Sinergias Educativas

Article

Assessment of digital tools in Personal Learning Environments in Higher Education students

Evaluación de las herramientas digitales en los Entornos Personales de Aprendizaje en los estudiantes de Educación Superior

Teresa Ordaz Guzmán*
Anahí Isabel Arellano Vega*

Abstract

Higher Education institutions have the challenge of including flexible and open methodologies for learning, which allow to take advantage of the educational potential of Information and Communication Technologies (ICT). An example of that is the Personal Learning Environments or PLEs emerge as a pedagogical approach strongly tied to digital tools. The objective of this article is to finalize the profiles of higher education students in relation to their perception of the digital tools they use for their learning strategies. Thus, this research corresponds to a quantitative-descriptive design of transversal cut. A survey-type technique was used to collect the data. The present study was applied with the sample was 376 students. It was found the students who prefers traditional Tools for learn and the student use the digital tool for search information but not to create and share. The higher education institutions need to generate scenarios for the training of students and offer opportunities to build knowledge to take advantage of the use ICT.

Keywords: Higher Education, PLE, ICT, Digital tools

* Doctorado, Universidad Autónoma de Querétaro, Querétaro, México teresa.ordaz@uaq.mx
https://orcid.org/0000-0002-5594-467X

* Doctorado, Universidad Autónoma de Querétaro, Querétaro, México, anahi.isabel.arellano@uaq.mx
https://orcid.org/0000-0002-5452-6660

Sinergias educativas
October - December Vol. 6 – 4 - 2021
http://sinergiaseducativas.mx/index.php/revista/
eISSN: 2661-6661
revistasinergia@soyuo.mx
Pag 1-28
Received: March 03, 2021
Approved: June 21, 2021

Resumen

Las instituciones de Educación Superior tienen el desafío de incluir metodologías de aprendizaje flexibles y abiertas, que permitan aprovechar el potencial educativo de las Tecnologías de la Información y la Comunicación (TIC). Un ejemplo de ello son los Entornos Personales de Aprendizaje o PLEs, estos emergen como un enfoque pedagógico fuertemente vinculado a herramientas digitales. El objetivo de este artículo es describir los perfiles de los estudiantes de educación superior en relación a su percepción de las herramientas digitales que utilizan para sus estrategias de aprendizaje. Esta investigación corresponde a un diseño cuantitativo-descriptivo de corte transversal. Se utilizó una técnica tipo encuesta para recolectar los datos. El presente estudio se aplicó con una muestra de 376 estudiantes. Se encontró que los estudiantes prefieren las herramientas tradicionales para aprender y las herramientas digitales para buscar información, pero no las utilizan para crear y compartir. Es así que, las instituciones de educación superior necesitan generar escenarios para la formación de los estudiantes y ofrecer oportunidades de construcción de conocimiento para aprovechar el uso de las TIC.

Palabras clave: Educación superior, PLE, TIC, Herramientas digitales

Introduction

Nowadays Higher Education institutions have the challenge of including flexible and open methodologies for learning, which allow to take advantage of the educational potential of Information and Communication Technologies (ICT) in general and Web 2.0 and the Web semantics. These methodologies are expected to promote experiences so that students can select and recognize the digital resources and tools that favor their own learning (Adams et al., 2017). Within the framework of this challenge, the Personal Learning Environments or PLEs emerge as a pedagogical approach strongly tied to digital tools. PLEs can be defined as learning ecosystems that are favored by the intersection of formal and informal contexts in which people unfold (Salinas, 2013).

The use of PLEs is based on constructivist theories of teaching-learning processes, which, on the one hand, suggest that learning is an active process of construction on the part of the individual; and, on the other hand, they conceive teaching as an orientation to such construction, rather than to the transfer of knowledge (Castañeda & Adell, 2014).

In that sense, PLEs offer opportunities to develop didactic situations centered on the students; and, in turn, encourage the acquisition and development of skills for the demands of the world that surrounds them. Therefore, it becomes a need for teachers to integrate the opportunities provided by the PLEs and that, based on the learning strategies that we know that students use in informal environments design more effective formal education processes (Martínez, Nolla, Vidal, & de la Torre, 2016).

In this sense, the construction of a PLE in formal education requires a participation in communication processes between students and teachers, in such a way that it is function for the teacher to propitiate the students' ability to build their own environments giving enough freedom and space to them to feel ownership of their own personal environments (Haworth, 2016).

In fact, the PLEs are based on a social component that produces an immediate and durable interaction that is integrated from a Personal Learning Network (PLN) (Martínez et al., 2016). And for all this, a series of resources, tools, and connection are used with other people, and this is where ICTs have a prominent role, since they favor all of these(Coll & Engel, 2014). This interaction allows us to extract information, share current information, reflect on the information to achieve the learning objectives that people suggest (Castañeda & Adell, 2013; Patterson, Stephens, Chiang, Price, Work, & Snelgrove-Clarke, 2017). And besides, the social component provides an active role for people to customize their PLEs, requiring several strategies to regulate their own learning process from resource management at hand and the development of meta cognitive skills (Dabbagh & Kitsantas, 2011).

These learning strategies are defined as a planned action that requires a sequence of activities to achieve learning objectives. They are intentional to the extent that decisions and processes are involved on the part of the person that adjust to the fulfillment of the goal or objective (Valle, Barca, González, & Nuñez, 1999) Achieving a learning strategy requires skills according to the context and objectives to be met. These skills allow planning goals, goal settings, identifying resources and tools within reach, execute actions and evaluate the results (Haworth, 2016).

On the other hand, and this is where we come full circle with ICT, skills students need to develop a PLE are linked to the technological component that defines them. Not in vain but based on the opportunities of Web 2.0 and the ubiquity of technology (Patterson, et al., 2017). Technological tools have functions and characteristics that allow to mainly search and selection of information, create, and edit content, share experiences, and collaborate and interact with others.

In this same context, the skills necessary to develop learning strategies in the PLEs have to do with self-management and selection of information and resources, self-regulation, and the development of metacognitive skills. Self-management refers to the ability to select and organize information. And, in turn, this implies the administration of resources and learning experiences to adapt them to their own needs(Attwell, 2007; Haworth, 2016). Ultimately, this self-management is a skill that demands decision making on what tools and resources are required, what information is needed, how to organize information and with whom and where they want to earn (Castañeda & Adell, 2013; Coll & Engel, 2014; Rahimi, Van Den Berg, & Veen, 2015).

