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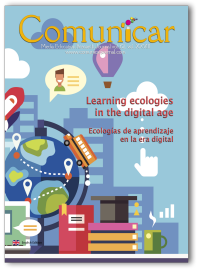

Digital learning ecologies and professional development of university professors

Ecologías digitales de aprendizaje y desarrollo profesional del docente universitario

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ABSTRACT

This study analyses the extent to which university faculty use the technological resources that make up their Learning Ecologies to promote their professional development as educators. The interest of this research lies on the growing impact of Learning Ecologies as a framework to examine the multiple learning opportunities provided by a complex digital landscape. Global data referred to the use of technological resources grouped in three dimensions (information access, search and management resources, creation and content editing resources, and interaction and communication resources) has been identified. In addition, the influence of different variables such as gender, age, years of teaching experience and the field of knowledge were also examined. The study was conducted using a survey-based quantitative methodology. The sample consisted of 1,652 faculty belonging to 50 Spanish universities. To respond to the objectives of the study, descriptive and inferential analyses (ANOVA) were carried out. On the one hand, a moderate use of technological resources for professional development was noted while on the other hand, significant differences were observed on all variables analyzed. The results suggest a need to promote, both at the individual and institutional levels, more enriched Learning Ecologies, in such a way that each professor can harness the learning opportunities afforded by the networked society.

RESUMEN

En este estudio se analiza en qué medida el profesorado universitario utiliza los recursos tecnológicos que configuran sus Ecologías de Aprendizaje para propiciar su desarrollo profesional como docentes. El interés de esta investigación radica en el creciente impacto del constructo de las Ecologías de Aprendizaje como marco para examinar e interpretar las múltiples oportunidades de aprendizaje que ofrece el complejo panorama digital actual. Además de identificar los datos globales referidos al uso de los recursos tecnológicos agrupados en tres dimensiones (recursos de acceso, búsqueda y gestión de la información, recursos de creación y edición de contenido, y recursos de interacción y comunicación), también se examina la influencia de diferentes variables como el género, la edad, los años de experiencia docente y la rama de conocimiento. La metodología empleada ha sido de corte cuantitativo a través de encuesta. La muestra está compuesta por 1.652 profesores pertenecientes a 50 universidades españolas. Para dar respuesta al objetivo del estudio se llevaron a cabo análisis descriptivos e inferenciales (ANOVA). Se constata un empleo moderado de los recursos tecnológicos para el desarrollo profesional y, además, se observan diferencias significativas en función de las variables analizadas. Los resultados alertan de la necesidad de fomentar, tanto a nivel individual como institucional, Ecologías de Aprendizaje más enriquecidas, de manera que cada docente pueda aprovechar mejor las posibilidades de aprendizaje que ofrece la sociedad en red.

KEYWORDS | PALABRAS CLAVE

Continuing education, teacher education, professional development, university teachers, higher education, learning ecologies, technological resources, informal learning.

Formación permanente, formación del profesorado, desarrollo profesional, profesorado universitario, educación superior, ecologías de aprendizaje, recursos tecnológicos, aprendizaje informal.

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1. Introduction and state of the art

The unrelenting explosion and expansion of knowledge, along with its obsolescence, generate great instability both at an individual and institutional levels, demanding the need for lifelong learning as a basic requirement for personal and professional development. But, in addition, learning has undergone a metamorphosis (González-Sanmamed, Sangrà, Souto-Seijo, & Estévez, 2018) as new formats have been fostered, time and space have been extended, and informal and non-formal models of knowledge acquisition have been strengthened. Thus, learning is characterized as ubiquitous (Díez-Gutiérrez & Díaz-Nafría, 2018), invisible (Cobo & Moravec, 2011), connected (Siemens, 2007) or rhizomatic (Cormier, 2008).

In this attempt to answer questions about what, how, when and where learning takes place in a networked society, the concept of Learning Ecologies (LE) emerges as a perspective to analyze and arbitrate proposals that account for the open, dynamic and complex mechanisms from which knowledge is constructed and shared.

