Analysis of PLEs' implementation under OER design as a productive teaching-learning strategy in Higher Education. A case study at Universidad Nacional de Educación a Distancia

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Abstract

This paper shows some research which analysed the didactic functionality of Personal Learning Environments (PLEs) and Open Educational Resources (OERs). They were created by students from the Master's Degree in Information and Communication Technologies applied to language teaching and processing, at Universidad Nacional de Educación a Distancia (UNED, Spain). A thorough analysis has been carried out based on a virtual ethnography methodological framework, with a twofold qualitative dimension: on the one hand, by using the Atlas-Ti program and on the other hand by following a reticular, category-based social network analysis with UCINET and yED Graph Editor. Results show that the joint use of PLEs and OERs designed by students improves their digital competence, mainly in capabilities such as: accessing and searching for online information; articulating information needs; finding relevant information; selecting resources effectively; navigating between online sources; and creating personal information strategies. Furthermore, the scrutiny of the forums using the reticular social network analysis shows how the main benefits of the implementation of PLEs and OERs are: a student-centric approach, the development of personal knowledge management strategies and the formation of a self-regulated learning model.

Keywords

Personal Learning Environment, Open Educational Resources, Higher Education, competences, teaching methods.

Análisis de la ejecución PLE ' en fase de diseño REA como una estrategia productiva de enseñanza-aprendizaje en la educación superior. Un estudio de caso de la Universidad Nacional de Educación a Distancia

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Resumen

Este artículo presenta una investigación en la que analizamos la funcionalidad didáctica de los Personal Learning Environment (PLE) y los Open Educational Resources realizados por estudiantes que cursan el "Máster universitario en Tecnologías de la Información y la Comunicación en la Enseñanza y Tratamiento de Lenguas" de la Universidad Nacional de Educación a Distancia (UNED) durante dos cursos académicos: 2014-2015 / 2015-2016. A través de una concepción metodológica basada en la etnografía virtual, aplicamos un procedimiento de análisis con una doble vertiente cualitativa mediante el empleo del programa Atlas-Ti y del enfoque reticular-categorial del análisis de redes sociales con la aplicación de UCINET y la representación mediante el visor yED Graph Editor. Los resultados de esta investigación muestran que el empleo conjunto de PLE y OER diseñados por los propios estudiantes mejora su competencia digital, principalmente en dimensiones como: búsqueda de información en línea, articulación de las necesidades de información, localización de información relevante, selección eficaz de recursos, navegación entre recursos en línea y creación de estrategias personales de información. Además el estudio reticular de los foros mediante técnicas de análisis de redes nos han proporcionado una red en los que los principales beneficios de los PLE y OER se relacionan con las siguientes categorías: enfoque centrado en el alumno, desarrollo de estrategias para el manejo de la información y la creación de un modelo de aprendizaje auto-regulado.

Palabras clave

Entornos personales de aprendizaje, recursos educativos en abierto, educación superior, competencias, métodos de enseñanza.

I. Introduction

The current context of massive and open education is changing the methodological paradigm of Higher Education towards the development of a methodology oriented to video-simulation and self-creation content (Chatti, Schroeder, & Jarke, 2012; Castañeda & Adell, 2013; Vázquez-Cano & Calvo, 2016). Due to this new educational change, a plethora of emerging web applications and widget-based aggregation tools provide numerous options for learners to access, synthesize, organize, and create content. At the same time, networked individuals enjoy unprecedented access to subject matter experts and open opportunities to collaborate with fellow learners around the globe. Personal Learning Environments (PLEs) can be seen as the spaces in which people interact and communicate and whose ultimate result is learning and the development of collective know-how (Dabbagh & Kitsantas, 2012; Veletsianos & Kimmons, 2012; Conole, 2013). In terms of technology, PLEs are made-up of a collection of loosely linked tools, including Web 2.0 technologies, used for working, learning, reflection and collaboration with others (CETIS, 2006; Attwell, 2007; Marin, Negre, & Perez, 2014).

In this academic and social context, the role of teachers should focus on two aspects: first, as a precursor of a methodology consistent with the new paradigms collaborative and mediated by ICTs (Information and Communication Technologies) and, second, as a content creator in fully accessible formats for integration into a ubiquitous, mobile, and visual universe (Drexler, 2010ab). Higher Education institutions can play a critical role in supporting their teaching staff in the creation of effective teaching and learning environments for students and providing ongoing opportunities for professional development (Shaikh & Khoja, 2014; Martín-Monje, Vázquez-Cano, & Fernández, 2015). Identifying and developing learning resources are both integral parts of this process. Institutions should aspire both to create Open Educational Resources (OER) and to use OERs from elsewhere. Students must be proficient in both decoding and encoding multimedia materials for developing their skills in Higher Education. In this context, increased online access to OERs has further promoted individualized study, which, coupled with social networking and collaborative learning, has created opportunities for pedagogical innovation (Berners-Lee, 2010; Okada, 2012). Learning occurs through interaction between members of a learning community; these learning interactions are considered learning activities; and the learning activities can take the form of words, written and spoken, images, video, multimedia, etc. (Downes, 2007).

In this article we will deal with the development of PLEs from the point of view of the materials for the creation and sharing of content, both for teachers and students. We need to consider learners not only as the subjects of learning, entities to whom we deliver learning content, but also the sources of learning, functioning as the perceptual input for the wider network. We concur with Fuchs (2005) that the Internet should not be considered as a mere technological system, but as a socio-technological system by encouraging PLEs and OERs inside them, learners are also taught how to construct, regulate, and control their own learning; thus creating a lifelong learner. From a social and pedagogical perspective OERs may support lifelong learning and personalized learning; therefore, it is important to explore how learning takes place within the framework of OERs. These, embedded in personal learning environments, will move the power over learning from the institutions to individual learners. In this context, teaching and learning material is not necessarily created by the subject teacher or even by a teacher at all; learners should be actively involved in the process of designing curricula and syllabi and in the creation of knowledge.