On the other hand, self-regulation is a skill that compromises the subject to fulfill their own learning objectives. From planning your learning, articulating the tools at your fingertips, developing, and sharing content, interacting, and evaluating their learning (Castañeda & Adell, 2014).

Finally, the skills for the development of metacognitive skills involve reflection and problem solving. It is necessary that the subjects are active and aware of the decisions they make to learn. It requires knowledge of an active role in which the best way to learn is recognized (Castañeda & Adell, 2013; Chaves, Trujillo, & López, 2015; Rahimi et al., 2015) . Reflection favors the analysis of the effectiveness of strategies, resources, and connections used in each specific learning situation(Manso-Vazquez & Llamas-Nistal, 2015).

As you can see, the reflection on the PLEs is not only technological, but has very interesting ramifications of deep pedagogical roots. Therefore, if we return to PLE from a pedagogical approach, we need to know how to use digital tools for training students and learning

strategies. Thus, having a complete picture of potential needs of students to help us promote the development or learning strategies for training have.

Because of all the above reflection, the objective of this article is to finalize the profiles of higher education students in relation to their perception of the digital tools they use for their PLEs. And, as specific objectives, we find the following:

- Describe the tools that students use management and planning information.
- Describe the tools that students use to self-regulate their learning
- Describe the tools students use to reflect and develop metacognitive skills.

Materials y methods

The present study corresponds to a quantitative-descriptive design of transversal cut. A survey-type technique was used to collect the data, which describes the students' perception on how they use technology to learn and their study habits. This study aims to know the characteristics and properties to describe with more specificity the use of digital tools in students' PLE. That is why a descriptive study was chosen because, as mentioned by Hernández, Fernández & Baptista (2010) a study of this nature allows describing the profiles of people, groups, communities, and processes.

The population that is studied in the present investigation is formed by the students of a state public universities. In total, a population of 16,114 students is considered. For the calculation of the population sample, the probabilistic method stratified by clusters is used. The sample is statistically representative with parameters of a ≥95 % reliability level and an error of ≤5 %. Applying the corresponding calculations, results in a sample size of n=374 students. For the present study, the questionnaire of the project "Competencies for permanent learning based on the use of PLEs (CAPPLE in Spanish)" was used, which aimed to study how PLEs of higher-level students in Spain are (Prendes-Espinosa et al., 2016).

It was decided to use this questionnaire for two reasons. The first is the scientific rigor that the questionnaire has since it has a complete process to guarantee its validity and reliability. The second reason is

for its conceptual orientation, which frames the questionnaire from a complex perspective of the PLEs that takes into consideration both the technological and the pedagogical aspects.

The questionnaire includes 8 nominal questions, 30 questions of frequency on a scale of 5 levels. It also includes 5 questions with a scale of 5 levels ranging from agreement to disagreement (Prendes-Espinosa et al., 2016). In addition, there are 5 questions with the contextual characteristics of the population (age, sex, faculty, area of study and campus).

The authors of the questionnaire carried out the construct validation that included an expert judgment carried out by 8 professionals in three consecutive rounds. The experts reviewed the questionnaire individually to validate the congruence of the items with the theoretical and methodological content and analyze the clarity of the questions (Prendes-Espinosa et al., 2016). Once validated by the experts, they conducted cognitive interviews with 24 subjects with 10 items to check the validity of the procedure and content.

Applying the questionnaire, those variables of the questionnaire were selected for the present article, which described the perception of the students on the use of digital tools to favor their learning strategies. The variables were classified into three dimensions: (1) variables describing the tools and resources they use for management and planning information; (2) variables that describe the tools and resources they use to regulate their learning process; and finally, (3) variables that reflect the tools and resources they use to reflect and develop metacognitive skills.

To verify the reliability of the questionnaire Cronbach's alpha was applied in accordance to the dimensions proposed in this article as described in Table 1, showing more than acceptable levels according to the requirements of our knowledge area.

Table 1. *Cronbach's Alpha Reliability*

Dimension	Cronbach's Alpha
Resources and tool for management and planning information	.751
Resources and tools for self-regulation of learning	.849
Resources and tools for reflection and metacognitves skills	.724

The investigation was carried out in three stages. The first consisted in the selection of the questionnaire. Next, the instrument was applied to the data collection. Finally, the data was analyzed with the SSPS (Statistical Package for Social Sciences) program in order to describe the profiles of the students from analyzing those variables that offered relevant information for the present study.

Each of the dimensions was analyzed first from a general perspective. In a second stage, the Kolmogorov-Smirnov normality tests were applied and significant differences between gender, training areas, and age were sought. However, the latter was not considered relevant since most of the sample is concentrated between 19 and 24 years. For the training area, the faculties were included considering the classification of the National Association of Higher Education Universities of Mexico (ANUIES in Spanish). This results into 5 areas of knowledge: Health Sciences, Natural and Fine Sciences, Social and Administrative Sciences, Education & Humanities, and engineering and technology.

In the normality tests, the result for each of the variables analyzed in the present study is $p \leq 0.05$ which indicates that the sample does not follow a standard distribution. Although all the clusters exceeded the threshold of 30 informants and the theory of the central limit could have been applied to admit any test of variance, it was preferred to proceed conservatively and perform non-parametric tests.

The U test by Mann-Whitney was chosen to analyze the gender, for two independent samples, to check for significant differences

between the sex of the students. For the training area, the Chi-squared test was chosen for K independent samples.

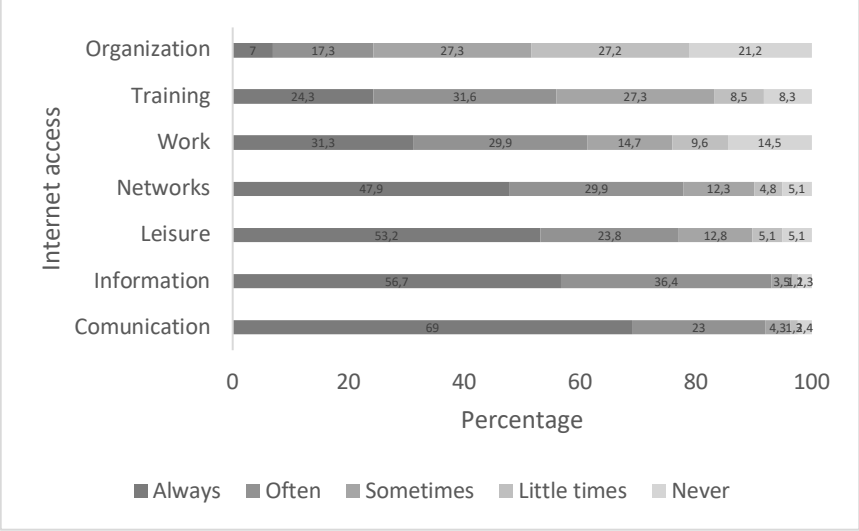
Results

Regarding the minimum characterization of the sample, a final sample of 374 questionnaires was obtained, they were answered by college students. 52.4% of the sample consisted of men and 47.6% of women. Regarding age, 15% was 18 years old or younger, 97% was between 19 and 24 years old and 2.7% are over 25 years.

