and work...” item

Interestingly, when asked about their preferred Internet sources for solving technical problems, EA students opt for Wikipedia (58%) and forums (50%), while SLS students go for social networks (50%).

4. Conclusions and Discussion

One interesting conclusion that we draw from the data of this project is that our degree students do not fit in with the “digital natives” model (Prensky, 2001). Indeed, a detailed analysis of our findings reveals quite the contrary – students who prefer traditional face-to-face methodologies, who use paper when studying, who print off digital documents and who do not place very much trust in the cloud for storing information; the social networks which they use so much in their personal relations do not seem to find so much interest as learning resources (Prendes, Castañeda, Gutiérrez & Sánchez, 2017), which is in line with other studies on digital native (Kirschner & De Bruyckere, 2017; Mararyan, Littlejohn & Vojt, 2011).

In general, the findings from the CAPPLE project coincide with those from the study (Prendes, Gutiérrez & Castañeda, 2015) carried out in Spain with a sample of 487 students, the results of which had already highlighted the importance of social networks for communication in personal contexts (family and friends alike), but that these enjoyed scant use as a teaching resource in the university academic world. In addition, as in the case of the studies carried out by García-Martínez and González-Sanmamed (2017) and López, González, Aguiar and Artiles (2017), students do not know many information management tools.

So, while studies like this one, that of Greenhow, Gleason and Li (2014) or that of Aladjem and Nachmias (2014) show the importance of technologies in the social sphere, CAPPLE project shows that that their use is much lower in the academic world, and in this the findings coincide with other studies with Spanish students like Becerra and Gutiérrez (2016) or Ruíz-Palmero and Gómez (2013). Hence, our students are somewhat removed from the digital natives that Prensky describes. These conclusions may be surprising for those who do not have a close knowledge of the university situation, but not so surprising, perhaps, for the teachers involved on a day-to-day basis, and the more so in recent years with the incorporation of the Bologna model. However, we cannot forget, as stated by Dabbagh and Kitsantas (2012) and Casquero et al. (2013), that the PLE -or iPLE- is an appropriate tool for creating a cohesive and participatory learning network that stands out from the one generated by VLE.

We have observed some differences in terms of gender and in relation to areas of knowledge. A notable difference was found between Social and Legal Sciences students (more motivated to attend class, more prone to using social networks, multimedia information, and more active in their publications), and Engineering and Architecture students who are quite the opposite (less accustomed to using social networks) but who do use Wikipedia or Google Drive, with the latter being the tool most used by all. As Rodríguez-Padial, Cacheiro-González and Medina-Rivilla (2015) point out, in science areas the use of tools such as Facebook or Twitter by teachers is quite limited, which does not encourage their use by students for learning. This difference could therefore be explained by this fact. The most frequent use made of the Internet is, in all cases, to search for information. In terms of gender differences, women place more value on the use of social networks for learning, which is related to Selwyn’s (2008) finding that women use more Internet for academic reasons.

In some aspects, e.g., plagiarism and the use of references to the authorship of digital information, it is surprising how many students claim that they do this. We wondered whether social desirability might have been decisive when answering this question, so this is something that should be addressed in greater depth in future research.

Over its four years the CAPPLE project has provided a broad database of knowledge for ascertaining how our university students are using technology in their learning. It is a model of the PLE construct which still requires cleansing, but which nevertheless has served in this exploratory study to detect and open up new lines of research: The data are of interest and have enabled us to put forward institutional recommendations and university policies. The project has also revealed the possibilities for further research in this field.

We would highlight the research we have been carrying out in collaboration with the University of the Basque Country in order to exploit our data with advanced statistical techniques that will enable us to cleanse the questionnaire, simplify the dimensions by detecting which are more significant, and so redefine the model. The database was cleansed, and two random subsamples were used for an Exploratory Factor Analysis (EFA) and a Confirmatory Factor Analysis (CFA). The EFA was performed with the first subsample, of 947 students, to recalibrate and adjust the scale used and also to check the initial model with the data obtained (subsample two, with 920 students) using the confirmatory factorial analysis to analyse the validity of the model and its components. Through this process the model was reduced to seven factors, which were grouped into 4 dimensions in order to prepare a new version of the tool which we will disseminate for future research into this subject.