II. PLEs and their development in Higher Education

The most important idea related to PLEs is that it is not an application (Attwell, 2007; Wilson, 2008); it is a concept for organizing learning. Graham Attwell (2010), one of the first researchers to write about PLEs, defined them as "the spaces in which people interact and communicate and whose ultimate result is learning and the development of collective know-how". The idea of the PLE is that it performs many of the functions of a content management system and of a social network system but from the perspective of the individual rather than the community or the institution (Attwell, 2007). In relation to technology, PLEs are configured with a collection of digital tools which can be used for working, learning, reflection and collaboration with others (Castañeda & Camacho, 2012; Dabbagh & Kitsantas, 2012). These digital environments give learners more control by allowing them to adapt their learning experience and connecting with other students, teachers and researchers (Marín, Salinas, & De Benito, 2012; Johnson & Sherlock, 2014). The main characteristics of PLEs are: first, they are mobile, flexible and not context dependent. They can move from one domain to another and make connections between them. Second, PLEs can support and facilitate a greater variety of relationships than traditional educational media. These include relationships within and between networks and communities of practice and support for collaborative working. And third, PLEs support a greater range of learning discourses than traditional educational technology. PLEs are able to link knowledge assets with people, communities and informal knowledge (Attwell, 2010; Downes, 2010; Griff, Matter, 2013; Hicks & Sinkinson, 2015) and support the development of social networks for learning. For this purpose, a PLE can use social software for informal learning which is learner driven, problem-based and motivated by interest that reinforces collaboration, community engagement, and also for embedding learning into working and living processes, generating a "community of innovation". To effectively perform all these functions PLEs must be able to support mobile communication devices (Drexler, 2010a; Mercier & Higgins, 2013) and integrate various digital resources than can be developed in community and available for all learners. A network of PLEs is a learning network.

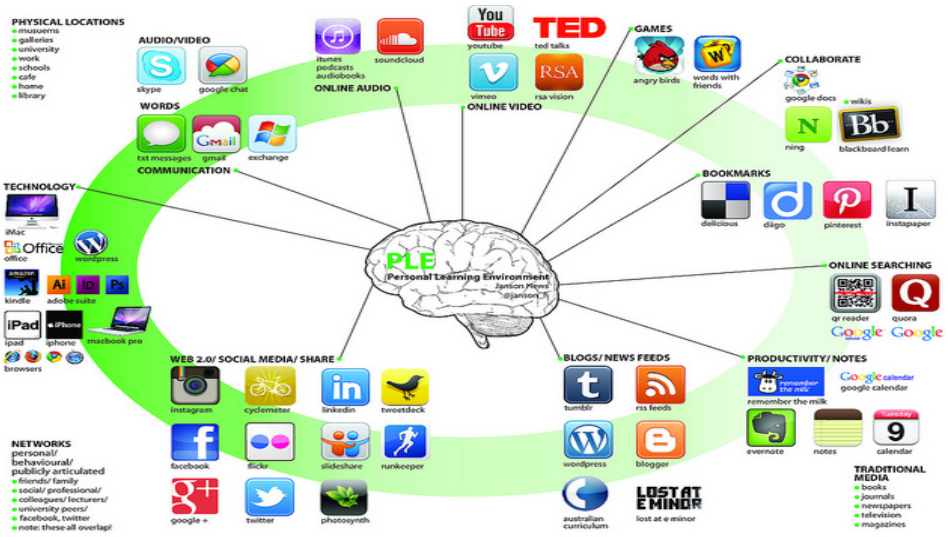

Figure 1. Characteristics of PLEs. (Photo credit: Janson Hews)

Despite these advantages, PLEs have to overcome some shortcomings:

- They rarely propose specialized learning content and tools.
- There are not enough visual tutorials for building personal learning spaces or semantic tools usage.
- There is an insufficient collection of easy-to-use semantic tools.
- They may pose problems in searching for relevant content.
- Significant computer skills are needed for arranging a good PLE space.

Nowadays current learning systems are teacher or institution-centered learning environments (CETIS, 2006) based on institutions, universities, teachers, courses, terms, timetables, etc.; and consequently they are based on the needs of the institution rather than the learner (Downes, 2010; Alloway et al., 2013). We might say that the formal curriculum is being pressured from two sides: on the one side, a growing body of data about the power of experiential learning in the co-curriculum; and on the other side, the world of informal learning and the participatory culture of the Internet (Bass, 2012; Singh & Holt, 2013). The subjects and courses offered are limited because they cannot adapt to the rapidly changing environments; they are developed for the average student; they are typically isolated from other bodies of knowledge; and they are on a timeline (Hall, 2010). Institutions generally offer learning services based on Learning Management Services (LMS), in which each course starts and finishes following a fixed schedule (Vázquez-Cano, Fombona, & Fernández, 2013). For instance, the Spanish National Distance Learning University (Universidad Nacional de Educación a Distancia, UNED) offers their students an LMS devised by the university itself, called aLF. These learning services, also called Virtual Learning Environments (VLEs), are used by almost any Higher Institution, but do not support lifelong learning, and additionally, they cannot be accessed by learners after they have graduated from that institution. They are quite effective for developing formal studies and subjects of the different university degrees but they fall short in delivering open materials and integrating the socio-digital learners' environment, since learners desire a learning system allowing for learning opportunities anywhere, anytime, and accessible by anyone (Drexler, 2010b; Sánchez & García-Rodicio, 2013). In that sense, PLEs go beyond the capabilities of an LMS or VLE and provide the opportunity to integrate and create OERs and allow students to control their own learning. While Higher Education has been the dominant force in formal learning, it seems that more and more individuals are exploring alternative learning routs and exploring PLEs, which incorporate the strengths of constructivism and connectivism learning theories as well as those of self-directed learning, and empower self-directed learners to access and control their path, not only in foreign language learning (Guth, 2009; Martín-Monje, 2012) but in Education in general (Cheung & Vogel, 2013).