It is important to mention that the scale was formed from 5 to 1, and that " always " was the maximum score and "does not use" the minimum rating. Regarding the use of the internet, it is observed that students access mainly to communicate, being chosen the option "always" by 69% of them ($\bar{X}$ =4.55, SD=.839). Followed by the variable to look for information in which the 56.7% of students also chose the option "always" ($\bar{X}$ =4.44, SD=.81).

In terms of access to the Internet for entertainment purposes, for social relations, and for work it was observed that students choose “always” in a 53.2% ($\bar{X}$ =4.15, SD=1.14), a 47.9 % ($\bar{X}$ =4.11, SD=1.11) and 31.3 % ($\bar{X}$ =3.54, SD=1.39), respectively. However, there is a significant decline in the use of the Internet in terms of training and organization purposes, since only the following chose "always" 24.3 % ($\bar{X}$ =3.55, SD=1.18), and 7 % ($\bar{X}$=2.62, SD=1.19), respectively. Figure 1 describes in more detail the distribution of the sample with respect to internet use.

Figure 1 Purpose of internet use



Resources and tools for self-management and planning

For the analysis of this dimension, we consider 4 categories with different variables each. The first category analyzes the students' perception of the use of tools and resources for their learning. According to the variables given in the questionnaire for this category, it is noted that frequencies of these variables are in "always" and "often" (Table 2).

Table 2 *Reason for the use of network tools*

Reason for the use of network tools	**Frequency of use**							
	Always	**Often**	**Sometimes**	**Rarely**	**Never**	**N**	**Average $\overline{X}$**	**SD**
The importance I give to learning	193	124	38	8	11	374	4.28	.94
The time I have for that learning	153	142	56	14	9	374	4.11	.95
The academic or professional assessment that this learning will have	139	144	60	12	19	374	3.99	1.05

The impact it will have on my network prestige	62	60	60	63	129	374	2.63	1.49

Part of the conformation of a PLE is the activity and use that are held in the network that leads to the construction of a digital identity (Álvarez, 2014).

On the other hand, Castañeda & Camacho (2012), describes two facets in the digital identity, on one side, the interest we show in the contributions of other users, our influencers, and the people we influence, and who therefore have an impact on the prestige we have in the network.

That said, in the analysis of the present study, it is striking that students rarely or never use digital tools because of the prestige that they can give them in the network. These data support the data found by Castañeda and Camacho (2012), who say that only one out of every four students is worried about their digital identity in their professional future. In their study, they realize that students are concerned about their image in the network, but in an immediate social way and not necessarily the impact on their professional future and employability.

In a second category, the preference in the student's tools to search for information is described. It is observed that 93.2 % of students do searches on general search engine (Google, Yahoo, etc.); followed by library, and databases in the network, option chosen by the 85 % of them. As for the specialized thematic search engines, this option is chosen by 68.2 % of the sample. It continues with specific search engines and social networks options chosen by 58.4 % and 58.1 %, respectively. Finally, several search engines and general forums are selected only by the 51.2 % and 50.7 %, respectively. These features describe the preferences of tools use for planning and managing their learning and provide knowledge as to which may be areas of opportunity to promote their use in students.

Regarding the study of the difference, we have found significant differences in terms of sex for the variables "When I want to learn something new I go to Wikipedia or encyclopedias in the network"

and for the variable "When I want to learn something new I go to experts in the subject in person" with $p \leq 0.05$. In table 3, it is observed that the mean of the first variable is higher for men and in the second variable it is higher for women. For the other variables analyzed, no significant differences were found between men and women.

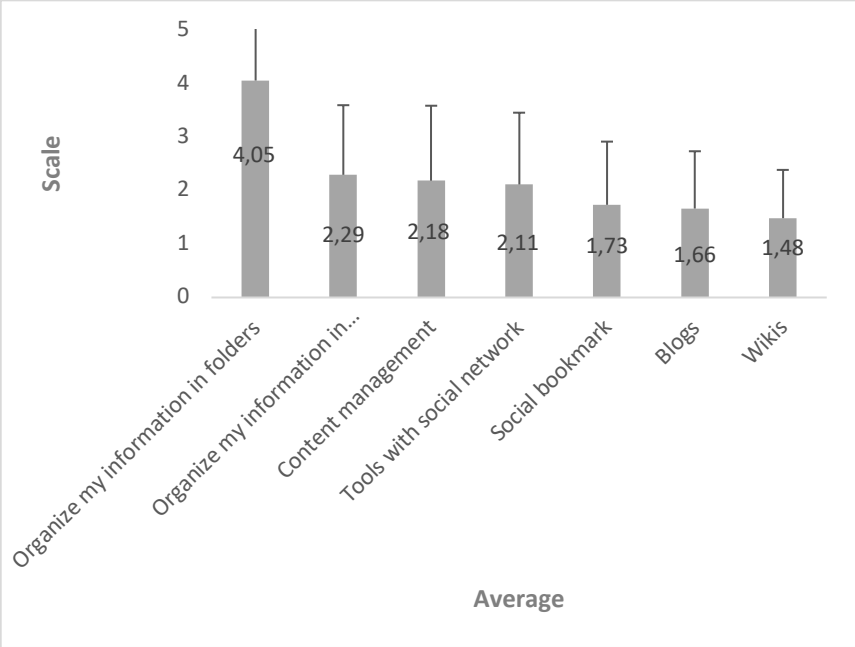
Table 3. *U by Mann-Whitney for gender*

WHEN I WANT TO LEARN SOMETHING NEW, I GO TO WIKIPEDIA OR ENCYCLOPEDIAS IN THE NETWORK							
	n	$\bar{X}$	**SD**	**Mdn**	**U de Mann-Whitney**	**Z**	**P**
MEN	192	3.20	1.41	3	14865	-1.967	.049
WOMEN	174	2.90	1.41	3			
WHEN I WANT TO LEARN SOMETHING NEW, I GO TO EXPERTS IN THE SUBJECT IN PERSON							
	n	$\bar{X}$	**SD**	**Mdn**	**U de Mann-Whitney**	**Z**	**P**
MEN	192	3.24	1.60	4	14114	-2.414	.016
WOMEN	174	3.73	1.302	4			