Several authors have upheld the relevance of LE as a construct that enables the appreciation and promotion of the broad and diverse learning opportunities offered by the current context (Looi, 2001; Barron, 2006; Jackson, 2013; Sangrà, González-Sanmamed, & Guitert, 2013; Maina & García, 2016). Specifically, Jackson (2013: 7) states that LE "understand the processes and variety of contexts and interactions that provide individuals with opportunities and resources to learn, to develop and to achieve".

The recent review by Sangrá, Raffaghelli and Guitert-Catasús (2019) reveals the interest aroused by this concept and the studies being conducted with various groups to reveal how they benefit from, and also how they could promote, their LE.

In particular, analyses have been developed to explore in-service teachers' LE and their links with learning processes and teachers' professional development (Sangrá, Guitert, Pérez-Mateo, & Ernest, 2011; Sangrà, González-Sanmamed, & Guitert, 2013; González-Sanmamed, Santos, & Muñoz-Carril, 2016; Ranieri, Giampaolo, & Bruni, 2019; Van-den-Beemt & Diiepstraten, 2016).

The confluence of both lines of reflection and inquiry is promising, especially when considering the assumption of professional development as a process of continuous learning, in which each teacher tries to improve their own training, taking advantage of the resources available through various mechanisms and contexts.

The demand for a teaching staff that is up to date, with the skills and knowledge that guarantee their adequate performance, and with the commitment required for the task of training future generations, takes on special relevance in the field of higher education. The professional development of university professors is a key factor in guaranteeing quality higher education (Darling-Hammond & Richardson, 2009; Inamorato, Gausas, Mackeviciute, Jotautyte, & Martinaitis, 2019).

Various studies have identified the characteristics, conditions and models of professional development for university faculty, and have also assessed the improvements these provide (Gast, Schildkamp & Van-der-Veen, 2017; Van Waes, De-Maeyer, Moolenaar, Van-Petegem, & Van-den-Bossche, 2018; Jaramillo-Baquerizo, Valcke, & Vanderlinde, 2019). The expansion of technology is generating new formats for professional development (Parsons & al., 2019) by facilitating learning anytime, anywhere (Trust, Krutka, & Carpenter, 2016). Specifically, university professors have begun to create opportunities for their own professional development using different resources such as video tutorials or social networks (Brill & Park, 2011; Seaman & Tinti-Kane, 2013).

These and other studies highlight the relevance of technological resources in the learning and professional development processes of university professors. The importance of resources has been recognized by various authors (Barron, 2006; Jackson, 2013; González-Sanmamed, Muñoz-Carril, & Santos-Caamaño, 2019) as one of the components of LE which, together with contexts, actions and relationships, represent the pillars upon which individuals can articulate, manage and promote their own LE.

As He and Li (2019) noted, learning is becoming increasingly self-directed and informal with the support of technology, hence the need to explore the resources used by faculty to foster their professional development from an integrative vision provided by LE.

On the one hand, we have to assume the importance and control of educators to direct their own learning according to their needs, interests and potentialities, determining aspects of professional development (Muijs, Day, Harris, & Lindsay, 2004), but we also have to take into account how resources influence or may influence the development of the other components of LE (fostering actions, stimulating relationships, generating contexts, etc.) that will contribute to the development of personalized learning and professional development modalities (Yurkofsky, Blum-Smith, & Brennan, 2019).

2. Materials and methods

This study is part of a wider project that analyses the LE of university professors and their impact on learning processes and professional development related to teaching. Specifically, the purpose of this study was to identify the technological tools that make up the LE of university professors, and to assess the extent to which they are used to promote their professional development. The following hypotheses were put forward:

1) Gender is associated with significant differences in the use of technological resources for the professional development of university professors from the LE perspective.

2) Age is a significant factor in the use of technological tools for the professional development of university professors.

The demand for a teaching staff that is up to date, with the skills and knowledge that guarantee their adequate performance, and with the commitment required for the task of training future generations, takes on special relevance in the field of higher education.

