

Exploring the effect of social media in Personal Learning Environments in the university settings: analysing experiences and detecting future challenges

Explorando el efecto de las redes sociales en Entornos Personales de Aprendizaje en el ámbito universitario: análisis de experiencias y detección de futuros desafíos

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Abstract

The concept of PLEs as connected learning and the shaping of them as a socio-material framework in which people learn, overlaps with the intrinsic characteristics of social media. Consequently, it is important to analyse how academic literature has treated the direct relationship between the two realities in the university sector. Accordingly, the objective of this work is to determine how this relationship has been treated with regards to contexts, authorship and positions, types of social media, objectives pursued, methodologies and results. Regarding methodology, we used the PICOC strategy to design the research questions and the PRISMA protocol to document the systematic review of academic production in SCOPUS and Web of Science between 2012 and 2021. We ultimately obtained a sample of 35 works. The findings show that use of media to build PLEs that meet users' needs should be explored in greater depth and analysed by using particular methodologies to reach conclusions that help to drive them. Academic and professional promotion stand out among the major challenges in the use of social media in PLEs, as does the possibility of bringing together non-formal, formal, and informal areas to create learning.

Keywords: personal learning environments, social media, self-regulated learning, online learning, systematic review

Resumen

La concepción de PLE como aprendizaje conectado y su configuración como entramado socio-material en el que las personas aprenden, confluye con las características intrínsecas que ostentan las redes sociales. Por tanto, resulta relevante analizar cómo la literatura científica ha tratado la relación directa entre ambas realidades en el ámbito universitario. De este modo, el objetivo del trabajo es determinar cómo se ha tratado dicha relación en cuanto a contextos, autorías y posicionamientos, tipo de redes sociales, objetivos perseguidos, metodologías y resultados. Referente a la metodología, se ha utilizado la estrategia PICOC para diseñar las preguntas de investigación y el protocolo PRISMA para documentar la revisión sistemática de la producción científica en SCOPUS y Web of Science entre 2012 y 2021. Finalmente, se obtuvo una muestra de 35 trabajos. Los hallazgos revelaron que se ha de profundizar el uso de redes para la construcción de PLE adaptados a las necesidades de los usuarios, y analizarlos utilizando determinadas

metodologías para así poder obtener conclusiones que ayuden a impulsarlos. Dentro de los grandes desafíos en el uso de las redes sociales en los PLE, destacan la promoción académica y profesional, así como la posibilidad de hacer converger ámbitos no formales, formales e informales para generar aprendizajes.

Palabras clave: entornos personales de aprendizaje, redes sociales, aprendizaje autorregulado, aprendizaje en red, revisión sistemática

1. Introduction

Personal learning environments (PLEs) have been the subject of analysis in academic literature in recent years. There has been considerable published literature on this subject and the application in university settings. For Dabbagh & Castañeda (2020), a PLE is a techno-social reality that represents the socio-material framework in which people learn. Torres et al. (2008) understood PLEs as confluence of information processing, connections between people and knowledge creation to position students at the centre of the learning process. Taking these characteristics of connected learning into account (Bender & Pepler, 2019) makes it apparent that the relationship between PLEs and social media is both necessary and tangible.

Authors such as Moreira et al. (2017) have identified the importance of including horizontal – and especially vertical – networks in PLEs to be able to introduce external experts into the settings, whether as potential employers of students or as possible advisers for new research lines and policies. Dabbagh & Kitsantas (2012) defined PLE as a strategy for understanding and promoting formal, informal, and self-regulated learning by students, and they also underlined the importance of social media for giving it sense. Rodríguez-Groba et al. (2014), considered that any proposal that combines PLE and social media requires a robust process of evaluation, which, in their case, they did through an e-portfolio developed in the setting of a social network. All of these works started from the need to seek teaching and evaluation methodologies that provide an alternative to purely quantitative ones in order to develop self-regulatory behaviours.

These ideas account for the need to focus on analysis of trends in academic literature when directly linking social media and PLE. Systematic reviews of academic literature synthesise research based on analysis of primary studies. They are research studies in their own right as they answer research questions, which, along with the anticipated results and taking into account the recipients to which they are directed, guide the presentation of results through a systematised method (García-Peñalvo, 2022). They fulfil the function of filtering theories, systematising practical evidence, and revealing gaps in research that must be filled, and so they are often the starting point for researchers and academic policies to direct research in their disciplines (Guirao-Goris et al., 2008; Maggio et al., 2020).

Nonetheless, there have been few systematic review studies into PLE in the last 10 years. Dabbagh & Kitsantas (2012) carried out a narrative review to establish a theoretical framework about PLEs and social media with regards to self-regulated learning. There have been works such as that of Raj & Renumol (2021) that analysed research that identified recommendation techniques, parameters of personalisation, models, algorithms and evaluation metrics for systems for recommending PLE content; or that of Humanante-

Ramos et al. (2017), which reviewed academic literature about the development of PLEs on mobile devices. Normadhi et al. (2019), in their literature review, dealt with identifying personal traits in learning environments from an adaptive viewpoint. Shemshack & Spector (2020) insightfully examined how personalised learning models mediated by technology – including social networks – helped to enhance knowledge, perspectives, skills and understanding in a way that satisfies individual needs. Last of all, and without constituting a systematic review in the true sense of the word, Castañeda et al. (2021) used qualitative methods (interviews) to reformulate a holistic framework for digital competence in teaching across different countries and observed three emerging categories concerned with PLEs, thus broadening our knowledge in this field. With this in mind, there has still been a need for reviews that take a systematic approach from the standpoint of the role of social media in the configuration of PLEs in recent years and so the present research is approached from this perspective.