In a third variable, the tools that students use to organize and manage information were analyzed. In Figure 2, it shows that the main tool used to organize the information are folders with a preference of 64.2% ($\bar{X}$ =4.05, SD=1.39) in the option totally agree. It can also be observed that the following variables referred to are rarely used by the student body. Only 8.6% ($\bar{X}$ =2.29, SD=1.30) refers to “agree” on the use of timelines to organize the information, 9.1% ($\bar{X}$ =2.18, SD=1.40) for content management and 7°% ($\bar{X}$ =2.11, SD=1.34) for tools with social network. Also, in social media bookmarks only 5.6% is observed ($\bar{X}$ =1.73, SD=1.18), blogs 3.2%($\bar{X}$ =1.66, SD=1.07) and wikis 1.6% ($\bar{X}$ =1.48, SD=.90) agree on its use. The

latter reflects the little use that students give to tools with a social content that is an important source of PLEs. Since these tools allow interaction and communication with others, therefore in a way to relate and collaborate with the learning of others (Álvarez, 2014). Finally, it can be said that no significant differences were found between men and women.

Figure 2. Tools to organize and manage information



Another variable that was analyzed has to do with the tools the students use to learn something new. The sample was analyzed by training areas. The Chi-Squared test was applied to analyze the differences that may exist. In table 4, there are significant differences in the use of the tools they use to learn something new. Except in the variable of "colleagues and friends in person " and the variable "Specific mobile applications of the subject" with $p \geq .05$.

In the differences, it is observed that to learn something new, the area of education and humanities are those that use the resources of means of communication in network the most. In contrast, students in social sciences and administration use social networks more, asking a colleague by means of a message or email and an expert on the subject in person. For their part, the students of engineering and technology are the ones who use blogs, Wikipedia, forums, and

tutorials more. On the contrary, those who use digital resources are those in health and natural sciences

Table 4 *Chi square for resources that they use to learn something new by training areas*

Variable	$\bar{X}$/SD					X^2	gl	p
	Health	N.S	S&A	H&E	I&T			
Colleagues and friends in person	2.33 1.5	2.6 1.32	2.37 1.2	2.58 1.33	2.44 1.25	2.99	4	.558 *ns
Media Network	2.35 1.65	1.71 1.33	2.10 1.12	2.52 1.35	2.25 1.21	11.57	4	0.021
Blogs or WEB pages	2.83 1.88	3.55 1.15	3.74 1.31	3.47 1.29	4 1.13	14.95	4	0.005
Wikipedia or encyclopedias in network	2.52 1.78	2.81 1.19	3.31 1.44	3.14 1.36	3.32 1.34	10.86	4	0.028
Social networks	1.98 1.43	1.57 1.25	2.78 1.47	2.51 1.32	1.83 1.44	33.60	4	0
Forums	2.52 1.51	1.88 1.06	2.64 1.46	2.75 1.4	2.92 1.57	14.92	4	0.005
Tutorials in video, network, or slides	3.5 1.61	3.6 1.06	3.73 1.3	3.65 1.36	4.3 .891	13.6	4	0.009
Mobile applications specific to the theme	1.61 2.23	2.02 1.58	2.7 1.58	2.43 1.62	2.48 1.62	6.5	4	0.161

Colleagues, Friends, or experts contacted by mail or private messages on other platforms	2.63 1.78	2.67 1.37	3.36 1.56	3.15 1.76	2.78 1.66	11.96	4	0.018
Experts in the field face-to-face	2.94 1.87	3.21 1.4	3.81 1.34	3.72 1.36	2.87 1.46	24.0	4	0

*ns Not significant p≥ 0.005

About the tools they use to manage and organize information, there are significant differences between the areas of knowledge in "organizing the information in folders" (X2=19.06, p=0.001) which is preferred by the student body that belongs to the area of administration and social sciences that out of the total who preferred "always", 39.1% belongs to this area. On the contrary, only 7.6% from natural sciences chose this option.

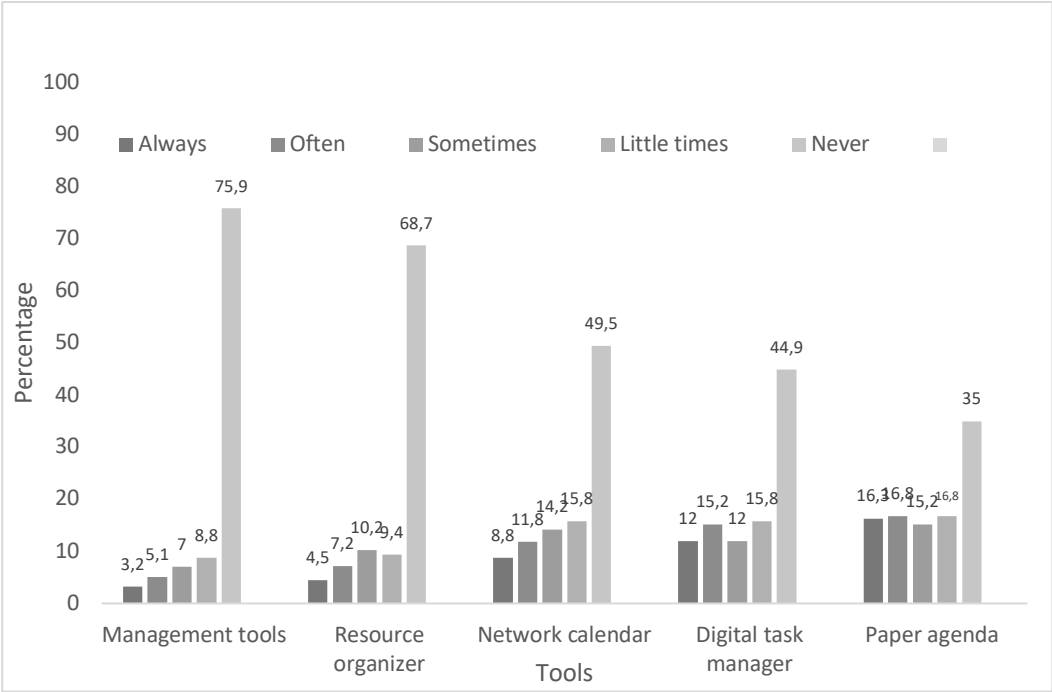
Regarding the "tools with social network" (X2=17.67, p=0.001) 50% of the option "always" belonged to the area of social sciences. On the contrary, only 3.8% belong to engineering and natural sciences.