3) Experience generates significant differences in the use of technological tools for the professional development of university professors from the LE viewpoint.

4) The professor's field of knowledge leads to significant differences in the use of technological tools for the professional development of university professors within the LE framework.

A descriptive methodology with a cross-sectional design was applied using a survey-based method. The data were collected through a questionnaire designed ad hoc from a systematic review of the literature on LE. To establish the validity of the content, the initial instrument was submitted to expert judgement. Nine professionals with training on the study subject (LE) and educational research methodology participated in the validation process, all of them with more than 12 years of professional experience at the university level. Based on their assessments, the first version was reworked and then a pilot test was conducted on 210 subjects to determine the reliability of the questionnaire. After verifying adequate psychometric levels and reviewing some grammatical aspects, the final version was created in digital format (Google Forms) and administered online. The application was open for 5 months. Different institutional managers collaborated and distributed the instrument by e-mail. A presentation was included explaining the objective of the study, framed within its research project, and providing anonymity and confidentiality guarantees. All questions had to be answered and the average response time was around 12 minutes.

The complete questionnaire included seven scales. The first four evaluated constructs within the personal dimension of LE and the next three delved into the experiential dimension of the Ecologies (González-Sanmamed, Muñoz-Carril, & Santos-Caamaño, 2019). To carry out this study, one of the scales included in the experiential dimension was used, namely the Resource Scale. Its design was based on the typology of digital tools proposed by Adell and Castañeda (2010), Castañeda and Adell (2013), Kop (2011), as well as Dabbagh and Kitsantas (2012).

The Resource Scale is comprised of 24 items (Table 1), with a Likert scale from 1 (not at all) to 5 (extremely), distributed into three factors. The first of these, with 10 items, includes the "resources for access, search and information management"; the second factor includes the "resources for creating

and editing content", with eight items; and finally, the third factor, made up of six items, groups the "interaction and communication resources". Once the questionnaire had been administered and the criteria of reliability had been met once again, the Cronbach alpha coefficient was calculated, both globally (α=.90) and for each of the dimensions making up the questionnaire: resources for access, search and management of information (α=.82), content creation and editing resources (α=.75), as well as interaction and communication resources (α=.75).

Table 1. Descriptive statistics according to the type of resources used by faculty for learning and professional development