Lastly, we are aware of the numerous questions that remain unanswered and that could be addressed in other studies, such as the relation between the PLE and academic performance (in this line we can find the study by Casquero et al., 2015), or the influence of the enhanced PLE on students’ learning strategies and its

significance There is also the possible relation between the PLE and the students' personal characteristics or the relation between the PLE and the teaching methodologies used in higher education in Spain.

Yet another area is the conceptual and/or real relation between the models used to analyse the PLE and the digital competencies models, since connections appear between them which may open up research lines of unquestionable interest. While the PLE points us toward the concept of self-regulation, the acquisition of competences leads us to consider self-regulation together with mediation in educational processes.

All of these lines of research on PLE will enable us in the near future to gain greater insights into the educational reality of the higher education institutions and to decide the where and how of the future of higher education institutions and to innovate the design of our educational systems, as Wilson et al. (2007) state. These lines of research will also facilitate understanding of the synergies that must come about between formal and informal learning of our students, along the lines pointed out in Cabero and Vázquez, (2013).

In short, and in agreement with Chaves and Trujillo (2015), we believe that PLE research still has a lot of interesting data to provide and that there are many lines open for studying PLE more deeply. However, the CAPPLE project is, perforce, a reference to be taken into consideration on account of the breadth of the sample and the data which it provides; data which have allowed us to get quite an accurate snapshot of how our final year degree students learn and how they use technologies as learning resources.

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References

- Adell, J., & Castañeda, L. (2010). Los entornos personales de aprendizaje (PLEs): una nueva manera de entender el aprendizaje. In R. Roig, & M. Fiorucci (Eds). *Claves para la investigación en Innovación y calidad educativas. La integración de las tecnologías de la información y la comunicación y la interculturalidad en las aulas* (pp. 19-30) Alcoy: Marfil
- Aladjem, R., & Nachmias, R. (2014). The mobile as an ad hoc PLE: Learning serendipitously in urban contexts. *Journal of Literacy and Technology*, 15(2), 157-170.
- Attwell, G. (2007). The personal learning environments - the future of eLearning? *eLearning Papers*, 2(1), 1-8.
- Becerra, M. T., & Gutiérrez, P. (2016). Necesidades formativas del alumnado universitario a partir de análisis de su entorno personal de aprendizaje. *RIITE. Revista Interuniversitaria de Investigación en Tecnología Educativa*, 1, 52-59. doi:<https://doi.org/10.6018/riite/2016/271971>
- Cabero, J., Barroso, J., & Llorente, M.C. (2010). El diseño de entornos personales de aprendizaje y la formación de profesores en TIC. *Digital Education Review*, 18, 27-37.
- Cabero, J., & Vázquez, A. I. (2013). Los entornos personales de aprendizaje: uniendo lo formal, informal y no formal para la construcción del conocimiento. In M. C. Fonseca (Coord.), *Los Entornos Personales de Aprendizaje. Visiones y retos para la formación* (pp. 9-26). Venezuela: Universidad Metropolitana
- Camacho, M., & Guilana, S. (2011). From personal to social: learning environments that work. *Digital Education Review*, 20, 24-36.
- Casquero, O., Ovelar, R., Romo, J., & Benito, M. (2014). Personal learning environments, higher education and learning analytics: a study of the effects of service multiplexity on undergraduate students' personal networks. *Entornos de aprendizaje personales, educación superior y analítica del aprendizaje: Cultura y Educación*, 26(4), 696-738. doi:<https://doi.org/10.1080/11356405.2014.985945>
- Casquero, O., Ovelar, R., Romo, J., & Benito, M. (2015). Reviewing the differences in size, composition and structure between the personal networks of high- and low-performing students. *British Journal of Educational Technology*, 46(1), 16-31. doi:<https://doi.org/10.1111/bjet.12110>
- Casquero, O., Portillo, J., Ovelar, R., Romo, J., & Benito, M. (2013). PLEs in Higher Education: Exploring the transference of Web 2.0 social affordances. *International Journal of Virtual and Personal Learning Environment*, 4(4), 31-43. doi:<https://doi.org/10.4018/ijvple.2013100103>