Resources and tools for self-regulation of learning.

The tools they use to self-regulate their learning are those that allow them to plan and organize their learning, as well as those tools that they use to produce digital content and communicate with others. To analyze this category, three categories with their respective variables were analyzed.

The first category to analyze the tools that allow students to plan and organize their learning. As shown in Figure 3, they use very little digital tools. The paper agenda is the most used with 16.2 % in the "always" option. However, the digital task manager, network calendar, resource organizer, time management tools that students "almost never use" or "do not use".

Figure 3. Tools to plan and organize your learning



The second category analyzes the sample according to the tools that students use when they find an interesting document/video/audio. In table 5, there are significant differences between men and women. It is noted that there is a preference on the part of women to download the document and make notes, as well as to take notes on paper. In contrast, men prefer to take notes directly in a specific program for it when they watch a video or listen to an audio.

Table 5. *Action tools for documents differences by gender*

DOWNLOAD THE DOCUMENT TO THE COMPUTER AND TAKE NOTES IN A SPECIFIC TOOL							
	n	$\bar{X}$	**SD**	**Mdn**	**U by Mann-Whitney**	**Z**	**p**
MEN	192	3.48	1.48	3	14646	-2.028	.043
WOMEN	174	3.84	1.3	4			
PRINT THE DOCUMENT AND TAKE NOTES ON PAPER, PASS THE NOTES to a TEXT DOCUMENT							
	n	$\bar{X}$	**SD**	**Mdn**	**U by Mann-Whitney**	**Z**	**p**
MEN	192	3.28	1.20	4	14114	-3.55	0
WOMEN	174	3.85	1.38	4			
I SEE/LISTEN THE VIDEO/AUDIO IN THE NETWORK AND TAKE NOTES IN SPECIFIC PROGRAM FOR IT							
	n	$\bar{X}$	**SD**	**Mdn**	**U by Mann-Whitney**	**Z**	**p**
MEN	192	2.01	2.20	2	13693	-2.56	0.010
WOMEN	174	1.51	1.51	1			

On the other hand, there were significant differences by area of knowledge in the use of tools when the students find an interesting document/video/audio as described in Table 6. Social sciences and administration read notes and use a specific tool for this the most, bibliographic management tools and printing the document to take notes on paper. Au contraire, the area of natural sciences is those that take notes on paper the most when they watch/listen to a video.
Conversely, it is observed that the area of natural sciences is the one that uses bibliographic management tools the least when they find

an interesting document. Finally, the area of engineering and technology takes notes online the least when it comes to finding a document, printing the document, and taking notes on paper, and does not use notes on paper as much when they find a video/audio.
It may seem there is no difference in the questions corresponding to download a document and take notes while reading on screen, watch or listen to a video to take notes in a document and watch or listen to a video and take notes in a specific program and its average is in the range of rarely or never. Therefore, it can be inferred that they are used very little by the students, despite the potential they may have for their training.

Table 6. *Action tools for document/audio/video*

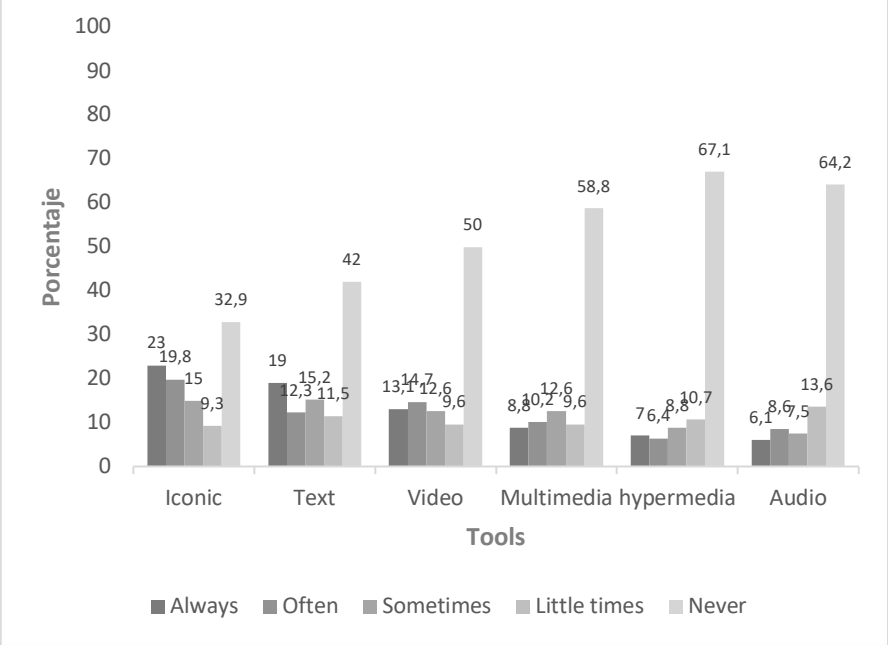
Variable	$\bar{X}$/SD					X^2	gl	p
	Health	N.S.	C.Sy A.	Hy E	IyT			
I read it online and I take notes in an online tool.	2.67 1.50	2 1.51	2.75 1.47	2.59 1.53	2.06 1.36	16.73	4	0.002
I include it in a specific bibliography management tool.	2.23 1.35	1.81 1.38	2.27 1.33	2.20 1.43	1.59 1.06	16.04	4	0.003
I download the document to my computer and take notes in a specific tool while I read it on the screen.	3.75 1.35	3.60 1.25	3.77 1.32	3.75 1.31	3.50 1.35	3.13	4	.536 *ns
I use metadata to incorporate it into my own resources.	2.67 1.50	2 1.26	2.49 1.41	2.41 1.30	1.81 1.08	16.05	4	0.003