	Not at all		Slightly		Moderately		Very		Extremely		M	DT
	n	%	n	%	n	%	n	%	n	%		
Resources for access, search and information management												
Video tutorials (YouTube, Vimeo, etc.)	241	14.6	335	20.3	449	27.2	412	24.9	215	13.0	3.01	1.24
Social Markers (Delicious, Diigo, etc.)	1279	77.4	194	11.7	115	7.0	38	2.3	26	1.6	1.38	0.83
Repositories of virtual learning objects (Minerva, Investigo, etc.)	948	57.4	258	15.6	243	14.7	133	8.1	70	4.2	1.86	1.18
Digital tools for notetaking (Onenote, Evernote, etc.)	855	51.8	266	16.1	269	16.3	148	9.0	114	6.9	2.03	1.28
Digital task managers (Evernote, Trello, WunderList, Google Tasks, etc.)	876	53.0	276	16.7	216	13.1	158	9.6	126	7.6	2.02	1.31
Digital calendars (Google calendar, iCal, etc.)	395	23.9	226	13.7	251	15.2	303	18.3	477	28.9	3.14	1.55
Digital project management (MS Project, Basecamp, Gantt PV, etc.)	1088	65.9	253	15.3	175	10.6	92	5.6	44	2.7	1.63	1.04
Cloud storage (Dropbox, Drive, Box, Onedrive)	97	5.9	142	8.6	268	16.2	387	23.4	758	45.9	3.94	1.22
Applications to sabe and read later (Pocket, Instapaper, etc.)	1092	66.1	241	14.6	149	9.0	110	6.7	60	3.6	1.67	1.11
Mail, planner, contact and task management software	113	6.8	103	6.2	153	9.3	366	22.2	917	55.5	4.13	1.22
Resources to create and edit content												
Blogs, Wikis, websites…for online writing	330	20.0	280	16.9	387	23.4	424	25.7	231	14.0	2.96	1.33
Audio editing tools (Podcasts)	824	49.9	368	22.3	248	15.0	163	9.9	49	3.0	1.93	1.14
Networks focused on document-based information (Slideshare, Glogster, etc.)	692	41.9	355	21.5	299	18.1	228	13.8	78	4.7	2.17	1.24
Networks focused on grouping and discussing content (Tumbrl, Pinterest, Scoopit)	947	57.3	331	20.0	214	13.0	125	7.6	35	2.1	1.77	1.06
Generic networks (Facebook, Google+)	594	36.0	339	20.5	286	17.3	282	17.1	151	9.1	2.42	1.36
Office automation (MS-Office, Adobe PDF, Zoho, LibreOffice, etc.)	109	6.6	76	4.6	189	11.4	379	22.9	899	54.4	4.13	1.19
Multimedia: creation in audio, video and image formats (Photoshop, Gimp, Powtoon, Audacity, iMovie, etc.)	499	29.6	358	21.7	340	20.6	254	15.4	211	12.8	2.6	1.38
Virtual classroom (Moodle, Blackboard, etc.)	201	12.2	126	7.6	227	13.7	400	24.2	698	42.3	3.76	1.38
Resources for interaction and communication												
Microblogging networks (Twitter, etc.)	856	51.8	282	17.1	236	14.3	170	10.3	108	6.5	2.02	1.28
Image-centric networks (Instagram, Flickr, etc.)	1028	62.2	265	16.0	164	9.9	124	7.5	71	4.3	1.75	1.16
Professional networks (LinkedIn, etc.)	603	36.5	368	22.3	301	18.2	239	14.5	141	8.5	2.36	1.32
Mobile messaging (Whatsapp, etc.)	421	25.5	302	18.3	292	17.7	342	20.7	295	17.9	2.8	1.45
Email	37	2.2	56	3.4	156	10.0	430	26.0	963	58.3	4.34	1.94
Videoconference (Skype, etc.)	282	17.1	297	18.0	416	25.2	424	25.7	233	14.1	3.01	1.29

Non-probability, convenience sampling was used. The sample was comprised of 1,652 university professors belonging to 50 Spanish universities, 50.5% male and 49.5% female. In terms of age, 23.8% were under 40 years of age; 33.1% were between 41 and 50 years of age, and 43.2% were over 51 years

of age. 33.4% had less than 10 years of teaching experience; 26.3% had between 11 and 20 years, and 40.3% had more than 20 years of experience. The distribution by field of knowledge was the following: 28% belonged to the Social-Judicial field, 21.4% to the field of Engineering and Architecture, 25.2% to Health Sciences, 13.8% to Arts and Humanities and, finally, 11.1% to the field of Sciences. Data was analyzed with the IBM SPSS (v.25) software.

3. Analysis and results

In Table 1, through the descriptive statistics of each item, organized into the three dimensions considered, it is possible to appreciate the tools that are used to a greater or lesser degree.

Table 2. Means, standard deviations, asymmetry, kurtosis and correlation matrix

		1	2	3
1.	Resources for access, search and information management	–		
2.	Resources for content creation and management	.70**	–	
3.	Resources for interaction and communication	.60**	.64**	–
	M	2.48	2.72	2.73
	SD	0.75	0.76	0.83
	Asymmetry	0.49	0.19	0.28
	Kurtosis	-0.01	-0.34	-0.39

**p<.001

Table 2 provides the means, standard deviations, asymmetry, kurtosis, as well as the Pearson correlation coefficients for the dependent variables used in this study. The normal distribution of the variables was analyzed based on the criteria adopted by Finney and DiStefano (2006), who indicate maximum values of two and seven for asymmetry and kurtosis, respectively. It can be concluded that the variables included in this study exhibit normal distributions.

