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Personal Learning Environments (PLE) in the Academic Achievement of University Students

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Abstract

The main purpose of this research is to analyze the elements that compose the PLE of pre-service teachers and to determine whether the composition of these environments is related to academic achievement in a course on Information and Communication Technologies in Education. The hypothesis is that a PLE with more components is related to a higher level of performance (higher grade in the course) and thus acts as a predictor of student achievement. A descriptive study is carried out. We analyze the PLE(tools, applications, services, and websites) of 245 university students who are pre-service teachers. The main outcomes and results are: the variability of components is very high, although there is a tendency toward concentration on seven elements and being different according specializations; also the students with a higher number of components in their PLE obtain higher grades. Finally, we draw implications for further research and for improving teachers' practices.

Introduction

There is currently a strong demand for research with the purpose of generating understanding on Personal Learning Environments (PLE) grounded in the concept that is proliferating in Web 2.0 (Atwell, 2007). The largest number of studies in the last five years focuses on the concept, definition, and elements that compose a PLE, but few studies attempt to confirm the extent to which this trend is related to academic achievement or other variables.

The Personal Learning Environment (PLE) is defined as a set of applications and tools, social media that provide a natural connection between formal and informal learning (Dabbagh & Kitsantas, 2012). The PLE makes it easier to perform different functions of information management in virtual environments and, as a result, to have good potential for constructing knowledge. Among the varied functions, we would stress searching, classifying, and filtering; creating and representing; personalizing and organizing; storing and recovering; communicating, collaborating, and sharing; and managing information.

Background

The theoretical frame of reference in this research is the PLE of pre-service teachers. Investigating the PLE of university students is interesting under any circumstances for university professors to know the tools with which their students work. But it is even more interesting in the case ofpre-service teachersfor the effect this will have on future generations. The PLE enables students to acquire greater control of what and how they learn. In the case of formal education, teachers will assume the role of active partnermemberswho must negotiate, exchange points of view, support the obtaining of necessary resources and validate the results of their learning (Väljataga & Laanpere, 2010).

The study starts from the question of professional practice itself. During the last few academic years, professors have asked university students to represent their PLE as part of an activity of reflection on their learning through a picture or diagram of ICT tools, in various courses on Information and Communication Technologies (ICT) in Education in a European university. It is reasonable to think that motivation for the assignment is not so much the activity itself—and its use as a diagnostic evaluation—but the promotion of reflection involved and the effect that this reflection can have on learning. It is for this reason that we believe it's important to evaluate the possibility and strength of a relationship—and what kind of relationship—between quality of the PLE represented and the student's performance.

The study by Valtonen et al. (2012) concludes that designing a PLE demands both ICT skills and awareness of one's own learning methods. The starting hypothesis is that reflecting on the tools, applications and services an individual uses to learn can promote some improvement in learning. If this occurs, it does so undoubtedly through an indirect effect. That is, the representations that students make in their PLE will be better if they have a higher degree of complexity, and this can be detected from their correlation with the grade earned in the course, among other possible analyses.

Conscious of the need for empirical research that associates the quality of the representations of PLE, reflection on PLE, and the student's performance, this article analyzes the relationship betweenPLE and academic achievement.

This study was informed usingthree bodies of important literature: (1) studies on the concept of the PLE in higher education, (2) research on institutional Virtual Learning Environments (VLE) in the student's PLE, and (3) research on academic achievement in the PLE.

Our research starts from the concept of PLE defined as a set of technological tools selected, integrated, and used by an individual to access new sources of knowledge (Chatti et al., 2010; Wild et al., 2008; Van Harmelen, 2006; Johnson & Liber, 2008). This is not a broad perspective. It focuses on the elements of a PLE, such as tools, applications, services, and websites that compose it. The concept is limited to tools that emphasize the role of the individual who learns with them in the framework of studies of Learning Environments.

Second, we focus on studies in which Learning Management Systems (LMS) or official institutional VLE canbe seen as yet another tool and may (or may not) be an element constituting an individual's PLE (Torres et al., 2008; White et al., 2010).