I read it printed on paper and I take notes on the same paper; the notes are passed to a text document.	3.33 1.49	3.64 1.32	4.04 1.26	3.85 1.30	2.70 1.36	45.22	4	0
I listen to it/watch it on a network and I take notes on paper.	3.40 1.39	4.31 .841	3.43 1.37	3.70 1.44	3.08 1.41	22.75	4	0
I listen to it/watch it on a network and I take notes in a text document.	2.88 1.31	2.57 1.36	2.90 1.31	2.87 1.36	2.73 1.28	2.46	4	.651 *ns
I listen to it/watch it on a network and I take notes in a specific program for it.	1.98 1.29	1.90 1.37	2.17 1.36	2.15 1.48	2.06 1.27	2	4	0.734 *ns

*ns Not significant p≥0.005

The third category analyzes the sample according to the contents that the students produce to share. No significant differences between men and women were found. Therefore, it can be generalized that regardless of gender students preferred to produce iconic content, text, video, multimedia, hypermedia, and audio as can be observed with the Figure 4.

Figure 4. Content Production



There are also significant differences in the areas of knowledge, all with a value p≤0.005. As can be seen in table 7, the humanities and education area are the one that is most inclined to produce content in text, video, hypermedia, and audio. In the same way, the area of social sciences and administration is inclined to produce iconic contents. On the other hand, it is observed that the natural sciences area produces the least content in all its modalities.

Table 7. *Differences by training area in content production*

Variable	$\bar{X}$/SD					X^2	gl	p
	Health	N.S	S&A.	H&E	I&T			
iconic	2.68	2.33	3.19	3.04	2.81	10.48	4	0.011
	1.64	1.72	1.55	1.54	1.52			
Text	2.19	2.05	2.69	2.79	2.59	13.07	4	0.033
	1.52	1.73	1.58	1.51	1.43			
Video	2.36	1.69	2.42	2.75	2.02	18.12	4	.001

	1.60	1.29	1.55	1.55	1.30			
Multimedia	2.38	1.43	2.08	2.25	1.80	14.49	4	0.006
	1.60	1.01	1.36	1.51	2.21			
Hypermedia	1.96	1.36	1.87	2.05	1.36	19.49	4	0.001
	1.45	1.00	1.30	1.35	.88			
Audio	1.85	1.29	1.93	2.21	1.34	24.58	4	0
	1.38	.77	1.29	1.45	.801			

*ns Not significant $p \geq 0.005$

Finally, the fourth category describes the tools that students use to collaborate and communicate. As can be seen in Figure 5, they prefer using informal settings such as messaging and social networking. In contrast, formal environments such as virtual learning environments greatly reduce their preference. Resources and tools for reflection and development of metacognitive skills Finally, the tools and resources that students use for training were analyzed in this section. from three categories: a) resources and tools that increase their interest to learn, b) tools that help you better understand information, c) tools that allow you to reflect and solve problems.

In the tools that favor the interest to learn something in the formation of the students, it can be observed that there is still a preference for traditional, formal means, and that it implies a less participatory stance. As shown the Figure 6, students are mainly motivated by attending class sessions with 52.9% "Always". It follows the multimedia sites with 33%. The traditional media with 19%, the use of blog with 19%, social networks with 19.8% and media network with 18.2%. It is also seen that there is a considerable decline in the variables Twitter with 9.4%, forums with 7.8% and news to the mail with 5.9%.

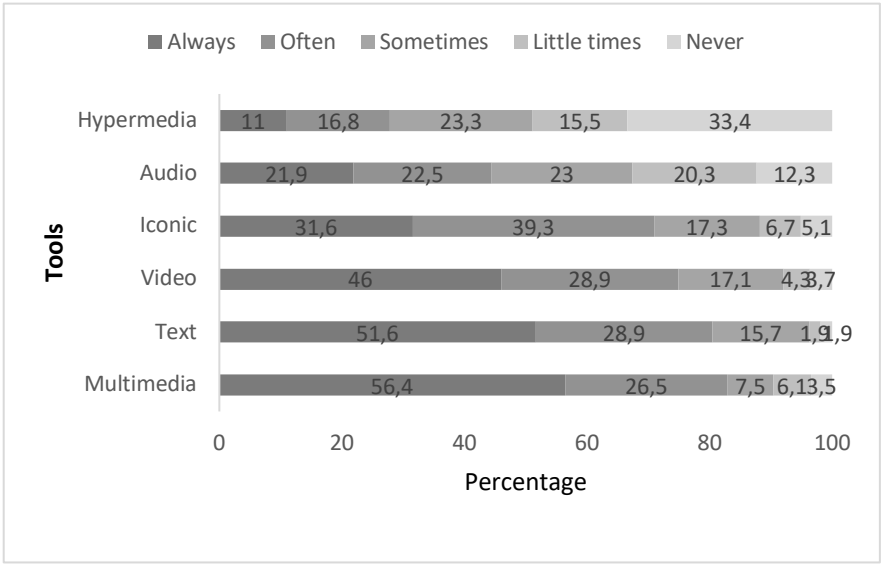
If significant differences are analyzed by gender, it means that there are differences in the use of Twitter and attendance with $p \leq 0.005$. With a preference for its use by women ($\bar{X}$ =3, SD=1.19) than men ($\bar{X}$ =2.11, SD=1.50).

It was analyzed by area of training that there are significant differences in this category. Especially, in the attendance variables,

twitter, social networks, and WhatsApp with a preference for the area of social sciences and administration. On the contrary, the area of engineering and technology and health sciences show the lowest values in these variables

For the second category, tools that allow you to understand the information, students have a considerable preference for the multimedia format with 56.4 %, text with 51.6 %, and video with 46 % in the option always. However, it is also observed that the hypermedia format only chooses the option always 11 %, which is a format that allows the possibility of navigating and interacting with other users' essential elements to communicate on the network and to be able to reflect on the information for the development of the metacognitive skills. Figure 7 shows this information in more detail. No significant differences were found between the areas of education and gender of the students.