To carry out this study, we have started from the hypothesis that it is necessary to analyse the direct relationship between PLEs and social media, focusing on the latter, given the intensive use of social media in higher education and their importance in the configuration of PLEs. Indeed, among the many authors who endorse this idea, we can cite: Dabbagh & Kitsantas (2012); Durak (2017); Gil-Fernandez & Calderón-Garrido (2021); Iredale et al. (2020); Ooi et al. (2018); Prendes-Espinosa et al. (2016); Shen (2020); Torphy et al. (2020).

Therefore, the aim of this work is to determine the specific role of social media in the configuration of personal learning environments in university contexts, to establish what the best practices have been, what their implications are and what future developments have been proposed.

2. Method: design and procedure

We have used a mixed method to carry out this systematic review, combining qualitative and quantitative focuses. The degree of heterogeneity that studies in the social sciences often display, and, furthermore, the objectives of this work, along with the nature of the questions that guide this research, motivate this choice (Harden & Thomas, 2010).

Mixed approaches make it possible to: integrate research works of different types, – on condition that the inclusion of studies that cannot be compared is regulated and limited; detect the development of the study of a specific topic; contemplate the mediating aspect of local factors; and attend to aspects relating to the implementation and impact of the phenomenon observed (Pawson, 2006). For Saini & Shlonsky (2012), there is no agreed set of parameters about how to implement this type of mixed method review, or at what moment in the synthesis should the focus be on the qualitative or quantitative approach. Therefore, balancing the two types of evidence so that they dialogue and interpret one another mutually is up to the judgement of the researcher. Accordingly, the optimal response to achieve the initial objective can be achieved.

To design the research questions, which serve as a guide to achieve the objective, we used the PICOC strategy for systematic reviews. This model modifies PICO, which was established for the health sciences (Higgins & Green, 2008; Moher et al., 2010) and

combines the essential elements to structure the evidence that the article provides and identify the necessary variables to systematise them: (P) population that is the object of the study; (I) interventions; (C) comparison effects; (O) outcomes and results, to which is added (C) context. This last variable is important for detecting solutions and interventions that have been successful in a given situation and can be applied in others (Petticrew & Roberts, 2006).

Following these directives, the research questions to respond to the objective and set out the variables that guide the findings, are:

R.Q.1 How has academic literature responded to the problem posed over a decade taking into consideration the different contexts, authorships and positions?

R.Q.2 What type of social media have been most used and analysed in the configuration of PLE?

R.Q.3 What are the principal objectives that have been pursued when directly linking social media to PLEs and to what educational roles have they been directed?

R.Q.4. What research methodologies and designs have been used to achieve the proposed objectives?

R.Q.5. What are the most noteworthy findings and what implications and future developments have been proposed?

The results of the review followed the indications of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Hutton et al., 2016; Moher et al., 2010; Urrútia & Bonfill, 2010). The methodological parameters established by Alexander (2020) to establish the quality of systematic reviews were also taken into account. By following this methodology, we have sought to comply with the necessary criteria of transparency, replicability, validity, objectivity and being up to date (Moher et al., 2009).

The search focussed on two databases that are relevant for the social sciences: Web of Science (WoS) and SCOPUS. Both of these are benchmarks of quality of academic literature and provide a multidisciplinary focus in the results. WoS provides access to Current Contents Connect, Derwent Innovations Index, KCI-Korean Journal Database, MEDLINE, Russian Science Citation Index, SciELO Citation, and the Core Collection, comprising: Science Citation Index, Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (AHCI), Conference Proceedings Citation Index-Science (CPCI-S), Conference Proceedings Citation Index-Social Science & Humanities (CPCI-SSH), Book Citation Index-Science (BKCI-S), Book Citation Index-Social Sciences & Humanities (BKCI-SSH), Emerging Sources Citation Index (ESCI), Current Chemical Reactions (CCR-EXPANDED) and Index Chemicus (IC).

The research was completed by searching for literature in SCOPUS, given the wide range of coverage of multidisciplinary studies that this database also contains. Access to both databases was done through the web portal of the Fundación Española para la Ciencia y la Tecnología (FECYT–Spanish Foundation for Science and Technology).

It was decided that a broad search string should be established to cover the greatest possible spectrum and so that in this way the three reviewers could filter the documents

directly and with consensus. The search equation used was replicated in both databases to seek equivalent results. It comprised the following sequence: TOPIC: “PLE” or “Personal Learning environment*” + Boolean operator AND + TOPIC: “social media” or “social network*”. Over the two databases, 221 documents were found in SCOPUS and 169 in WoS.

Subsequently, the only filter applied on a preliminary basis referred to the publication date, as we chose the decade between 2012 and 2021. The reason for choosing these years – apart from the fact that there was no review production on the specific topic chosen – was the intensification in the last decade of the necessarily globalised focus that both networks and PLEs represent (Dabbagh & Castañeda, 2020). It also covers 2018, the year in which the European Union (2018) reflected the personal and social learning competence – well reflected in social media – among the sources of lifelong and independent learning and, finally, it covers the period of the global Covid-19 pandemic, which intensified the use of networks in the educational sphere inside and outside the PLE (Gil-Fernández et al., 2021).