An ideal educational scenario should include the development of PLEs inside the LMS provided by Universities, and consequently the learner would continue developing knowledge and interactions after formal learning has ended. One of the main strengths of PLEs is the varied resources that can be accessed and controlled. In the Personal Learning Environments Reference Model Project conducted by the University of Bolton in 2006, researchers identified 77 different patterns of use and classified them under 8 categories*: 1) chat and messaging tools; 2) groupware and community tools; 3) calendaring, scheduling, and time management tools; 4) news aggregation tools; 5) weblogging and personal publishing tools; 6) social software; 7)authoring and collaboration tools; 8)and integration tools* (CETIS, 2006; Wilson, 2008). Moreover, there are some extra digital tools and open-source materials such as mini-videos, concept maps or portfolios which can be freely accessed in PLEs and can be created and adapted by students and teachers.

a. Open Educational Resources: creating and sharing digital content

According to UNESCO, the concept of "Open Educational Resources" (OERs) describes any educational resources (including curriculum maps, course materials, textbooks, streaming videos, multimedia applications, podcasts, and any other materials that have been designed for use in teaching and learning) that are openly available to be used by educators and students, without the obligation to pay royalties or license fees. The concept of Open Educational Resources (OER) was originally coined during a UNESCO Forum on Open Courseware for Higher Education in Developing Countries held in 2002. During a follow-up, online discussion, also hosted by UNESCO, the initial concept was further developed as follows:

> *Open Educational Resources are defined as 'technology-enabled, open provision of educational resources for consultation, use and adaptation by a community of users for non-commercial purposes. They are typically made freely available over the Web or the Internet. Their principle use is by teachers and educational institutions to support course development, but they can also be used directly by students. Open Educational Resources include learning objects such as lecture material, references and readings, simulations, experiments and demonstrations, as well as syllabuses, curricula, and teachers' guides.* (Wiley 2006).

Pedagogically, the concept is underpinned by the notion of using resources as an integral method of communication of curriculum in educational courses. Specifically, it is the ease with which digitized content can be shared via the Internet that has the potential to unleash the full power of resource-based learning without bankrupting educational systems. Importantly, as with "Open Source", the key differentiator between an OER and any other educational resource is its license (Downes, 2007; Bissell & Boyle, 2007). Thus, an OER is simply an educational resource that incorporates a license that facilitates reuse —and potentially adaptation— without first requesting permission from the copyright holder (Lowe, 2010). This opens up opportunities to create and share a wider array of educational resources, thereby accommodating a greater diversity of student needs. The digital information, combined with its increasingly widespread dissemination, poses significant challenges to concepts of intellectual property. As a result of this new trend, copyright regimes and business models for publication have become under scrutiny.

Teachers and students need to create and develop learning materials: the former when developing an adequate methodology and the latter as they learn by doing. For this reason, it is really important to use technology as a partner in the teaching and learning process to engage and support thinking and reflection. The design of OERs gives learners the option to set their own goals and reflect on their progress in an effort to allow them to understand their learning process, and perhaps apply this learning to new situations in the future. Actual structures of the network, along with many of the resources exchanged in the network, are created by the students themselves. Teachers and students are placed in the role of a producer of content, artifacts, and knowledge requiring them to make decisions and wrestle with real issues associated with designing a meaningful PLE (Smith & Casserly, 2006). This requires each member of a group to achieve a common understanding of the tasks presented and to agree on the stages and the methods they would use to achieve the goal of the project. For this purpose, the accompanying OERs should be created, including the following characteristics: access/search for information and knowledge; aggregating and scaffolding by combining information and knowledge; manipulating, rearranging and repurposing knowledge artefacts; analyzing information to develop knowledge; reflecting,

questioning, challenging, seeking clarification, forming and defending opinions; presenting ideas, learning and knowledge in different ways and for different purposes; representing the underpinning knowledge structures of different artefacts and support the dynamic re-rendering of such structures; sharing by supporting individuals in their learning and knowledge; and networking by creating a collaborative learning environment.

The students of the 21st century need to cultivate an active global citizenship and for that purpose, employability, transferable skills and knowledge, communication skills, creativity and innovation are needed. When OERs are adequately implemented, students have great potential to support Higher Education providers in sourcing, adapting and producing OER in partnership with academic staff. Although creating teaching and learning environments that harness OERs in educationally effective ways is primarily the responsibility of faculty, student bodies —as key stakeholders in Higher Education— should be aware of the relevant issues and integrate them as appropriate into their interactions with other students.

In this context, it is suggested that student bodies (UNESCO, 2011ab):

1. *Understand the issues of OER and undertake advocacy of OER*. Students should adopt a producer role as active participants in the learning process.
2. *Encourage their members to publish work as OER*. Students can make a significant contribution to increasing the use of OER by publishing their work (preferably under the guidance of academic staff and within institutional protocols) under an open license.
3. *Take an active role in assuring the quality of OER through social networks*. Student bodies can encourage students to participate in the social networking environments that have been created around OER repositories, so that they play an active role in assuring the quality of content by adding comments on what content they are finding useful and why.
4. *Recognise that ICTs are an increasingly important part of the Higher Education experience* and are often crucial for students with special educational needs.
5. *Encourage student participation in activities to support OER development*. Student bodies can help to shape the nature and quality of students' educational experiences by encouraging and supporting the use of OER for the purposes of self-directed study and, at the more advanced levels, by having students create their own curriculum/courses of study.

III. Methodology

a. Context and description of the research project based on PLE and OER self-creation

All the activities related to action research were organized fully online in the Moodle-like virtual learning environment developed by UNED, aLF, as devised in the course in which this research took place, "Creation and edition of printed and audiovisual materials", within the Master's Degree in Information and Communication Technologies applied to language teaching and processing offered by this university.

The design of this course is based on the study of different topics with the help of reference books and online resources. These topics revolve around three main content blocks: 1) School, ICT and language teaching; 2) theoretical foundations and resources for the design of audiovisual materials and learning environments in online teaching; and 3) Applicability of digital materials to foreign language teaching. Students are subsequently asked to critically summarize the most prominent

aspects of each topic, using an audiovisual format. With that aim, students are offered a range of free online tools which can be used to generate OERs. These past two academic years the chosen tools have been the following:

- **Lino** (http://en.linoit.com/).