Third, literature is emerging on the degree to which a PLE can encourage learning results (Camacho & Guilana, 2011; Reisas, 2012; Gil, 2012; Attwell & Deitmer, 2012; Panckhurst & March, 2011). Studies by Reisas (2012) and Camacho & Guilana (2011) address the process of PLE creation. Reisas (2012) finds that students generate an environment that stresses the social, since "*technology enhanced learning environments alone don't facilitate students'achievement of the desired goals: Knowing how to use tools doesn't help students in emerging and complex situations; it only supports unquestioned and routine activities*" (Reisas, 2012,1).

In the teaching of foreign languages, studies like those by Gil (2012) and Panckhurst & March (2011) stand out. These researchers were keen to check whether this shift would compromise diversity, autonomy, openness, and interaction, which are keywords associated with network usage. Gil (2012) affirms that students pass from a basic PLE, constituted of tools recommended by friends and subjectto fashion, focusing on leisure and oriented almost exclusively to social relationships, to a PLE with more educational potential andincluding new tools, which takes into account the recommendations of teachers and parents. They also find improvements in linguistic competencies (the content developed, in this case), in digital competencies and analysis of information, andin the capability for collaborative work with colleagues.

Other studies have been performed on students from Faculties of Education in Spain who created personal learning networks (PLN) to contribute to personal and collective learning (Camacho & Guilana, 2011) and on empowering student teachers' PLE (Tur & Urbina, 2012).

Research Questions and Hypotheses

To examine the relationship between the components in the pre-service teachers' PLE and achievement in the course on educational technology, we sought to answer the following interrelated research questions:

- Research Question 1: Is there a profile type in the PLE of pre-service teachers in the study? What tools, applications, servicesand websites are most common?
- Research Question 2: Is there a relationship between the components in the pre-service teachers' PLE and the specialization they are pursuing?
- Research Question 3: Is there a relationship between the number of components in the pre-service teachers' PLE at the beginning of the academic year and theiracademicachievement at the end?
- Research Question 4: Is there a relationship between the presence of the institution'sLMS or VLEin the pre-service teachers' PLE at the start of the academic year and theiracademic achievement when it ends?

This study conceives PLE as interrelated learning instruments. It is grounded in studies by Atwell (2007), Johnson & Liber (2008) and Gil (2012), as well as Valtonen et al. (2012). We expect that the highest achievement of pre-serviceteachers will be found in the cases with a richer PLE that contains more components.

We therefore formulate the two guiding research hypotheses:

- Research hypothesis 1: The PLE of pre-service teachers from different specialties shows specific components that belong to their specialty at the start of a course in educational technology.
- Research hypothesis 2: Pre-service teachers whose PLE contain a greater number of components will show improved grades.

Material and methods

Participants

Pre-service teachers from a university in a European country were recruited in five classrooms for the study. A total of 245 undergraduate students were recruited. Participation in the study was compulsory. Participants' demographics and specialtiesare shown in Table 1 and Figure 1, respectively. The students represent all four specialties in the two-year Teacher Education programme and took the ICT course in either academic year 2010-2011 or 2011-2012. This course is related to the use of ICT for teaching in the classroom (second year of the undergraduate program). It's a compulsory subject in the curricula of teaching degrees and the contents and practices try to prepare the future teachers for the integration of technologies in their professional development.

Table 1 shows the data on the number of participants according to gender and area specialty within their Teacher Education programs.

Specialty	Participants	Men	Women
Teacher: Foreign Language Specialty (Year 2010-2011)	65	8 (12%)	57 (88%)
Teacher: Foreign Language Specialty (Year 2011-2012)	25	4 (16%)	21 (84%)
Primary School Teacher (Year 2011-2012)	56	21 (37%)	35 (63%)
Preschool School teacher (Year 2010-2011)	59	4 (7%)	55 (93%)
Degree in Social Education (Year 2011-2012)	40	5 (12%)	35 (88%)
TOTAL	245	42 (17%)	203 (83%)

Table 1. Distribution of the participants according to specialty and sex

The total distribution of the students in each specialty follows similar tendencies. By sex, all of the specialties in the study have a higher percentage of women than of men (Figure 1), with the greatest difference in the specialty of Early Childhood Education (95% vs. 5%).