It was not moderated by any other filter available in the databases. Ineligible works were subsequently eliminated, rejecting those with a substantive distance from the topic, for example, some relating to health sciences as the acronym PLE corresponds to three medical terms. The following inclusion and exclusion criteria were applied to the resulting sample:

Table 1.

Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
	Duplications
Years 2012–2021	Other years
Areas of knowledge: All. Language, type of source, type of document, countries, type of access: All.	
Formal, non-formal and informal educational area	Works that are not related to the problem. Research with samples that were not collected in teaching areas or that do not have an educational intent.
Research on PLE that focused the study on the contribution of social media in their configuration.	Works that refer to the use of <i>media</i> and the internet in general to configure PLE without specifically and directly focussing on social media.
Level: Higher education (university)	Research works that refer to primary or secondary level studies
Educational role: all. Teachers, students, researchers, institutions, academia in general	
Types of networks: general social media and educational, academic, professional, and <i>ad hoc</i> (horizontal and vertical) designed social media	

Source: Own elaboration.

To apply the exclusion criteria, each article was analysed by three experts. If there was a disagreement between them, a fourth expert was consulted. However, this disagreement

only occurred in three cases. The resulting flow chart, which follows the PRISMA 2020 protocol indications, is shown below (Page, 2022):

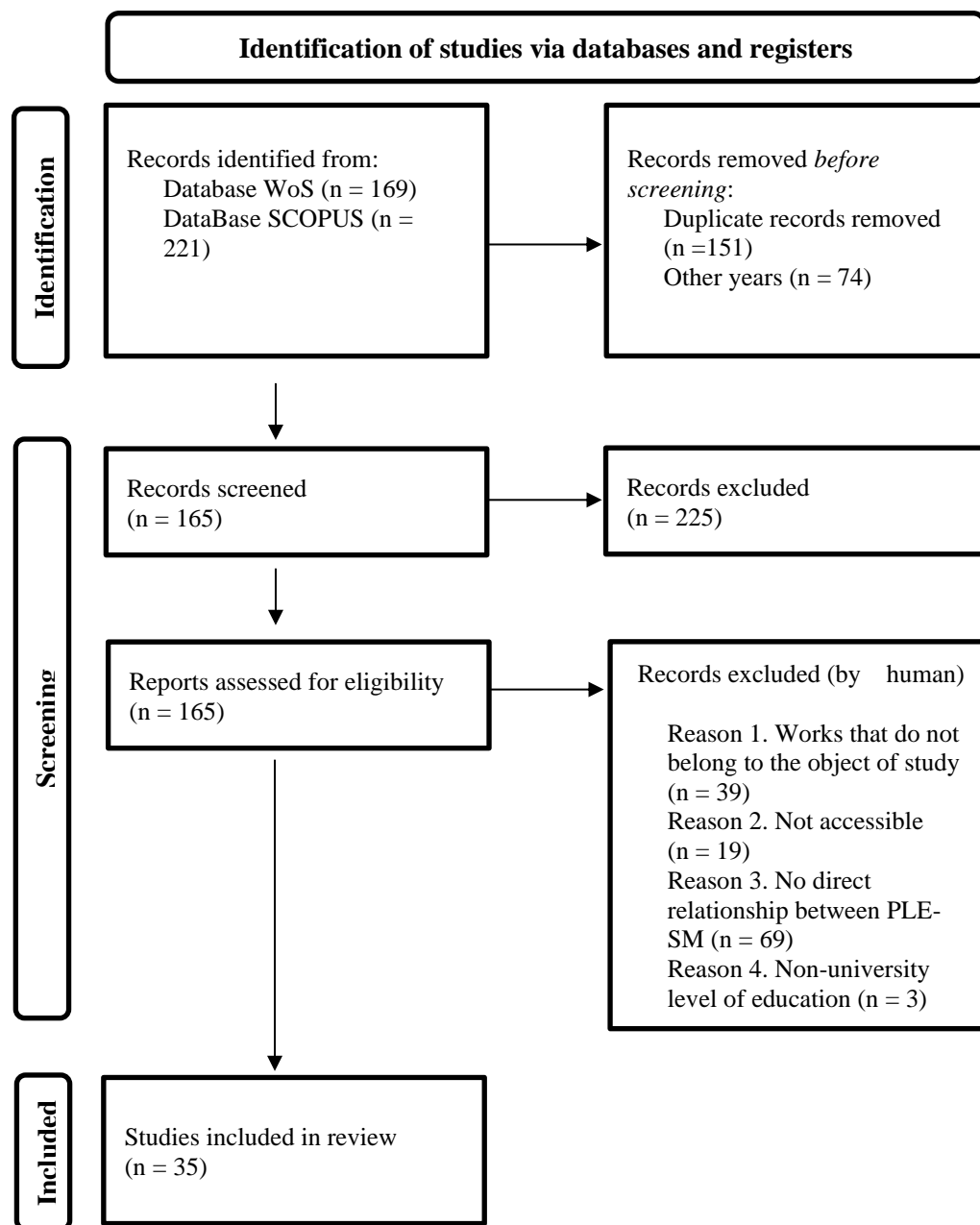


Figure 1. Flow diagram of the sample collected.