Lino is an online sticky note service that can be used to post memos, to-do lists, ideas, and photos anywhere on an online web canvas.

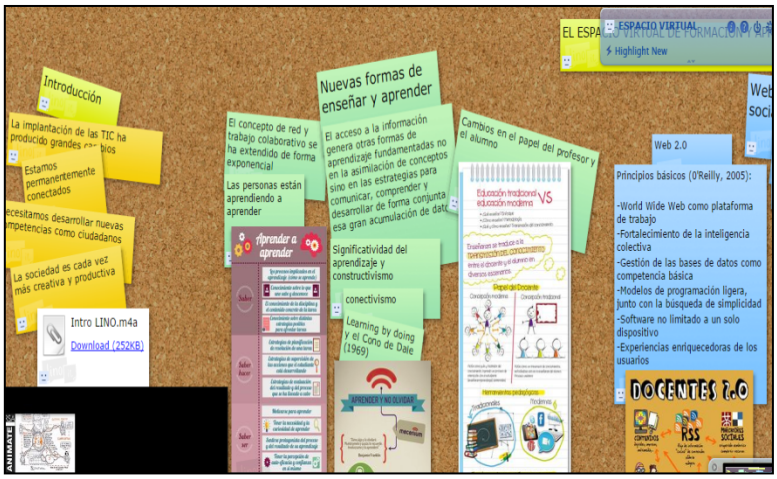

Figure 2. Lino activity
http://linoit.com/users/irenepuenteg/canvases/ESPACIO%20VIRTUAL

With this tool students created an interactive poster in which they showed the main contents of the first thematic block in the course, "School, ICT and language teaching" using text boxes, images, icons and videos. This was later linked to the student's PLE through a button in Symbaloo.

- **Prezi** (https://prezi.com/).

Prezi is a cloud-based presentation software. Instead of slides and bullet points (as PowerPoint or Keynote), Prezi uses a "zoomable canvas" upon which concepts can be displayed. The speaker navigates amongst the data and visuals along a pre-determined navigation 'path', offering an engaging explanation that sticks in the minds of the audience and providing thus a more effective presentation.

Figure 3. Prezi activity
https://prezi.com/tfhlznhsrucx/diseno-de-entornos-y-material-audiovisual/?utm_campaign=share&utm_medium=copy

Students used this tool to generate a presentation which showed the key concepts that any teacher, course designer or material creator should take into account when devising learning environments and audiovisual resources for language learning.

- **Mindomo** (https://www.mindomo.com/es/).

It is a free tool based on Mind Mapping. While there are many different ways to use Mindomo in a wide range of applications, we have focused on two basic mind maps: "Reference mind maps" for keeping track of information and "Presentation mind maps" for presenting or training.

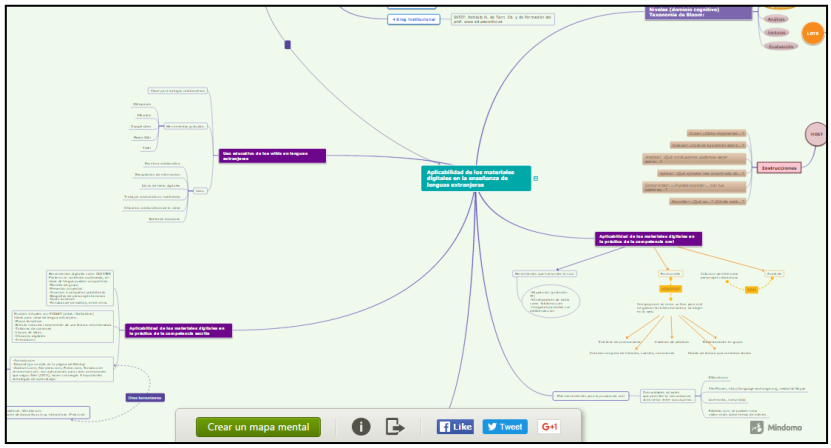

Figure 4. Mindomo activity
https://www.mindomo.com/es/mindmap/6e44c93fb3de49398c281ff5e29f4ab2

Students used Mindomo to develop an OER that encapsulated the complex topic of "Applicability of digital materials to foreign language teaching", since it contained numerous definitions and digital

resources. This tool is quite versatile and allows for the embedding of virtually any digital material, which proved to be ideal in the context of this thematic block.

- **Aurasma** (https://www.aurasma.com/).

Aurasma is an Augmented Reality site which allows you to see and interact with the world in a new way. With Aurasma, every image, object and even place can have its own aura. Auras can be as simple as a video and a link to a web page or as complex as a lifelike 3D animation.

Figure 5. Aurasma activity
http://auras.ma/s/N5Pz8

Students used this application to create 'auras'-small augmented reality representations- for foreign language teaching and learning, with the aim of offering a more real, focalized approach to certain cultural, linguistic, literary or social aspects which may be relevant when learning a language.

- **Video creation tools** (Movie Maker or any of the free tools for video creation and edition: VirtualDub, Wax, Avidemux, Blender, ZS4 Video Editor, Jahshaka, Zwei-Stein or Movica).

Figure 6. Video activity
https://www.youtube.com/watch?v=xEwoeVZtw14&feature=youtu.be

Students looked for some OER related to any significant aspect of foreign language learning and created a video adapting, re-mixing and repurposing that OER to create a video that would be broadcast on YouTube. This video would then become a new OER to be linked to the student's PLE in Symbaloo, as would happen with the other resources created in the rest of the course tasks.

- **PLE with Symbaloo** (https://www.symbaloo.com/home/mix/13eOcLjTaQ)

Figure 7. Symbaloo activity
https://www.symbaloo.com/mix/tarea5miguelramirez

Students were asked to create their own PLE with the free online tool Symbaloo, where they would link all the OERs they had created throughout the course (Lino poster, Mindomo mind map, Prezi presentation, YouTube video). They were also encouraged to expand their PLE adding other relevant online resources. Online participation was not only enhanced through the creation of PLEs, but also through participation in online forums, purposely created by the course teacher to enable critical reflection on the course contents. Furthermore, a specific forum was created (Figure 8) with the intention of providing feedback on the functionality of PLEs and the activities which had been devised for the creation of OERs.