Figure 1 represents the distribution according to age and gender of the total population of students from different specialties.

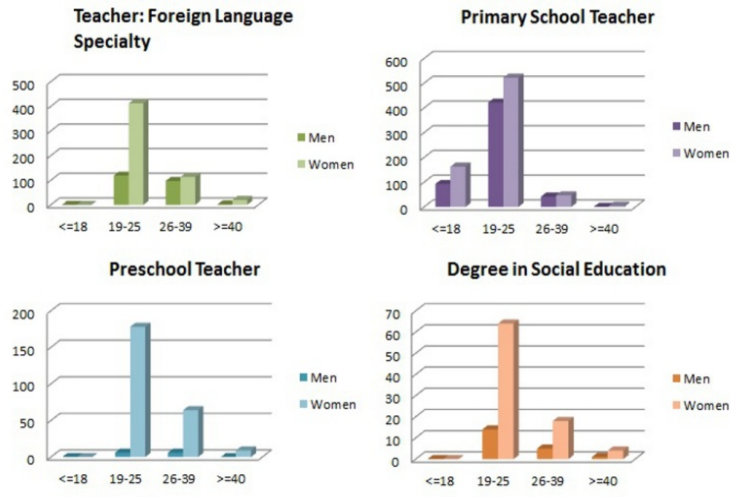

Figure 1. Characterization of the population according to specialty, sex and age

We see that the largest categoryin all of the groups corresponds to women between the ages of 19 and 25.

Procedure

In this study, as in the study by Väljataga et al. (2010), the students were free to choose tools, media and services to support their learning and to use them in a personalized way. In fact, the idea was deliberately not to have any interference or teacher influence or modification in the PLE. We therefore analyzed the PLE constructed at the beginning of the course.

The information was gathered through an activity proposed at the beginning of the course. In the first or second session, we informed the students of the meaning and main characteristics of PLE. We used the following classification of the basic elements of a PLE as an example (Adell & Castañeda, 2010, 2013):

1. *Tools and strategies for reading: information sources that I access that provide me with this information in the form ofan object or artifact(multimedia libraries)*
2. *Tools and strategies for reflection: environments or services in which I can transform information (places where I write, comment, analyze, relax, publish)*
3. *Tools and strategies for socializing: environments where I socialize with other people from/with whom I learn*

For each of the future teachers participating, we collected specific documents from this activity in the form of a diagram of their own PLE. In these representations, students show all the components that they use in their daily learning after they reflect about the building of this environment. Moreover, for the student's performance, we considered

the final grade that the student received in the course. The grade was determined by formative evaluation performed throughout the course and was composed of the following elements:

- Theoretical and practical activities (20%)
- Preparation of a project on good ICT practices in education, which included a report, a poster, a blog and a presentation of the project (50%)
- Final exam (30%)

We aim to confirm whether the construction of a rich, varied PLE is a significant element for predicting best results in the course.

Another question we investigate in this article is the repercussions of including institutional components (LMS or VLE) in the PLE. To do so, we determine the relationship between including or not including them in the PLE and the final grade that the student received in the course. The institutional elements are varied: (a) virtual teaching and teacher support platforms: LMS *Virtual Classrom, Moodle*, *SWAD* and University's Teaching Management space; (b) *Identified access* (platform for academic and administrative management for users at the University of Granada); *Webmail UGR* (corporate email system of theUniversity of Granada); and other institutional websites.

The procedures for analyzing the information gathered consisted of analyzing the representations of the PLE and then countingof the frequency and analyzing the correlations using SPSS.