Table 3. Descriptive statistics (mean and standard deviation) pertaining to the different age groups in terms of their use of digital resources

	Under 40 years old (1)		Between 41 and 50 Years old (2)		Over 51 years old (3)	
	M	SD	M	SD	M	SD
Resources for access, search and information management	2.60	0.74	2.57	0.75	2.34	0.74
Resources for content creation and editing	2.79	0.76	2.81	0.74	2.61	0.76
Resources for interaction and communication	2.83	0.91	2.78	0.83	2.63	0.78

Note. Scheffé test: information access, search and management resources 1-3, 2-3; content creation and editing resources 1-3, 2-3. Games-Howell test: interaction and communication resources 1-3, 2-3. Age (1=Under 40; 2=Between 41 and 50; 3=Over 51).

In terms of correlations, there is a significant and positive relationship between the use of resources for access, search and management of information and resources for content creation and management (r=.70; p<.001); furthermore, there is also the relationship between the use of resources for content creation and management and resources for interaction and communication (r=.64; p<.001), and finally the one between the use of resources for creation and management and resources for interaction and communication (r=.60; p<.001).

Analyses of variance (ANOVA) were conducted to find out if there were statistically significant differences in the use of resource typologies according to gender, age, years of experience and field of knowledge. Subsequently, Scheffé's post-hoc contrast tests were used, and in order to know the size of the effect, the partial eta-square coefficient was used (η_p^2); the interpretation of the latter is based on the criterion established by Cohen (1988), indicating that an effect is small when η_p^2=.01 (d=.20), medium when η_p^2=.059 (d=.50) and large if η_p^2=.138 (d=.80).

First, taking gender as an independent variable, and the three types of resources as dependent variables, the ANOVA results show that there are statistically significant differences with a small effect size in the use of information access, search and management resources [$F_{(1.1650)}$=3.962, p<.05; η_p^2=.002], as well as in the use of resources to create and edit content [$F_{(1.1650)}$=38.917, p<.001; η_p^2=.02], and finally in

the use of interaction and communication resources [$F_{(1.1650)}$=33.584, p<.001; η_p^2=.02] according to gender, with female participants using the three types of resources at a greater degree.

Table 4. Descriptive Statistics (mean and standard deviation) corresponding to different groups of professors according to their teaching experience, in the use of digital resources

	Less than 10 years (1)		Between 11 and 20 years (2)		More than 21 years (3)	
	M	SD	M	SD	M	SD
Resources for access, search and information management	2.63	0.74	2.53	0.77	2.32	0.72
Resources for content creation and editing	2.83	0.76	2.77	0.75	2.60	0.75
Resources for interaction and communication	2.87	0.88	2.73	0.82	2.60	0.78

Note. Scheffé test: information access, search and management resources 1-3, 2-3; content creation and editing resources 1-3, 2-3. Games-Howell test: interaction and communication resources 1-3, 2-3, 1-2. Years of Experience (1=Less than 10 years; 2=Between 11 and 20 years; 3=More than 21 years).

Second, an ANOVA was performed considering age as an independent variable (1=under 40 years; 2=between 41 and 50 years; and 3=over 50 years) and the use of the three types of resources as dependent variables. In the case of interaction and communication resources, the robust Brown-Forsythe (F*) tests were used, followed by Games-Howell post-hoc tests, not assuming equal variances. The results show statistically significant differences with a small effect size on the use of information access, search and management resources [$F_{(2.1649)}$=20.689, p<.001; η_p^2 =.02], in the use of resources to create and edit content [$F_{(2.1649)}$=12.243, p<.001; η_p^2=.01 and in the use of interaction and communication resources [$F^*_{(2.1313)}$=9.032, p<.001; η_p^2=.01] depending on age.

Specifically, there are differences in the use of the three types of resources considered between professors who are under 40 and those who are over 51, and between those who are between 41 and 50 and those who are over 51.

Results show the same trend: greater use of digital resources for professional development by the youngest group of professors, followed by the group between 41 and 50 years of age, and a distinctly lower use by the group over 51 years of age (Table 3).