The quality of the studies was evaluated by the three reviewers. To do so, seven criteria that observe different aspects were used. The criteria (set out in Table 1) are adapted from those used by Matas (2018), which, compared with other valuation systems based on scales, display a greater flexibility and ease of adaptation to the different studies that form part of this research. Each criterion consists of a question with a yes/no answer, corresponding to a score of 1 or 0 respectively.

The inclusion of the quality criteria described is endorsed by authors such as Rodríguez-Sabiote et al. (2022), who performed a study which proved the importance of analysing the methodological/analytical indicators in the level of application of research designs in scientific articles on education. They showed that the studies which included indicators on criteria associated with methodological rigour, types of sampling, and problems in the study approach were most suitable in detecting the most thorough methodological designs.

The analysis of the quality criteria, as can be seen in Table 2, showed that the quality of the articles was generally very high. The description of the working method turned out to be the weakest aspect of all of them. Some correlations can be observed in this sense, since, as can be seen, non-inclusion of this description was related to the lack of use of reliable and valid measurements, and also with not using appropriate techniques or evaluating implementation. Furthermore, the use of reliable measurements was correlated with the use of appropriate techniques and coherence in the discussion and conclusions.

Table 2.
Quality criteria of the articles and correlations between them

	Correlations (r_{ho})								
	Yes	No	CC1	CC2	CC3	CC4	CC5	CC6	CC7
QC1. Match between the objectives and the sample/object of analysis	32	3	1						
QC2. Description of the working method	29	6	.132	1					
QC3. Clear description of the sample/subject of analysis	32	3	-.094	.132	1				
QC4. Use of reliable and valid measurements	33	2	.258	.551**	.258	1			
QC5. Use of appropriate techniques	33	2	.258	.551**	.258	.860**	1		
QC6. Consistency of the discussion and conclusions with the results	33	2	.364*	.215	-.075	.389*	.389*	1	
QC7. Implementations/results are evaluated, and future implications presented	33	1	-.053	.377*	-.053	.271	.271	-.042	1

* $p < 0.05$; ** $p < 0.001$

Source: Own elaboration.

The protocol for recording the moderating variables follows the parameters indicated by Tawfik et al. (2019) and is shown in Table 3.

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Table 3.
 Variables used

IDENTIFICATION		Author	
		Title	
	Extrinsic variables	Source of publication Year of publication	
CHARACTERISTICS	Substantive variables	Formal/non-formal/informal education Discipline Level of studies Host country of the study Network(s) used	
		Methodological variables	Objectives Design Sample Instrument
		RESULTS	Dependent variables

Source: Own elaboration.

3. Results

3.1. Analysis of academic production

No clear trend is apparent in year of publication, although the years with the most publications on the topic covered here were 2013 ($n = 6$), 2014 ($n = 5$) and 2015 ($n = 5$).

The most prolific country was Spain with a total of 12 publications, followed by the USA ($n = 4$), Portugal ($n = 3$), China ($n = 2$) and 12 other countries with one publication each.

In relation to number of authors, works with three ($n = 12$) or two ($n = 10$) were most common. A total of 91 authors were found, most of whom were author of one work each with the exception of seven who were authors of two pieces of research (Dabbagh, Gewerc, Kistsantas, Lama-Penin, Moreira & Pedro).

With regards to the journals that published the research, *Comunicar* stands out with three relevant articles and *Digital Education Review* with two. The other publications only featured one piece of research each.

3.2. Educational contexts and users of social media in the configuration of PLEs in the university sector

Regarding the analysis of the contexts and educational settings where PLEs are implemented, on the one hand, the redefinition of the pedagogical paradigm in a globalised, digital, and interconnected society was taken into account, and, on the other hand, the educational process, the educational settings, as well as the agents involved were considered (from the institution itself to teachers and students).

So, taking into account the fact that the present analysis focusses on the university sector (and that research referring to studies at the primary or secondary level was one of the exclusion criteria), it is considered that the contexts where experiences of using and

setting up PLEs were implemented, were all in the formal context or connected it to non-formal or informal ones.

Nevertheless, we must take into account that formal education is purposeful, planned and its content is regulated. Therefore, we must reflect on whether the proven methodologies suitably transpose approaches and experiences which derive from informal contexts, and if it is possible to correctly integrate them in the PLEs. Accordingly, after analysing the 35 selected pieces of research, we see that the proposals offer and develop tools with optimal results that are used casually day-to-day and where the subject is an active part of his or her own education.

With regard to the disciplines that the selected literature displays and in which social media as a tool for PLE have been tested, a large majority were observed where the experiences are applicable to all sorts of content (there being ten articles that treat them transversally). We should note that the most numerous groups have also been evaluated taking into account the eight groupings under which university studies are usually distributed, namely: 1) natural, exact and communication sciences; 2) social sciences, administration and law; 3) education; 4) engineering, manufacturing and construction; 5) arts and humanities; 6) agronomy and veterinary sciences; 7) health; and 8) services. Those from the education group are predominant, with seven experiences relating to pedagogy, teachers or education in general (Castaño-Garrido et al., 2015; Charteris et al., 2018; Gewerc-Barujel et al., 2014; Rodríguez-Groba, et al., 2014; Saz-Peñamaría, et al., 2016; Tur & Marín, 2015).