Results and Discussion

In counting the components of the PLE, we find a total of 440 different types, including highly varied tools, services, and applications. As So et al. (2012) claim, the profile of the Net Generation student teachers shows a more heterogeneous composition than we initially expected, and teacher educators need to be cautious about making generational assumptions based solely on the structural and technological changes.
Despite the large number of different components, the most numerous and therefore those most used by the pre-service teachers are concentrated in the first 20. These 20 represent the great majority, more than the other three quarters of the elements, which were only used by fewer than five students.

Table 2 shows the 20 components mentioned most often by the students as active elements that enable their daily learning at the university. Note in the column "Frequency of appearance" the number of students who incorporate these items in their PLE. The table shows that nearly all of the students mention the first tools on the list.

	PLE COMPONENT	Frequency of appearance
1.	Tuenti	212
2.	Facebook	201
3.	Google web	196
4.	Youtube	195
5.	Wikipedia	174
6.	Hotmail	153
7.	Messenger	149
8.	MS Word	109
9.	Skype	97
10.	Official University SWAD	95
11.	MS Power Point	89
12.	Twitter	79
13.	Official University Webmail	75
14.	Gmail	65
15.	Official LMS Virtual Classroom	64
16.	Website of the University	63
17.	Dictionary of the Spanish Royal Academy	53
18.	Spotify	53
19.	University's Teaching Management space	52
20.	Windows Media Player	50

Table 2. The 20 components that appear most often in the university students' PLE

Among the components in Table 2, we would stress the social networking and communication applications, such as *Tuenti* (social network widely used by Spanish youth), *Facebook*, and *Hotmail*; information search services, such as *Google* and *Wikipedia*; and institutional teaching tools from the university itself (Official University *SWAD,* Official LMS *Virtual Classroom, Website of the University, University's Teaching Management space, institutional Webmail*). We also find other kinds of tools that the students consider useful in their learning, such as the programs *Word* and *PowerPoint* from *Microsoft Office* or *Spotify*.

The tools emerge spontaneously, generating differences from the study by García-Martín & García-Sánchez (2013), who provide the participants with the ten Web 2.0 tools most frequently mentioned in the review conducted of the international and Spanish journals. Differences in the ages, educational level, and uses to which these tools are put also influence this difference. The importance of social tools to enhance the experiences of students is highlighted in other studies such as Mathews, Andrews & Adams (2011).

Figure 2 represents what might be a typical diagram of a PLE of a future teacher, Education student today. We use it to represent the 10 most-used components with a size proportional to the number of students who mention each (Table 1) in order to provide a visual representation of the importance of each.

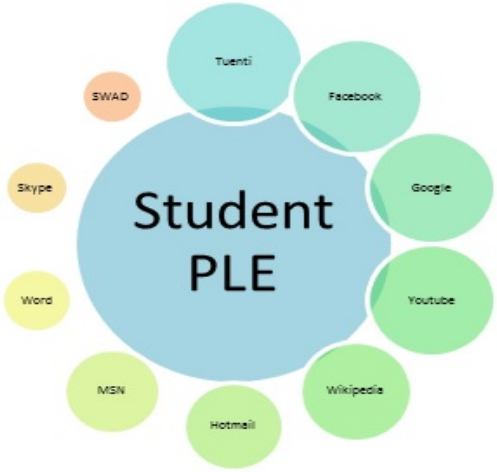

Figure 2. Model of a typical Education student's PLE (Top ten)

To confirm whether there are significant differences between specialties, Table 3 presents the 10 elements most mentioned by specialty. We can see that seven elements are repeated, although in different order of importance, in the four specialties studied.