Table 5. Descriptive statistics (mean and standard deviation) relating to the different fields of knowledge in the use of digital resources

	Social-Judicial (1)		Engineering and Architecture (2)		Health Sciences (3)		Arts and Humanities (4)		Sciences (5)	
	M	SD	M	SD	M	SD	M	SD	M	SD
Resources for access, search and information management	2.53	0.81	2.48	0.71	2.51	0.72	2.5	0.75	2.27	0.73
Resources for content creation and editing	2.78	0.79	2.59	0.70	2.78	0.74	2.81	0.84	2.55	0.70
Resources for interaction and communication	2.91	0.83	2.51	0.80	2.81	0.78	2.79	0.86	2.41	0.81

Note. Scheffé test: interaction and communication resources 1-2, 1-5, 2-3, 2-4, 3-5, 4-5. Games-Howell test: information access, search and management resources 1-5, 2-5, 3-5, 4-5; content creation and editing resources 1-2, 1-5, 2-3, 2-4, 3-5, 4-5. Field of Knowledge (1=Social-Judicial; 2=Engineering and Architecture; 3=Health Sciences; 4=Arts and Humanities, 5=Sciences).

Third, an ANOVA was performed taking the years of experience as an independent variable (1=less than 10 years, 2=between 11 and 20 years, 3=more than 21 years) and the use of the three types of digital resources as dependent variables. In the case of interaction and communication resources, the robust Brown-Forsythe (F*) tests were used, followed by Games-Howell post-hoc tests, given that the assumption of variance homogeneity was not met. The results indicated that there are statistically significant differences (with a small effect size) in the use of access, search and management resources [$F_{(2.1649)}$=26.774, p<.001; η_p^2=.03], as well as in the use of resources for creating and editing

content [$F_{(2.1649)}$=15.39, p<.001; η_p^2=.02], and in the use of interaction and communication resources [$F^*_{(2.1516)}$=15.86 , p<.001; η_p^2=.02], depending on the years of experience. Although the effect is small in all three cases, there are differences in the use of access, search and information management resources between professors with less than 10 years of experience and those with more than 21 years of experience, and between the group with between 11 and 20 years of experience and the group with more than 21 years of experience. The trend in all three cases is that the use of digital resources to foster professional development decreases as teaching experience increases.

Finally, a final ANOVA was carried out taking the field of knowledge as an independent variable (1=Social-Judicial, 2=Engineering-Architecture, 3=Health Sciences, 4=Arts-Humanities, 5=Sciences), and the use of interaction and communication resources as a dependent variable. At the same time, the other two dependent variables (information access, search and management resources, as well as the use of interaction and communication resources) were taken into account. At the same time, since the other two dependent variables (information access, search and management resources, and content creation and editing resources) did not meet the homoscedasticity assumption, the robust Brown-Forsythe (F*) tests were used, followed by post-hoc Games-Howell tests. The results show statistically significant differences with a small effect size on the use of information access, search and management resources [$F^*_{(4.1384)}$=4.29, p<.01; η_p^2=.01], in the use of content creation and editing resources [$F^*_{(4.1336)}$=7.29, p<.001; η_p^2=.017], and in the use of interaction and communication resources [$F_{(4.1647)}$=19.92 , p<.001; η_p^2=.046,] based on years of experience (Table 5).

Although the size of the effect was small, significant differences were found in the use of access, search and information management resources between the teaching staff in the science field and those in the other fields, with this group displaying the lowest rates of use of this type of resources. In this case, the teaching staff of the Social-Judicial area exhibits the highest use values. In terms of the use of resources of content creation and editing, the Arts and Humanities group exhibits the highest usage indexes, followed by the Health Sciences faculty and those in the Social-Judicial field; the groups that use these resources to a lesser extent are those in Engineering and Architecture, and Science. As for interaction and communication resources, the faculty of the Social-Judicial field stands out with the highest rates of use of this type of tools, followed by the Health Sciences and the Arts and Humanities groups, with the Engineering and Architecture as well as the Science faculties using these resources the least.