This is followed by the social sciences, mainly relating to languages or political science (Barbosa, et al., 2017; Junior, 2020; Suslova & Grebenshchikova, 2019; Sweet-Cushman, 2019); and finally by the more experimental ones, such as statistics or health sciences (Gutiérrez-Portlán, 2018; Ferri & Pozzali, 2012; Pimmer, 2018; Wu, 2021; Wu et al., 2020) with fewer examples relating to the service sector such as hospitality and tourism (Wei et al., 2021).

On the other hand, we cannot neglect the fact that the three major roles at play in any educational process are still dominant, despite new forms of learning and the varied student profiles that result in scenarios that differ from the traditional ones and involve new forms of teaching and giving guidance in a digital knowledge society. So, the three agents involved in any educational action, whether face-to-face or online, are the educational institution, the teachers and the students. On these lines, the selected articles display experiences in the formal university framework that are situated both in face-to-face contexts that have a virtual classroom or something similar as support to semi-face-to-face or blended learning contexts; and, clearly, to completely virtual, non-face-to-face e-learning contexts (Gil-Fernández et al., 2019; León-Gómez et al., 2019).

With regard to the samples, while students were the principal object of study, some works also analysed teachers jointly (Abdullah et al., 2021; Dabbagh & Kitsantas, 2013; Reed, 2013; Wu et al., 2020) or exclusively (Marín-Díaz et al., 2014; Morán-López, 2013) and these tools as an effective continuous training instrument, above all in the case of teaching skills or techniques (Marín-Díaz et al., 2014; Morán-López, 2013). We have also found

that in some of the works, other figures also appear such as professional and external experts (Abdullah et al., 2021; Moreira et al., 2017; Pimmer et al., 2018).

With regard to students, the majority of the proposals have centred on them and their training, and the fact is that we should not forget that the specific role of social media in the configuration of the PLEs students use, is analysed.

As a summary, Figure 2 includes the different interactions studied on the topic. Shows the relationship established in the sample analysed between educational environments (formal, non-formal and informal), fields, and the main subjects studied.

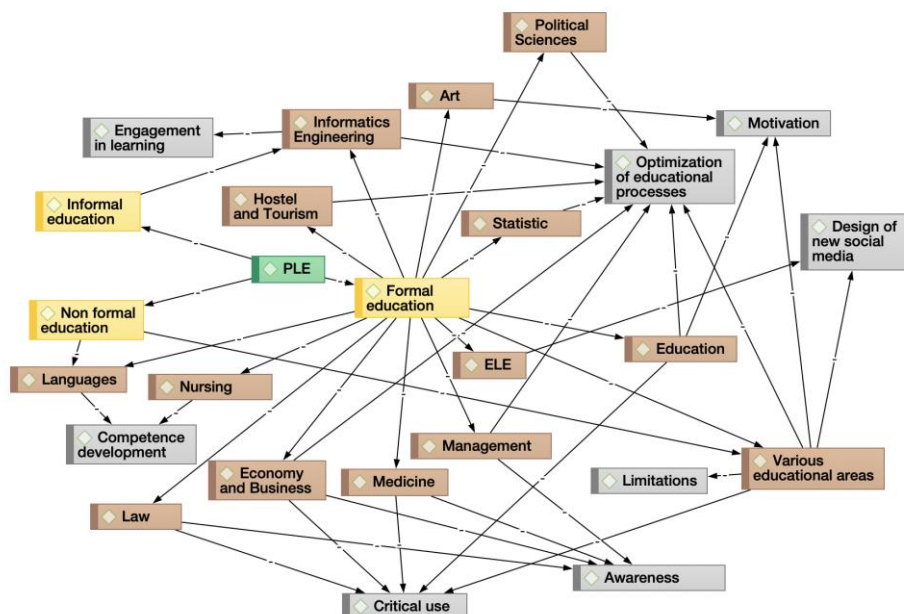


Figure 2. Topics and areas studied.

3.3. Social media most commonly associated with PLEs and their classification.

To systematise the social media that the 35 works analyse, we identified three categories within these works: 1) Ones that do not centre on any network in particular (such as those of Dabbagh & Kitsantas, 2012 or Prendes-Espinosa et al., 2016), as given their focus, either as literature reviews or theoretical reflections, they focus on social media in general and the role that the networks fulfil in PLEs ($n = 7$); 2) Ones that use specific networks ($n = 10$) with a vertical character – whether professional or strictly educational (Durak, 2017, Ossiannilsson et al., 2017) and finally, 3) Ones that are based on the use of general networks, $n = 34$. To be able to carry out a more exhaustive analysis, we added an item referring to the works that create PLEs through the use of various networks, whether by combining various specific (Arquero et al., 2017) or general networks or using both in a same configuration (Castaño-Garrido et al., 2015). Table 4 shows the results.