Teacher: Foreign Language Specialty		**Primary Education Degree**		**Preschool Education Degree**		**Social Education Degree**	
Tuenti	76	Tuenti	52	Facebook	50	Google web	37
Facebook	74	Facebook	44	Google web	50	Tuenti	34
Google web	72	Youtube	44	Tuenti	50	Youtube	34
Messenger	69	MS Word	43	Youtube	48	Facebook	33
Youtube	69	Wikipedia	39	Wikipedia	41	Hotmail	30
Wikipedia	64	Google web	37	SWAD	37	Wikipedia	30
Hotmail	57	MS Power Point	36	Hotmail	34	Skype	18
WordReference	44	Hotmail	32	Messenger	32	Messenger	17
Skype	42	Messenger	31	Official LMS VirtualClassroom	21	MS Word	17
MS Word	40	Windows Media Player	31	Skype	21	Twitter	14

Table 3. Frequency of components of the students' PLE by specialty

In each specialty, the students add some components directly related to their area of specialization. For example, students in the Foreign Language specialty quite often choose the online language dictionary *WordReference* as part of their usual learning environment. The students in the Primary Education program incorporate applications such as *Geogebra* for the teaching of mathematics, and students pursuing the Social Education certificate seek websites with content more closely related to their interests, such as *Amnesty International* or the Social Educators' gateway *eduso.net*.

If we compare the results obtained by sex, we can confirm that there are no significant differences between men and women. As shown in Table 4, the average number of tools that women incorporate in their PLE is slightly higher than that of the men, although so is the average grade obtained. The difference is slightly higher in the number of women who incorporate institutional tools in their environments, as shown in the last column of Table 4.

	COMPONENT AVERAGE	AVERAGE GRADE	INSTITUTIONAL COMPONENTS
MEN	15.3	6.7	60%
WOMEN	16.1	7.2	68%

Table 4. Distribution of components and grades by sex

Now that we have presented the general results obtained from analyzing the representations of the students' PLE, we will investigate the relationships between the representations and the results obtained by each student in the course taken. To do this, we establish the correlation between the number of components that the student mentions in his/her representation and the final grade obtained in the course.

There is a significant Pearson correlation (r=0,230) between the variable *Final Grade* (grade obtained by the student at the end of the course) and the variable *Number of Components* (number of elements that the student mentioned in his/her PLE). Correlation is significant at the <0,01 level (bilateral). We can thus determine that there is a relationship between the variety and richness of student's environment and the final grade achieved in the course. This relationship could be joined to other results from other studies, such as previous performance, integration or self-efficacy (McKenzie & Schweitzer, 2001). The scatter plot of the relationship of these two variables is observed in Figure 3.

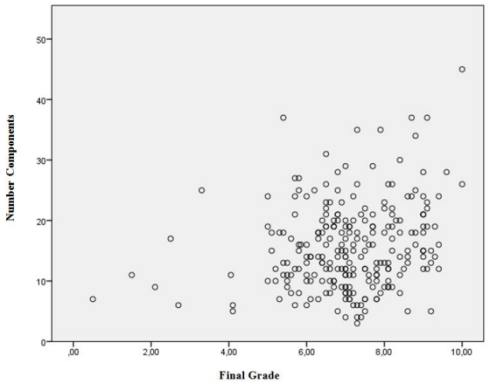

Figure 3. Scatter plot of the relationship between variables Final Grade and Number of Components

We have also attempted to study the relevance of including official tools and services of the university institution in the student's PLE. In this section, we counted the different teaching support platforms in the University, as well as the institutional email services and student information webpages. Of all students who participated in this study, 33% did not incorporate any of these tools in their PLE, while the others included at least one of the elements.

If we compare the grades earned by the students who incorporated the institutional components to those who did not, we see that the distribution of grades is very similar, except in the ranges of higher grades, where we find a significant difference between students. A larger number of students who incorporate the institutional tools in their PLE also obtain the highest grade (Excellent). This comparison can be seen clearly in Figure 4.