- Coll, C., & Engel, A. (2014). Introducción: los entornos personales de aprendizaje en contextos de educación formal. *Cultura Y Educación*, 26(4), 617-630. doi:<https://doi.org/10.1080/11356405.2014.985947>
- Conde-González, M. Á., García-Peñalvo, F. J., Rodríguez-Conde, M. J., Alier, M., Casany, M. J., & Piguillem, J. (2014). An evolving Learning Management System for new educational environments using 2.0 tools. *Interactive Learning Environments*, 22(2), 188-204. doi:<https://doi.org/10.1080/10494820.2012.745433>
- Chaves, E., Trujillo, J. M., & López, J. A. (2016). Acciones para la autorregulación del aprendizaje en entornos personales. *Pixel-Bit. Revista de Medios Y Educación*, 48, 67-82. doi:<https://doi.org/10.12795/pixelbit.2016.i48.05>
- Dabbagh, N., & Kitsantas, A. (2012). Personal learning environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and Higher Education*, 15(1), 3-8. doi:<https://doi.org/10.1016/j.iheduc.2011.06.002>
- Ebner, M., & Taraghi, B. (2010, June). *Personal learning environment for higher education: A first prototype*. Paper presented at the meeting World conference on educational multimedia, hypermedia and telecommunications, Chesapeake VA, USA.
- Fielder, S. H. (2011). Personal Learning Environments: Concept or Technology? *International Journal of Virtual and Personal Learning Environment*, 2(4), 1-11. doi:<https://doi.org/10.4018/jvple.2011100101>
- Fournier, H., & Kop, R. (2011). Factors affecting the design and development of a Personal Learning Environment: Research on super-users. *International Journal of Virtual and Personal Learning Environment*, 2(4), 12-22. doi:<https://doi.org/10.4018/jvple.2011100102>
- Gallego-Arrufat, M. J., & Chaves-Barboza, E. (2014). Tendencias en estudios sobre entornos personales de aprendizaje (personal learning environments -PLE-). *EDUTEC. Revista Electrónica de*, 49, 1-22. doi:<https://doi.org/10.21556/edutec.2014.49.89>
- García-Martínez, J.A., & González-Sanmamed, M. (2017). Entornos personales de aprendizaje de estudiantes universitarios costarricenses de educación: análisis de las herramientas de búsqueda de información. *Revista de Investigación Educativa*, 35(2), 389-407. doi:<https://doi.org/10.6018/rie.35.2.253101>
- Greenhow, C., Gleason, B., & Li, J. (2014). Psychological, social, and educational dynamics of adolescents' online social networking. *Media Education Studi, ricerche, buone pratiche*, 5(2), 115-130.
- Kirschner, P. A., & De Bruyckere, P. (2017). The myths of the digital native and the multitasker. *Teaching and Teacher Education*, 67, 135-142. doi:<https://doi.org/10.1016/j.tate.2017.06.001>
- López, M.C., Flores, K., & Beas, K. (2012). La gestión del aprendizaje del estudiante universitario a través de los entornos personales. *Apertura, Revista de innovación educativa*, 4(1), 20-31.
- López, P., González, V., Aguiar, V., & Artiles, J. (2017). La gestión de la información en entornos personales de aprendizaje: estudio exploratorio en alumnado del último curso de grado. *Revista Complutense de Educación*, 28(4), 1303-1320. doi:<https://doi.org/10.5209/RCED.51849>
- Margaryan, A., Littlejohn, A., & Voigt, G. (2011). Are digital natives a myth or reality? University students' use of digital technologies. *Computers & Education*, 56(2), 429-440. doi:<http://doi.org/10.1016/j.compedu.2010.09.004>
- Marín, V., Salinas, J., & De Benito, B. (2014). Research results of two personal learning environments experiments in a higher education institution. *Interactive Learning Environments*, 22(2), 205-220. doi:<https://doi.org/10.1080/10494820.2013.788031>
- Pérez, L. (2016). Usabilidad de los entornos personales de aprendizaje institucional. *Journal for Educators, Teachers and Trainers*, 7(2), 77-94.
- Prendes, M.P., Castañeda, L., Gutiérrez, I., & Román, M. (2016). Still far from personal learning: Key aspects and emergent topics about how future professionals' PLEs are. *Digital Education Review*, 29, 15-30.
- Prendes, M.P., Gutiérrez, I., & Castañeda, L. (2015). Perfiles de uso de redes sociales: estudio descriptivo con alumnos de la Universidad de Murcia. *Revista Complutense de Educación*, 175(26), 175-195. doi:https://doi.org/10.5209/rev_RCED.2015.v26.46439
- Prendes, M.P., Castañeda, L., Ovelar, R., & Carrera, X. (2014). Componentes básicos para el análisis de los PLE de los futuros profesionales españoles: En los albores del proyecto CAPPLE. *EDUTEC, Revista electrónica de Tecnológica Educativa*, 47, 1-15. doi:<https://doi.org/10.21556/edutec.2014.47.139>
- Prendes, M.P., Castañeda, L., Gutiérrez, I., & Sánchez, M.M. (2017). Personal learning environments in future professionals: nor natives or residents, just survivors. *International Journal of Information and Education Technology*, 7(3), 172-179. doi:<https://doi.org/10.18178/ijiet.2017.7.3.861>
- Rodríguez-Padial, L., Cacheiro-González, M. L., & Medina-Rivilla, A. (2015). Conocimiento y uso de las tecnologías de la información y de la comunicación en la formación médica continuada. *FEM: Revista de la Fundación Educación Médica*, 18(4), 283-291. doi:<https://doi.org/10.4321/S2014-98322015000500010>

- Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5), 1-6. doi:<https://doi.org/10.1108/10748120110424816>
- Ruiz-Palmero, J., & Gómez, M. (2013). Entornos personales de aprendizaje: estado de la situación en la Facultad de Ciencias de la Educación de la Universidad de Málaga. *Pixel-Bit, Revista de Medios y Educación*, 42, 171-181
- Selwin, N. (2008). An investigation of differences in undergraduates' academic use of the Internet. *Active learning in Higher Education*, 9(1), 11-22. doi:<https://doi.org/10.1177/1469787407086744>
- Schaffert, S., & Hilzensauer, W. (2008). On the way towards personal learning environments: Seven crucial aspects. *eLearning Papers*, 9, 1-11.
- Torrano Montalvo, F., & González Torres, M.C. (2004). El aprendizaje autorregulado: presente y futuro de la investigación. *Revista Electrónica de Investigación Psicoeducativa*, 2(1), 1-34.
- Wilson, S., Liber, O., Johnson, M., Beauvoir, P., Sharples, P., & Milligan, C. (2007). Personal Learning Environments: Challenging the dominant design of educational systems *Journal of e-Learning and Knowledge Society*, 3(3), 27-38.
- Zimmerman, B. J. (2000). Attainment of self-regulation: A social cognitive perspective. In M. Boekaerts, P. Pintrich y M. Zeidner (Eds.), *Self-regulation: Theory, research, and applications* (pp. 13-39). Orlando, FL: Academic Press. doi:<https://doi.org/10.1016/B978-012109890-2/50031-7>