Table 4.
 Networks analysed in the works

NO NET WOR K	NETWORK	Specific			General			Combination of networks		
		Alone	+others	Total	NETWORK	Alone	+others	Total	Specific only	
7	LinkedIn	0	1	1	Ning	0	1	1	General only	4
	ELGG	3	1	4	Skype	0	1	1	Specific+General	2
	DIPRO2	2	0	2	Facebook	5	5	10		
	Edmodo	0	1	1	Twitter	5	4	8		
	SAPO network	2	0	2	YouTube	0	3	3		
					MySpace	0	1	1		
					Instagram	2	1	3		
					Flickr	1	1	2		
					WhatsApp	1	2	3		
					Telegram	0	1	1		
					Journi	1	0	1		
7		7	3	10		15	20	34		6

Source: Own elaboration.

The results show a clear preference for the use of general networks to configure PLEs, either on their own or combined with others (Ferri & Pozzali, 2012; Suslova & Grebenschikova, 2019, for example), or along with specific networks (Castaño-Garrido et al., 2015; Lu & Churchill, 2013). The general networks most analysed in the 35 articles were Facebook ($n = 10$) (as in the works of Abdullah et al., 2021; Wu et al., 2020; Wu, 2021) and Twitter ($n = 8$) (Reed, 2013 or Tur & Marín, 2015). For their part, YouTube (Suslova & Grebenschikova, 2019), Instagram (Junior, 2020) and WhatsApp (Pimmer et al., 2018) were examined three times, Flickr twice and the other networks (Ning, Skype, MySpace, Instagram, Telegram and Journi) on one occasion.

The educational network that played the largest role in the configuration of PLEs was ELGG ($n = 4$). Users can easily reconfigure this network in response to the needs of different social settings (Gewerk et al., 2014). It is followed by DIPRO2 ($n = 2$) (Marín et al., 2012) and the SAPO Campus's proprietary network ($n = 2$) (Almeida et al., 2014; Aresta et al., 2013). Edmodo was used on 1 occasion and the professional network LinkedIn was also used on 1 occasion.

Figure 3. Shows how the social media have been grouped to configure the PLEs and graphically demonstrates how and how often the different social networks have been combined to configure them:

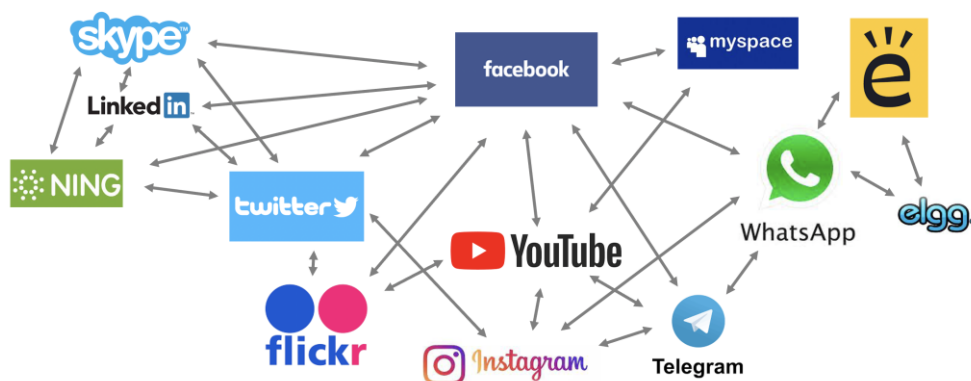


Figure 3. Interaction between the social media.

3.4. Fundamental objectives when determining the role of social media in the optimisation of PLEs

In reference to the objectives formulated in the 35 pieces of research analysed, which relate to assessing social media with regards to the best possible results in personal learning environments, we note two large groups:

The first group comprises those that strengthen transversal competences relating to socialisation and communication. So, this first group would firstly be divided into those that boost socio-professional indicators (Pimmer et al., 2018), through debates or similar tools (Wu et al., 2020) and foster the sense of belonging to a community. On the other hand, there are all of the competencies referring to communication and its efficacy, such as discursive skills, language ones (Barbosa et al., 2017; Junior, 2020) or of correct transmission of messages (Wu, 2021).

The second block relates to the process of learning in different disciplines and the competences that students strengthen through social media linked to PLEs. We refer to prior competences, such as motivation or self-regulation (Dabbagh & Kitsantas, 2013), ones relating to the experience acquired, such as improved performance (Castaño-Garrido, 2015) and significant learning quality.

3.5. Methodologies used, samples and instruments

Regarding methodological designs, the largest group (42.8% of cases) opted for qualitative studies in which interactions between participants were analysed or they were asked about different aspects. A quantitative methodology was used in eight works. A mixed design was used in four pieces of research and non-systematic literature reviews in two. Furthermore, six works were based on the design of models and explaining their advantages and disadvantages.

In the case of the quantitative or mixed studies, the great majority opted to use *ad hoc* questionnaires. Some studies started from already validated instruments to analyse some of the variables, such as, for example, the *Social Media Motives Scale* in the case of Lau (2016) or the *Instructional Materials Motivation Survey* used by Castaño-Garrido et al. (2015).

Regarding sample size, a wide variety was observed. We found studies that analysed the responses of 2054 subjects (Gutiérrez-Portlán et al., 2018, Prendes-Espinosa et al., 2016) or 21 people (Lu & Churchill, 2013; Wei et al., 2021).