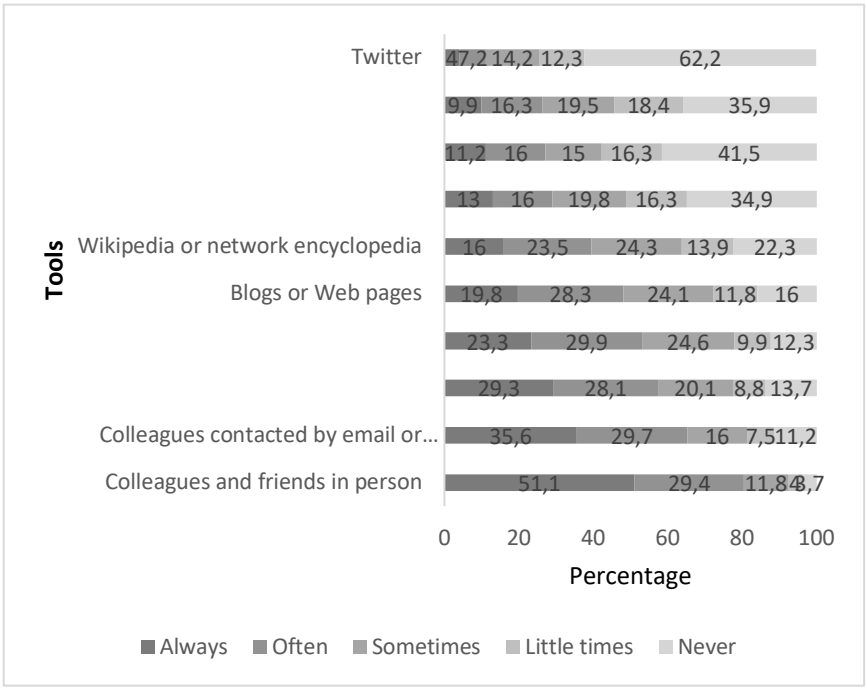
Figure 5. Tools and Resources Format to understand the data



In the third category, tools used primarily to reflect reflection of what they are learning, the students use little or hardly ever, as can be seen in figure 5, in which it is observed that the frequency of use of Blog in the option " always " is 6.7% and email is 4.5%. There is a slight preference for the use of Word of 20.3% and paper sheets 29.9%. However, in the 4 variables the option chosen by the students focuses on "almost never". Neither in this case were significant differences

found by gender or by areas of training. To end the analysis in this section students were asked who they go to in case of content doubt. In Figure 6, it is observed that the students prefer to go to colleagues or friends face- to- face with 51.1% in the "always" option, followed by looking for it through a message in a platform with 35.6% in the option always. However, we also note that, from the perception of students Twitter, internet forums, mobile applications, and social networks are valued with only 4%, 9.9%, 11.2% and 13% respectively in the option "always" are very little valued by them to resolve a content doubt (figure 6).

Figure 6. Resources and tools to resolve content doubt



Discussion

From all these exposed data, it is relevant to consider the use of Internet that students make to analyze their learning strategies in the PLEs. In this study, it is confirmed that they prefer to use the Internet to communicate and seek information and purposes related to leisure. However, they are not shown as a student body specially linked to knowledge construction processes in the formal field linked to the use of the network or the PLEs.

In this regard, Torres-Diaz, and al. (2015) reaffirms students who have an activity on the Internet for training with different tools based on the interaction between peers and teachers have a better academic performance than those who only use it to find information. And, in addition, the authors refer that the use of the internet for leisure moderately generates a positive impact on the academic development of students, since they have more skills to interact on the Internet. However, it seems that this would not be the scenario in which we find the sample analyzed, in the sense that they would be part of a group that apparently, and priori, wasted all this potential.

Therefore, this diagnosis leads us to consider that getting students perceive and use the Internet for training becomes an area of opportunity in college to promote a more complete development of their PLEs. Under the internet characteristics students should consider it as a tool for training, to develop strategies that will help them achieve their own learning objectives (Castañeda & Adell, 2014).

From the perception of the students, there is a clear preference for the use of more traditional tools and resources to organize and plan their learning, which often does not involve interaction. However, from the perspective of PLEs, these connections and interactions become relevant to manage and plan a form of learning that transcend the institutional limits and organize experiences for the construction of knowledge (Casquero, Ovelar, Romo, & Benito, 2014). More specifically, to building a PLE requires a proactive student participation that leads to the use and the management tools with a high degree of interaction and connections, for they can take control of their educational processes and plan their own learning (Rahimi et al., 2015).

On the other hand, in our data it is also observed that by training areas there are significant differences in the use of tools and resources for self-management and planning of learning. And, beyond the general assessment of technical consumer profiles, part of the limitations of this study is precisely not to have more profound to describe these differences. Is therefore required qualitative to learn more about methodologies is as differences. As for the tools they use for self-regulation, it was observed that students prefer tools with very limited social component, which puts them a passive place. We see that they almost do not produce content and, if they produce it, the format of the content is iconic or purely

textual. On the contrary, a PLE, from a pedagogical concept, requires students to develop skills to become prosumer of content. And this involves creating content, evaluating it from interactions, and making decisions about their own learning (Guodong & Xinghua, 2016; Manso-Vazquez & Llamas-Nistal, 2015; Rahimi et al., 2015) .

In turn, the social component of the PLEs allows collaboration with the other to interact and relate to promote knowledge exchanges and self-regulate from the organization and planning of learning (Guodong & Xinghua, 2016; Martínez et al., 2016)). As it is seen, all this abounds in the necessity to foment the interaction between the pairs, in opposition to what we find in our sample.

Finally, in the tools for the reflection and development of metacognitive skills, the same tendency has been taking place. From the students' perception, they use little digital tools to reflect on their own learning. In turn, they do not find a use of tools with a social component to understand information or solve problems.

As a conclusion, the perception that the students have about the use of digital tools for their formation is evident and worrisome. According to the UNESCO report on policies in the Latin-American education system (UNESCO, 2014), the Mexican average to OECD is that 10 % use tools for learning, which places the country in the second-to-last place of all the OECD members.

However, society today presents new demands that require rethinking the educational systems and modify the methodologies, emphasizing learning as a center of pedagogical practice (Martínez et al., 2016) and relying on ICT tools. And, for that reason, educational institutions must be proactive to face this challenge. The PLEs constitute a pedagogical approach that can propitiate new methodologies that suppose generating competences for the demands of the current world. For this, it becomes a necessity that institutions integrate opportunities that provide the PLEs and encourage the use of ICT with a strong social component (Martínez et al., 2016) to generate scenarios for the training of students and offer opportunities to build knowledge (Villaverde & Delgado, 2015).