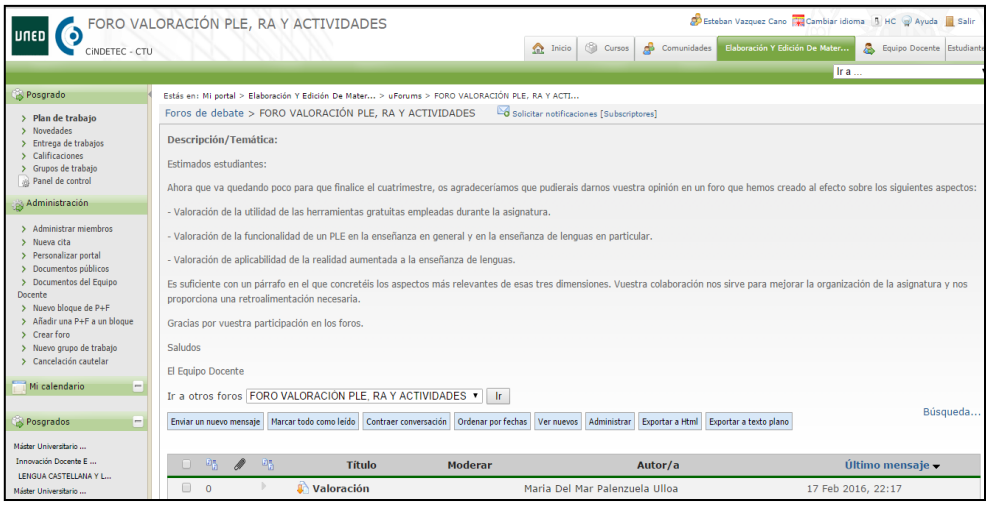

Figure 8. aLF-online environment subject PLE forums

This forum was complemented by a brief final questionnaire in order to ascertain students' perception of this course and the tasks proposed. It can be visualized following this link: http://cort.as/cOHX

b. Description of research objectives and cohort

This research is based on the following hypothesis: "The PLEs' implementation under OER design is a productive teaching-learning strategy in Higher Education". This hypothesis is researched according to the following objectives:

- To assess the potential of PLEs in the development of Higher Education.
- To analyze the usefulness of OER self-creation for the acquisition of competences.

With these aims as the basis for the investigation, three specific factors were taken into account when planning the research design:

- Factor 1: PLE and OER for promoting digital competence.
- Factor 2: PLE and OER for fostering content creation.
- Factor 3: PLE and OER and new didactic strategies to be applied in future learning scenarios.

The following table shows the cohort that took part in this research project:

Variables	*Items*	*F*	*%*
Gender	Male	31	45.58
	Female	37	54.41
Age	22-25	10	14.70

	25-30	21	30.88
	30-35	27	39.70
	35-40	8	11.76
	+40	2	2.94

Table 1. Cohort

c. Procedure for data analysis

Quantitative approaches are not appropriate for describing cognitive abilities in virtual learning environments. The statistical techniques that these approaches use normally entail a categorical distributive conception of structures, which results in uni- or multivariate distributions of individual attributes. That is the reason why the authors of this paper have opted for a double qualitative approach and a reticular, category-based social network analysis. In the first place we have performed a qualitative analysis identifying the most recurrent text frequencies in the final questionnaire, which was geared towards a virtual narrative about advantages and disadvantages of PLEs and OERs. With this aim we have used the tool included in Atlas-Ti 7.0 with text extracts, memos and word-cruncher. In the second place we have analysed the messages posted in the forum from a SNA (Social Network Analysis) perspective. This methodology provides a relational approach based on the reticular morphology of social interaction and connections. This allows for an understanding of the form and shape of these relationships as a whole, which is fundamental in order to understand the cause-effect mechanisms subjacent to student appraisals in the forums, making it possible to discover hidden interaction patterns (Barabási, 2002; Knoke & Yang, 2008).

SNA is based on the notion that through the study of structures created by the relationships among elements we gain a better understanding of the whole, the social environment and even of each single elements, than if we consider the attributes of those elements in isolation (Borgatti et al, 2002; Castells & Monge, 2011; Caverlee, Liu, & Webb, 2010). Hence, the joint analysis by means of Atlas-Ti and the reticular SNA generates a more thorough explanation of VLE interactions. To this end, we have applied SNA methodology to the identification of textual units that can help explain the motivations and reasoning as presented by students when appraising the possible benefits of the use of PLEs and OERs for language teaching and as educational resources in general.

These action-research activities were all devised to be performed online in the VLE provided by UNED, aLF, and constituted the teaching-learning curriculum in the aforementioned course "Creation and edition of printed and audiovisual materials". Consequently, our research methodology falls within the framework of interpretive and dialogic and epistemological trends, more specifically, phenomenological, socio-historic, critical virtual ethnography, which uses techniques ascribed to qualitative research and a structural, network approach through matrix representations and graphs. The methods employed, all of them adapted to virtual environments and educational contexts, were: discourse analysis (Ricoeur, 1998); content analysis (Miles & Huberman, 1994), participant observation (Fetterman, 1984) and network analysis (Wasserman & Faust, 1994).

The qualitative analysis was founded on a codification and categorization process, which was divided into two differentiated stages: a descriptive stage and an interpretive stage. The procedure followed three phases:

- Phase 1: Segmentation and identification of units of meaning and grouping according to descriptive categories.
- Phase 2: Construction of a system with emerging thematic cores or meta-categories.
- Identification of qualitative domains (sequential and cross-sectional analysis of the meta-categories).

As for the data descriptive analysis, a count of frequencies was performed in the final questionnaire 'Analysis of PLEs and OERs in the Master's Degree in Information and Communication Technologies applied to language teaching and processing (UNED)'. Reducing raw data to macro-categories, categories and units of meaning was a complex process in which the codification process was performed using Atlas-Ti 8.0, obtaining 765 units of meaning, grouped into 3 domains/dimensions and 30 deductive/inductive dimensions. After an intra-categorial comparison the following units have been defined in relation to the three dimensions of this research paper: "digital competence" (6 categories), "content creation" (7 categories) and "new didactic strategies" (8 categories), around which all the units of meaning have been grouped.