3.6. Conclusions and implications of the study of the role of social media in PLEs in research and in educational policies: decision making

With regard to the conclusions of the works analysed in this sample, the analysis showed a polarisation of the results into 3 principal thematic areas:

1. Works that centre on evaluating user experiences, and placing their focus on them, such as those by Sweet-Cushman (2019), Arquero et al. (2017), Abdullah et al. (2021), and Lau (2016).
2. Works that evaluates or measures the weight of particular factors of the teaching–learning process such as motivation, collaboration, exchange of knowledge, conscious and self-regulated learning, creativity and innovation, and other aspects. This is the most numerous group and it includes works such as those of Almeida et al. (2014), Arquero et al. (2017), Castaño-Garrido et al. (2015), Dabbagh & Kitsantas (2013). Dabbagh & Kitsantas (2013), Kjærgaard & Sorensen (2014), Laru & Järvelä (2015) Tu et al. (2014) or Wei et al. (2021).
3. Works which focus on analysing the leading role of a certain network which transports a particular model or environment, and summarises its results (Dabbagh & Kitsantas, 2012; Kožuh et al., 2015; Marín-Díaz et al., 2012; Moreira et al., 2017).

With regards to the implications and future lines of action or research, the works that stood out especially were those relating to recommendations about particular networks or already configured or newly created environments, indications on methodologies, objectives and analysis of contexts to tackle, and those that offer directions for educational policies (Barbosa et al., 2017; Charteris et al., 2018; Dabbagh & Kitsantas, 2013; Gewerc-Barujel et al., 2014; Marín et al., 2012; Moreira et al., 2017; Tur & Marín, 2015).

4. Discussion, conclusions, implications, and limitations

In relation to the application of networks in the configuration of PLE and what needs they cover, the results reflect an intense debate that is already under way regarding the use of social media in education in general, and which on this occasion is transferred to the construction of environments. In the results shown below, the digital competence, teacher digital competence and the digital agency are always evident, either implicitly or explicitly.

The experimental studies referring to the university sector showed the expediency of using networks to configure working communities and environments (Calderón-Garrido & Gil-Fernández, 2022; Gil-Fernández & Calderón-Garrido, 2022), but this can either come about through networks designed with an educational or professional purpose with a view to developing the professional or academic curriculum (Akayoglu et al., 2021; Cozma & Dimitrova, 2020; Durak, 2017; Purnawarman et al., 2016) or through general

networks (Brouwer et al., 2020, Dalvi-Esfahani et al., 2020; Gil-Fernández & Calderón-Garrido, 2021; Ghareb et al., 2018; Kamalodeen & Jameson-Charles, 2016).

These observations coincide with the studies by Martínez and Ferraz (2016), which concluded that Facebook was the most well-known and common social network among university students at the time and in the context the study took place. This correlates with the results shown in this study. This network reliably transports the PLEs according to the sample analysed around these years, as shown in the data obtained which also coincide with those observed by Franklin (2019). Likewise, the appearance of Pinterest is justified as one of the most frequently used social networks for educational purposes as it is both useful and motivating for students (Amer & Amer, 2018). It is also worth highlighting the educational use of WhatsApp, already shown to be the most common social network used among Spanish university students by Fondevila-Gascón et al. (2019) and YouTube, which enables different learning strategies to be developed among the students, as described by Sadaba & Rendueles (2016).

As has been shown, the works analysed from a quantitative perspective in the present article favour the use of general networks. The authors who have made this choice, on most occasions have underlined certain advantages that these present. The case of Pimmer et al. (2018) can be used as an example, which, by using general networks in the development of PLEs, takes advantage of the intensive use of social capital that can be implemented with these networks – in this case WhatsApp, which authors such as Tyrer (2019) also note – or the possibility of interaction, that makes Charteris et al. (2018) propose the use of Facebook in PLEs. This idea is backed by authors such as Premadasa et al. (2019) and Connolly et al. (2019), who recommend interacting through this particular network, as it is the one most used by students and teachers. As previously noted, for many of the authors of the works in the sample selected, general networks offer the advantage of being able to include established professionals, evaluators, employers or potential clients in a PLE (Laru & Järvelä, 2015; Moreira et al., 2017).

Although it is to a lesser extent, some works favour the use of specific networks, which they also justify solidly, as they consider that they respond to other important purposes in the configuration of a PLE. ELGG was chosen as it is specially designed to favour self-regulated learning, which makes it especially attractive for insertion in a PLE (Gewerc-Barujel et al., 2014, Rodríguez-Groba et al., 2014). Another example is Edmodo, used by authors such as Lu & Churchill (2013) who initiated a line shared years later by Durak (2017), who considered the advantage of a network which eliminates any type of distraction as it is exclusively educational.

There is no lack of works that promote the expediency of using general and specific networks in a subsidiary way, as the combination of both types of networks – educational-workplace and general ones – does not have to come into conflict and is not exclusionary. This is how Castaño-Garrido et al. (2015) understood it who included LinkedIn as well as various general networks in the PLE that they configured to design a MOOC to complement their functionalities; or Lou & Churchill (2013) who used Edmodo along with general networks to combine the social aspect with the more strictly professional one.

With regard to the conclusions and future prospects that they obtained, the works analysed in this sample, outlined a PLEs scenario in which the challenges that have been fulfilled and remain to be fulfilled by social media are identified.

As has already been seen, some results focused on the valuation of user experiences, users' perceptions (Sweet-Cushman, 2019) or the intention and continuity of use (Arquero et al., 2017). The value of the relationship between instructors and students (Abdullah et al., 2021) and differences in motivation among students (Lau, 2016) are emphasised on occasion and continued analysis of this type is recommended.