Table 5 also shows that the trend towards the use of resources for creation and editing, and for interaction and communication is greater than the use of resources for access, search and management of information in all the fields of knowledge. The scarce use of digital tools by Science teaching staff as compared to professors in the rest of the fields of knowledge stands out.

4. Discussion and conclusions

First of all, it should be noted that this study is part of an emerging line of research that still needs to be conceptually strengthened and empirically explored. In addition, it could be regarded as pioneering, since the scarce work available on professional development processes within the framework of LE has been performed with educators at non-university levels.

A global analysis of the results enables a glimpse into the most used resources for professional development: email, office automation, mail managers, planner, virtual classroom, cloud storage, digital calendars, and video tutorials. These are all tools used daily in teaching and, perhaps, the most accessible and manageable tools to promote update and continuous improvement processes. Each professor includes some of the tools in his/her Learning Ecology through diverse experiences, interactions and contexts along his/her life journey, turning them into resources for professional development to the extent to which they are activated consciously and autonomously to foster localized and personalized learning. In fact, research carried out on digital competence (Durán, Prendes, & Gutiérrez, 2019) or studies on TPACK (Jaipal & al., 2018) in higher education teaching staff confirm the need to strengthen the integration of technology at the university level, and to reinforce the technological training of faculty. Responsibility lies with each professor, and also with the institutions themselves, to facilitate access to and promote the use of technological resources that enable the configuration of an enriched ecology from which each

professor could guide his or her own professional development. The analyses carried out indicate that all the hypotheses raised have been met. With regard to gender, it must be noted that this is a controversial variable given the discrepancies in the results of previous research concerning its impact on the use of technology and on teaching professional development. In order to assess the data in this study, which reveals that females account for the majority use of the three types of resources for their professional development, it is important to point out that female university professors are more interested in carrying out self-actualization training activities than male professors (Caballero, 2013). However, it would also be advisable to study the influence of other variables such as the perception of self-efficacy, anxiety, attitude or intrinsic motivation towards the use of technology (Drent & Meelissen, 2008).

With regard to results in terms of the fields of knowledge, it is worth noting that Science professors, followed by Engineering and Architecture professors, are the ones who use digital resources the least to develop professionally. These data can be evaluated in light of the study carried out by Cabero, Llorente and Marín (2010). In addition, the scarce use of Interaction and Communication resources among Science as well as Engineering and Architecture professors may suggest a preference for individual rather than cooperative work (Caballero, 2013).

In general, the results obtained reflect a discrete use of technological resources for professional development, revealing some significant limitations in the configuration of university professors' LE. The implications of these results have to be assessed from a three-fold perspective: they warn of the need to increase the range of resources available for teacher training, warn of the desirability of broadening the formats for professors' professional development, and encourage the establishment of mechanisms that contribute to reinforcing LE in order to make them more prosperous.

The impact of these implications is twofold. On the one hand, at the professional level, each professor must be aware of the components that make up his or her LE, since this would mean taking control of their learning process according to individual needs, interests and opportunities (Maina & García, 2016). On the other hand, at an institutional level, the recognition of the importance of LE for professors' optimal and fruitful professional development would be the starting point for improving the training offering by universities through the design of continuous faculty training plans with more personalized, open and flexible itineraries.

Finally, although the study has focused on the analysis of digital resources, recognized as essential components of the experiential dimension of LE (González-Sanmamed, Muñoz-Carril, & Santos-Caamaño, 2019), it is essential to take into account their interdependence with the other components of LE (Relationships, Contexts and Actions). Thus, resources can facilitate collaboration between professors, evidencing their potential to avoid isolation and to promote success in professional development, for example, through social networks or learning communities (Lozano, Iglesias, & Martinez, 2014). On the other hand, resources not only favor, but also expand learning contexts, in a continuum ranging from most formal to informal settings (Sangrá & al., 2011). Finally, digital resources reduce spatial-temporal limitations, offering new and timely ways to carry out training actions in todays' complex scenario.

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