This qualitative analysis of frequencies has been complemented with the analysis of online interactions in forums, following the perspective of SNA. With that purpose the authors have used the programs UCINET 6 and the visor yED Graph Editor 3.11.1 in order to edit the graph and make it more accessible. The matrix used to generate the graph is the following:

$$fi(x) = a_0 + \sum_{n=1}^{\infty} \left(a_n \cos \frac{n\pi x}{L} + b_n \sin \frac{n\pi x}{L} \right)$$

IV. Results and discussion

The description of the qualitative, matrix and relational results are shown attending to the aforementioned dimensions and are represented by means of the tools employed in the data analysis through Atlas-Ti, UCINET and the graphic editor yED Graph.

a. Dimension 1: PLE and OER for promoting digital competence

One of the most interesting aspects in the creation of PLEs and use of OERs is connected to the improvement of digital competence as acknowledged in the European Higher Education Area (EHEA). Besides, its implementation can assist in the development of generic competences such as self-regulated learning and interpersonal competence (Dublin Descriptors, 2005) and also specific competences from UNED degrees and master's programmes, especially those related to the following competence areas: autonomous and self-regulated work management, ICT process management, and team work –performing different roles. In all these digital competence is an essential part of their learning, not only as university students, but also as future professionals. Table 2 shows the frequency distribution in the most significant categories, in the dimension measuring the impact of PLEs and OERs in the development of ICT skills and digital competence.

Dimension 1: PLE and OER for fostering information and communication skills	***Cases/ Quotes***	***% Cases***	***Nb Words***	***% Words***
Browsing, searching and filtering information	47	23,9%	121	19,6%
Sharing information and content	35	17,8%	102	16,5%
Storing and retrieving information	40	20,4%	111	17,9%
Evaluating Information	21	10,7%	97	15,7%
Collaborating through digital channels	28	14,2%	99	14,1%
Managing digital identity	25	12,7%	87	14,1%

Total	***196***	***100%***	***617***	***100%***

Table 2. PLEs and OERs for fostering information and communication skills

The units of meaning with a greater percentage weight are: "Browsing, searching and filtering information (N= 47/23,9%). Students consider that this activity based on OER self-creating and its dissemination in PLEs help to develop students' digital competence: To access and search for online information, to articulate information needs, to find relevant information, to select resources effectively, to navigate between online sources, to create personal information strategies. Another remarkable category was: "Storing and retrieving information" (N= 35/17,8%). Students consider that this activity may help to manipulate and store information and content for easier retrieval and to organise information and data. Similar results have been put forward by Fiedler, & Väljataga (2013). Finally, "Sharing information and content" (N= 40/20,4%) is a competence that can be enhanced by the use of PLEs and OERs by sharing with others the location and content of the information found. Furthermore, these activities based on PLE and OER can allow the students to share knowledge, content and resources, to act as intermediaries, to be proactive in the spreading of news, content and resources, to learn about citation practices and to integrate new information into an existing body of knowledge. These benefits have also been stated in recent literature (Griff & Matter, 2013; Juarros, Ibáñez, & Crosetti, 2014).

b. Dimension 2: PLE and OER for promoting content creation

The creation of OERs to be included in a PLE as a form of learning and disseminating content can be of great help for the students' future professional career. The number of online tools and applications for the design of digital resources has had an exponential growth in the past few years, and very often educators find that there are no fixed criteria when assessing their quality and applicability in Education in general and in language learning in particular. The compilation of these purposely-created OERs in a PLE facilitates a unified environment in which quality resources can be easily accessible. Table 3 shows the frequency distribution in the most significant categories, in the dimension analyzing the potential of PLEs and OERs in content creation.

Dimension 2: PLE and OER for promoting content creation	***Cases/ Quotes***	***% Cases***	***Nb Words***	***% Words***
Copyright and Licences	37	15,9%	112	14,3%
Innovating and creatively using technology	35	15,0%	121	15,5%
Identifying digital competence gaps	28	12,0%	113	14,5%
Developing content	54	23,2%	160	20,5%
Integrating and re-elaborating	47	20,2%	132	16,9%
Identifying needs and technological responses	31	13,3%	141	18,1%
Total	***232***	***100%***	***779***	***100%***

Table 3. PLEs and OERs for promoting content creation

Content creation is one of the most positive aspects in the development of PLE-based activities with authoring tools. Among the most prominent categories in the analysis we can highlight: "Developing content (N= 54/23,0%). Self-creating content and its distribution in PLEs allows students to design content in different formats including multimedia, to edit and improve content

that s/he has created or that others have created and to express creatively through digital media and technologies. Developing activities and tasks which focus on content creation is a real didactic need nowadays: students shift from being mere passive content receivers to becoming active content creators, as suggested by research (Letón, et al, 2009; Castañeda & Soto, 2010; UNESCO, 2011ab). Another important category was: "Integrating and re-elaborating" (N= 47/20,2%). Students can modify, refine and mash-up existing resources to create new, original and relevant content and knowledge. This category has also proved to be relevant in a recent study that focused on teachers' perception of how PLEs can be used in Higher Education (Şahin & Uluyol, 2016). Finally, the third most relevant category was: "Copyright and Licences" (N= 37/15,9%). The OER design and creation help students to understand how copyright and licences could be applied to information and content in order to make it free and fully accessible.

c. Dimension 3: PLE and OER and new didactic strategies to be applied in future learning scenarios

One of the key elements in the use of PLEs and OERs is fostering the acquisition of skills, capabilities and competences that can be applicable in lifelong learning. Students can expand their PLEs in their work/academic/personal sphere, generating thus a comprehensive digital identity. Table 4 shows the frequency distribution in the most significant categories, in the dimension analyzing the potential of PLEs and OERs in lifelong learning.