Other works offered conclusions in relation to the weight of certain factors present in the teaching–learning process, such as collaboration (Almeida et al., 2014; Tu et al., 2014), motivation (Dabbagh & Kitsantas, 2013), exchange of knowledge and the possibility of a more conscious learning through the use of smartphones (Kjærgaard & Sorensen, 2014; Laru & Järvelä, 2015), self-regulated learning (Dabbagh & Kitsantas, 2013), creativity and innovation (Wei et al., 2021) or cognitive needs (Arquero et al., 2017). The results were always presented as positive, although some works did note that students' high satisfaction resulting from the confluence of these educational factors sometimes does not display a correlation with better academic results (Castaño-Garrido et al., 2015).

The insertion of networks in PLEs to favour these factors is on the same lines as other studies, such as that by Akcaoglu & Lee (2018), which, regardless of the mechanism in which they were inserted, showed that networks in formal learning in university contexts led to students achieving positive feelings and increase sociability, or Saini & Abraham (2019), who explored the “motivational influence” construct, which ultimately revealed itself to be a very important factor for predicting the choice of the educational use of networks. These ideas come together with the objectives of the authors when configuring a PLE.

Some of the works focus on offering conclusions on how certain network(s) positively influence the configuration of a PLE – given their characteristics – or the results obtained after creating a particular pedagogical setting or particular models (Dabbagh & Kitsantas, 2012; Kožuh et al., 2015; Marín-Díaz et al., 2014; Moreira et al., 2017). These ideas match those set out in works like those of Kamalodeen & Jameson-Charles (2016) that experimentally determined the central role in the teaching–learning environment and the collaborative character of the networks.

On this line, Barbosa et al. (2017) concluded that the productive and multimodal discourse of Instagram was optimal for the configuration of a PLE; Charteris et al. (2018) emphasised the emotional support generated in Facebook and Wu et al. (2020) underlined the benefits of this same network for generating an integrated learning framework. Heredia et al. (2013) underlined the projection of social identities on Twitter, as did Reed (2013) and Pimmer et al. (2018) who identified the benefits of WhatsApp for generating social capital. In the field of educational networks, Gewerc-Barujel et al. (2014) positively assessed ELGG owing to its high level of interaction and pertinence. Gutiérrez et al. (2018), after analysing a broad sample of students, determined that the branch that uses social media most intensively in the configuration of PLE was social and legal sciences.

There is lack of critical perspectives in works that reveal the wide margin for improvement that must be addressed, such as the one by Prendes-Espinosa et al. (2016), which focusses on the lack of reflexive strategies by students or that of Ferri & Pozzali (2012) who doubted that the students' digital literacy would enable them to make use of web resources. This more adverse perception can also be noted in works such as that of Patahuddin et al. (2020) and Scott (2018).

The implications and future developments that the authors of the works proposed with regards to the conclusions were on the line of recommending the use of one network (Barbosa et al., 2017) or several in a PLE (Arquero et al., 2017), proposing the use of an already configured environment (Almeida et al., 2014) through architectural models (Moreira et al., 2017), or the use of a new network (Marín et al., 2012). Some works centred on indicating which methodologies, objectives and analysis of contexts should be implemented to fill gaps in research (Gewerc-Barujel et al., 2014, Tur & Marín, 2015). Contributions such as that of Thompson et al. (2015), recommend methodologies to detect instructional problems. Finally, other works indicate good practices to establish changes in teaching plans (Dabbagh & Kitsantas, 2013), orientation of educational policies (Charteris et al. 2018) or permeability between formal, non-formal and informal teaching (Junior, 2020). This last line is one previously analysed by authors such as Parmaxi & Zaphiris (2017).

The main limitation of this work lies in the conscious decision not to include what has been defined as grey literature. The study objectives and scope, centred on finding the current state of the line of research, lead to us taking this preliminary decision (Ferrerías-Fernández et al. 2015; García-Peñalvo, 2022). However, we fulfilled the directives established in AMSTAR (Shea et al., 2002), which recommend using a minimum of two sources. Likewise, we have attempted to eliminate part of the possible bias by including all the WoS databases in the searches. Looking to the future, we consider a further analysis with a wider coverage, in which we could include more generalised databases such as ERIC, Google Scholar or Dialnet. We also contemplate reconsidering some of the inclusion and/or exclusion criteria in the searches to minimise the risk of excluding significant works, whether it be documents located in secondary sources or because the main study authors have used different terms in the study title, summary or key words. However, in this study, we have aimed to use the appropriate semantic group in the search.

In summary, having condensed the principal conclusions, it can be stated that when inserting social media into PLEs, it is necessary to consider users' needs in greater depth, promote flexible and adapted configurations of PLEs and analyse them with optimal methodologies to be able to obtain results that boost these communities. It is necessary to seek factors that are conducive to improving teaching–learning processes, as they can in themselves improve aspects such as motivation or intention in continuity of use, but these are not always correlated with better academic or professional results. Among the major challenges in the use of PLEs in university educational settings, academic and professional promotion and obtaining fluid convergence between non-formal, formal and informal fields are the most pressing ones. In this way, PLEs, viewed from the perspective of social media, must confront these challenges for the future, both in the field of teaching practice and in educational research.

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