References

Adams, S., Cummins, M., Davis, A., Freeman, A., Hall, C., &

Ananthanarayanan, V. (2017). *NMC.Horizon Report: 2017 Higher Education Edition.* Austin, Texas: The New Media Consortium. Retrieved from http://cdn.nmc.org/media/2017-nmc-horizon-report-he-EN.pdf

Álvarez, D. (2014). *Entornos Personales de Aprendizaje (PLE): aprendizaje conectado en red.* España: Ministerio de Educación, Cultura y Deporte.

Attwell, G. (2007). Personal Learning Environments - the future of eLearning ? *ELearning Papers*, *2*(January), 1–8. https://doi.org/10.1080/19415257.2011.643130

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: un e. *Cultura y Educacion*, *26*(4). https://doi.org/10.1080/11356405.2014.985945

Castañeda, L., & Adell, J. (2013). La anatomía de los PLEs. *Entornos Personales de Aprendizaje: Claves Para El Ecosistema Educativo En Red*, 11–27. Retrieved from https://digitum.um.es/jspui/handle/10201/30408

Castañeda, L., & Adell, J. (2014). Beyond the tools: Analysing personal and group learning environments in a university course | Más allá de la tecnología: análisis de los entornos de aprendizaje personales y grupales de estudiantes en una asignatura universitaria. *Cultura y Educacion*, *26*(4). https://doi.org/10.1080/11356405.2014.985946

Castañeda, L., & Camacho, M. (2012). Desvelando nuestra identidad digital. *El Profesional de la Informacion*, *21*(4), 354–360. https://doi.org/10.3145/epi.2012.jul.04

Chaves, E., Trujillo, J. M., & López, J. A. (2015). Self-regulated learning in personal learning environments on the grade of elementary education, university of granada, Spain | Autorregulación del aprendizaje en entornos personales de aprendizaje en el grado de educación primaria de la universidad de gra. *Formacion Universitaria*, *8*(4).

https://doi.org/10.4067/S0718-50062015000400008

Coll, C., & Engel, A. (2014). Introduction: Personal Learning Environments in the context of formal education / Introducción: los Entornos Personales de Aprendizaje en contextos de educación formal. *Cultura y Educación*, *26*(4), 617–630. https://doi.org/10.1080/11356405.2014.985947

Dabbagh, N., & Kitsantas, A. (2011). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and Higher Education*. https://doi.org/10.1016/j.iheduc.2011.06.002

Gallardo-Echenique, E., Bullen, M., & Marqués-Molías, L. (2016). Student Communication and Study Habits of First-Year University Students in the Digital Era. *Canadian Journal of Learning and Technology*, *42*(1), n1. https://doi.org/http://dx.doi.org/10.21432/T2D047

Guodong, W., & Xinghua, S. (2016). Building a personal learning environment with IFTTT service. *Journal of Software Engineering*, *10*(4). https://doi.org/10.3923/jse.2016.431.436

Haworth, R. (2016). Personal Learning Environments: A Solution for Self-Directed Learners. *TechTrends*, *60*(4). https://doi.org/10.1007/s11528-016-0074-z

Hernandez, R., Fernandez, C., & Baptista, M. del P. (2010). Metodología de la investigación. In *Metodología de la investigación* (5th ed., p. 656). México: McGrawHill. https://doi.org/- ISBN 978-92-75-32913-9

Manso-Vazquez, M., & Llamas-Nistal, M. (2015). Proposal of a Learning Organization Tool With Support for Metacognition. *IEEE Revista Iberoamericana de Tecnologias Del Aprendizaje*, *10*(2), 35–42. https://doi.org/10.1109/RITA.2015.2417932

Martínez, G., Nolla, N., Vidal, M., & de la Torre, L. M. (2016). Personal learning environments in the formal and informal training process | Los entornos personales de aprendizaje en los procesos de formación formales e informales. *Revista Cubana de Educacion Medica Superior*, *30*(3). Retrieved from

http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0864-21412016000300013

Patterson, C., Stephens, M., Chiang, V., Price, A. M., Work, F., & Snelgrove-Clarke, E. (2017). The significance of personal learning environments (PLEs) in nursing education: Extending current conceptualizations. *Nurse Education Today*, *48*, 99–105. https://doi.org/10.1016/j.nedt.2016.09.010

Prendes-Espinosa, M., Castañeda-Quintero, L., Solano-Fernández, I., Roig-Villa, R., Aguiar-Perera, M. V., & Serrano-Sánchez, J. L. (2016). Validación de un cuestionario sobre hábitos de trabajo y aprendizaje para futuros profesionales: Explorar los Entornos personales de Aprendizaje. *Revista Electrónica de Investigación y Evaluación Educativa*, *22*(2), 1–46. https://doi.org/10.7203/relieve.22.2.7228

Prendes, 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), 172–178. https://doi.org/10.18178/ijiet.2017.7.3.861

Rahimi, E., Van Den Berg, J., & Veen, W. (2015). Facilitating student-driven constructing of learning environments using Web 2.0 personal learning environments. *Computers and Education*, *81*. https://doi.org/10.1016/j.compedu.2014.10.012

Salinas, J. (2013). Enseñanza Flexible y Aprendizaje Abierto, fundamentos clave de los PLE. In *Universitat Jaume I* (pp. 53–70).

Torres-Díaz, J.-C., Duart, J. M., Gómez-Alvarado, H.-F., Marín-Gutiérrez, I., & Segarra-Faggioni, V. (2016). Internet Use and Academic Success in University Students. *Comunicar*, *24*(48), 61–70. https://doi.org/10.3916/C48-2016-06

Torres-Diaz, J. C., & Valdiviezo, P. (2015). Integración de redes sociales y entornos virtuales de aprendizaje Integrating Social Networks and Virtual Learning Environments. *Revista de Educación a Distancia*, (35). Retrieved from http://www.um.es/ead/red/35

UNESCO. (2014). *Políticas TIC en los sistemas educativos de America Latina*.

Valle, A., Barca, A., González, R., & Nuñez, J. (1999). Las estrategias de Aprendizaje. Revisión teórica y conceptual. *Revista Latinoamericana de Psicología*, *31*(3), 425–461. Retrieved from http://www.redalyc.org/pdf/805/80531302.pdf

Villaverde, V. A., & Delgado, V. (2015). Aprendizaje percibido y actitud hacia las TIC desde la perspectiva de los PLE Perceived Attitude Towards Learning and ICT From the Perspective of PLE, *5*, 91–110. Retrieved from http://www.redalyc.org/html/310/31045570006/