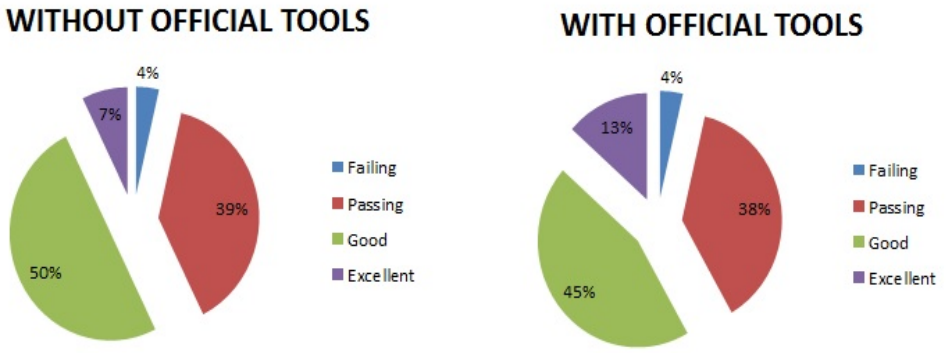

Figure 4.Comparison between grade and use of institutional tools

The institutional and space-time context of the investigation conditions the results obtained, although the significance of the results of this study are especially interesting in contexts of universities with similar characteristics.

Conclusions and implications

Hypotheses 1 and 2 have been confirmed. First, the PLE of the pre-service teachers from different specialties show specific components that belong to their specialty at the beginning of a course in educational technology. The university professor should therefore start by taking this background that the student has incorporated into account at the start of the course; learning in no way starts from zero. Second, although quantity does not necessarily mean quality, pre-service teachers whose PLE have a higher number of components definitely show better grades.

The implications of those findings can be discussed through various arguments:

The PLE of university students become particularly interesting when we seek the reorganization of educational technology by shifting the "locus of control" of technology towards the learner.The students' PLE seem to be much richer and more varied than those of the university institution (including those of the professors and staff), although professors should still help students to share tools and attempt to enrich existing ones to help students in certain aspects of their learning. Finally, one should attempt to take advantage of the PLE in teaching.

From the descriptive and interpretative point of view, the pre-service teachers' PLE are ephemeral and changing. Users' preferences vary for the same utility. For example, one does not find *WhatsApp Messenger* in the first year, but it is extremely frequent in the second. One of the tools that appears most often, *Windows Live Messenger*, used for free instant messaging, is replaced by *Skype* and *Facebook*, which also begins to appear in the PLE (the contacts are updated to *Skype* instant messaging). The speed of change in the PLE is definitely greater than that of the university as an educational institution. This means that we must continue to research the major factors driving technology adoption (Cheung & Vogel, 2013).

More in-depth research should be performed, in which the students reflect to a greater extent on the construction of their PLE. That is, research could continue with a second

phase, in which case studies are used, having the students record the tools that they use every day for at least a week.

If we add up all of the appearances of the university institutional elements, the set of tools, applications, and services of the PLE take first place. This finding has two possible explanations: first, that in matters of learning, the students understand clearly that learning occurs primarily—or that they give a special place to learning—within the institution; second, unfortunately, there are a great number of institutional tools in the university (since the same PLE can have at least six different tools that belong to the institution). To these two interesting ideas, we would add another, more suggestive one: it is worth noting that1/3 of the students do not indicate any of the university tools in their PLE.

Finally, it would be interesting to develop in greater depth measures of students' perceptions of constructivist-based, personal learning environments and students' self-efficacy beliefs (Ellet et al., 1997) and how they can be engage in this online environments (Dyment, Downing, & Budd, 2013). It would also be interesting to use students' rating information for formative evaluation purposes and students' reflections on personal learning as an element of assessing the quality of teaching and learning in higher education settings. One promising line of research is self-evaluation connected to reflection on the student's PLE. According to Kim & Hannafin (2011), research is needed to refine our understanding of situated case-based approaches' potential both to promote meaningful technology integration knowledge and skill and to address a range of everyday classroom teaching and learning issues, decisions and practices. This effort would let to approach the current environments of learners ().

In this study, we considered only the different components that each student mentioned, taking into account the tools, applications and services related to the use of the computer and Internet. Future studies could analyze the relationships between these and other elements related to the students' physical environment or elements of the PLE, as they influence connections and might lead to a view of PLE as a flexible process to scaffold individual and community learning and knowledge development (Atwell & Deitmer, 2012).

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