Dimension 3: PLE and OER and new didactic strategies to be applied in future learning scenarios	***Cases/ Quotes***	***% Cases***	***Nb Words***	***% Words***
Set my own learning goals	101	12,7%	198	15,6%
Interaction and collaboration with others	98	12,3%	176	13,9%
Interconnect relevant data	107	13,4%	210	16,5%
Share and circulate the results of activities	121	15,2%	217	17,1%
Acquire filtering criteria	109	13,7%	198	15,6%
Offer opportunities for free, unguided, and unstructured exchange and collaboration	87	10,9%	76	6,0%
Promote ubiquitous learning	91	11,4%	102	15,7%
Allow me to socialize with others	79	9,9%	89	8,0%
Total	***793***	***100%***	***1266***	***100%***

Table 4. PLE and OER and new didactic strategies to be applied in future learning scenarios.

Due to the fact that many of this master's students are actually language teachers or trainee teachers, it is especially pertinent to show them the applicability of these didactic strategies in their own professional context. Within this third dimension, students have discussed how PLEs and OERs can enforce the development of didactic strategies for lifelong learning. They affirm that the use of PLEs and OERs jointly is a good strategy to "Share and circulate the results of activities" (N= 121/15,2%). On many occasions, the materials produced by these master's students are not efficiently distributed and disseminated on the web and thus these resources are not known to other students or just interested individuals. PLEs allow for public distribution of activities, projects

and resources and can be expanded and enhanced throughout their personal and professional life. Likewise, another key competence for them as teachers is the cognitive skills put in practice when creating these OERs, since they have to "Acquire filtering criteria" (N= 109/13,7%). This is an essential skill to be able to select and curate information and adapt it to the objectives and competences needed for each specific educational scenario. This has also been highlighted in other publications in this field (Johnson & Liber, 2008; Martindale & Dowdy, 2010). Finally, the category "Interconnect relevant data" (N= 107/13,4%) has also emerged as relevant in the analysis. Studies such as Van Harmelen's (2008) or Vázquez-Cano, Martín Monje, & Fernández's (2014) show that PLEs and OERs may be helpful when interconnecting information, so that meaningful connections can be established among resources that are already available and any new resources that may be generated in the future.

The Atlas-ti analysis of frequencies in the final questionnaire was complemented with the examination of perceptions, comments and opinions as expressed in the different threads of the forum "PLEs, OERs and Activities" in the course online platform. The authors analyzed the network of interactions, paying special attention to the most prominent nodes and connections. With this aim, the resulting network was edited with yED Graph Editor 3.11.1 (Figure 9), in order to make it more visual and understandable.

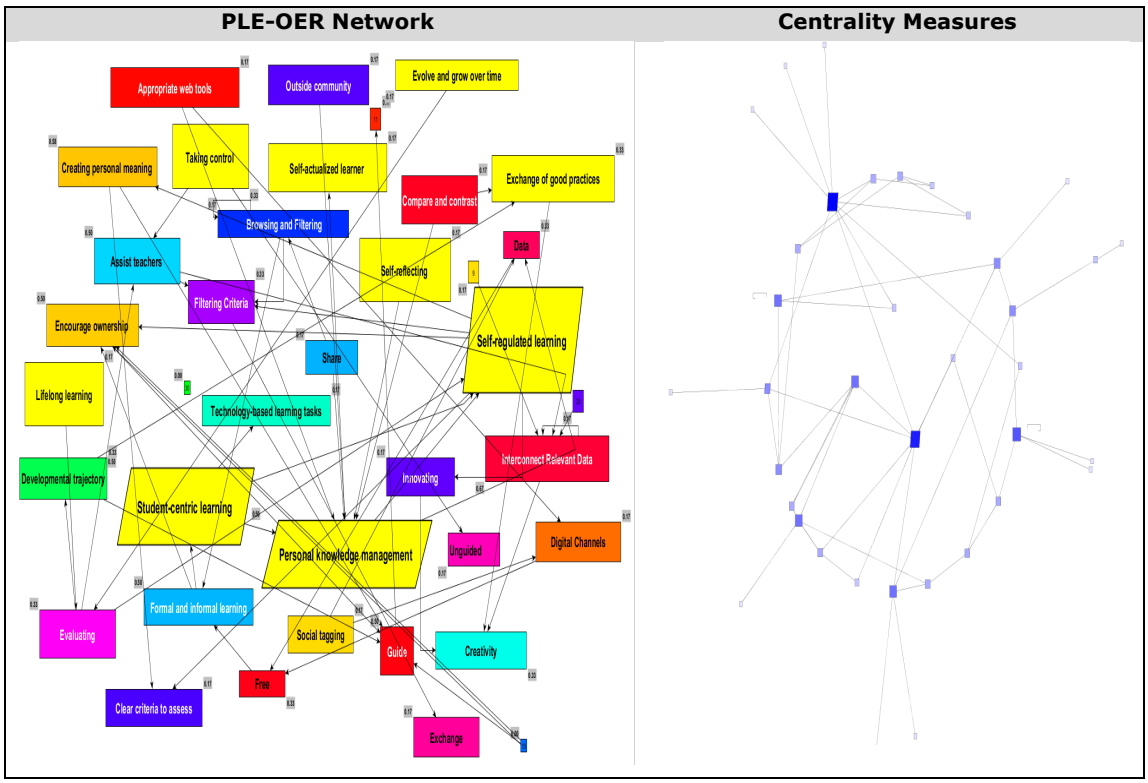

Figure 9. PLE-OER Network and centrality measures

We can observe three main nodes, shown in a parallelogram format in the figure, which correspond to the three main threads in the forum, The average density of these three threads –with a dichotomized matrix- was .51 with a .19 standard deviation; which represents a medium-high value for a sample of 68 students and with an average web range of 2,998. This indicates that each key word is interconnected with an average of almost 3. This value is also medium-high for a total of 20 nodes. Besides, this result shows that almost to thirds of all possible links have been present and also demonstrates a high student involvement and participation in the online discussion. We have analyzed centrality in the network, in order to identify the most prominent elements. To this end, we have resorted to the analysis of degree centrality, betweenness centrality and closeness centrality:

Nodes		Degree Centrality		Betweenness centrality		Closeness centrality	
		Deg.	NrmD.	Betw.	nBetw.	Far.	Clos.
Central Nodes	Student-centric learning approach	18.0	51.000	61.0	29.5	74.0	39.50
	Exchange of good practices	15.0	48.250	58.0	28.5	67.5	37.91
	Assist teachers in identifying the usefulness and learning values of web tools	16.0	49.150	57.0	24.5	67.5	29.90
	Selection of appropriate web tools	10.0	31.550	31.5	20.5	52.5	31.00
	Design of appropriate technology-based learning tasks	10.5	29.220	28.0	19.5	49.5	28.55
	Defining clear criteria to assess, evaluate, and introduce the learning affordances	11.0	28.550	27.5	18.5	51.0	27.86
	Self-regulated learning model	16.0	35.000	36.5	25.5	67.5	31.67
	Taking control and responsibility over learning	15.5	32.755	32.5	23.5	58.0	31.41
	Connect to the outside community	14.0	31.000	49.0	27.0	69.0	35.55
	Compare and contrast	15.5	47.000	52.0	29.5	68.5	35.70
	Facilitate a personal developmental trajectory	10.0	25.700	29.0	17.5	51.0	30.35
	Personal knowledge management strategy	15.5	46.750	54.5	29.5	67.5	37.30
	Self-reflecting and critical thinking	16.0	48.550	55.0	27.5	68.5	35.00
	Social tagging	10.0	25.000	28.0	15.5	51.0	29.55
	Creating personal meaning from learning experiences	10.0	24.500	29.0	16.5	50.5	28.60
	Support and facilitate lifelong learning	15.5	30.500	43.0	23.5	61.5	36.55
	Evolve and grow over time	15.5	31.000	51.5	27.0	68.0	35.55
	Help to connect both formal and informal learning	8.0	16.000	11.0	9.0	14.5	10.31
	Encourage ownership and voice in the learning process	15.5	48.750	55.5	28.5	67.0	37.90
	Self-actualized learner and learning autonomy	16.5	36.750	49.5	29.5	58.5	38.31

Deg. (Degree) / NrmD. (NrmDegree) / Betw. (Betweenness) / nBetw. (nBetweenness) / Far. (Farness) / Clos. (Closeness)

Table 5. Degree centrality, betweenness centrality and closeness centrality

Centrality indicates the position of these concepts in the network (Spencer, 2003) and shows a rather high result, with 57%, in a total of 20 nodes. The maximum degree (the maximum number of relations of a node in the network) is 18 ("Student-centric learning approach"), conforming nodes 12-17. Results show that the aspects with a greater normalized range (Nrmdegree: percentage of connections that a node has over the network total) and a greater node degree are concentrated in the shaded items in Table 5. These nodes constitute the cores of centrality in the

graph, according to the 'k-cores' concept (Seidman, 1983). As for betweenness centrality, the results (51.101) provide relevant information with respect to quantifying the number of times a node acts as a bridge between two other nodes along the shortest path. We have highlighted those nodes with higher betweenness centrality (≥15): *personal knowledge management strategy, self-regulated learning model, evolve and grow over time, support and facilitate lifelong learning, taking control and responsibility over learning and self-actualized learner and learning autonomy*. As for closeness centrality, these bigger nodes are concentrated around aspects which inter-relate students' general view about PLEs and OERs. In sum, we can conclude that all secondary nodes are accessible through the connections established by the three main nodes: Student-centric learning approach, Personal knowledge management strategy and Self-regulated learning model.

V. Conclusions

If we want to design meaningful work based on PLEs it is necessary to understand the contexts in which learning takes place and the different discourses associated with that learning. A PLE makes it possible both to transpose the different contexts in which learning takes place, and to move from one domain to another, creating connections between them. As shown in this research, it can support and facilitate a greater variety of relationships than those achieved by traditional educational media. It is therefore necessary to acknowledge that the center of significant learning has shifted to a new, re-centered core and that, from the perspective of deep learning and impact, most of the formal curriculum now must move from the margins to the center. We as educators need to think more about how to move beyond an individualistic faculty model and get involved in team-design and implementation models on our campuses. Furthermore, we need to consider that in doing so we may fundamentally change the ways in which the burdens of innovation are often placed solely on the shoulders of faculty. Accordingly, we consider that there are three essential approaches in this new model: student-centric learning approach, personal knowledge management strategies and self-regulated learning activities.

The results of our research show that the joint use of PLEs and OERs –designed by student themselves- improves their digital competence, predominantly in dimensions such as: accessing and searching for online information; articulating information needs; finding relevant information; selecting resources effectively; navigating between online sources; and creating personal information strategies. Likewise, they are become content creators through the use of authoring tools. Creating their own content and distributing it in PLEs allows students to design materials in different formats, including multimedia, to edit and improve content that they or others have created and to express creatively through digital media and technologies. Students can modify, refine and mash-up existing resources to create new, original and relevant content and knowledge. Since many of the master's students are language teachers or trainee teachers, it is of special importance that part of the didactic strategies experienced throughout the course can be of interest and clearly applicable to their academic or professional career. Additionally, the reticular analysis of the forums through SNA has provided us with a network in which the main benefits of the PLEs and OERs are exposed through the following categories: *personal knowledge management strategy, self-regulated learning model, evolve and grow over time, support and facilitate lifelong learning, taking control and responsibility over learning and self-actualized learner and learning autonomy*.

In line with the results obtained in this research, we can conclude that the PLE-OER combination brings transparency to educational processes, facilitating collaborations between educators and

students. OERs will help over-stretched educators to manage their work more effectively, rather than adding new work requirements to their job description, as some may fear. The most successful OER initiatives will be those that can be used immediately and add educational value within the existing ICT infrastructure constraints of universities and other educational institutions. Sharing materials that others can adapt and use recognizes the value inherent in team work, and the cognitive improvements that will emerge from such collaboration. Moreover, this shift towards the implementation of PLEs and OERs in education has the potential to re-focus educational systems, restoring the core values of building and sharing knowledge that underpin quality education, and systematically encourage us to work with and learn from one another.

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