Teachers' perceptions of digital competence at the lifelong learning stage

Esther Garzón-Artacho, Tomás Sola-Martínez, José-María Romero-Rodríguez, Gerardo Gómez-García * 
Department of Didactics and Scholar Organisation, University of Granada, Granada, Spain

ARTICLE INFO

Keywords:
Digital competence
Teacher training
ICT
Permanent education
Lifelong learning stage

ABSTRACT

In recent years, the educational landscape has been in a period of constant change due to the advent of Information and Communication Technologies (ICT). As a result, training in digital competence has become one of the challenges to be met by the teaching staff, in order to incorporate these skills into their professional practice. As a result of this, the present work aimed to analyse the level of digital competence presented by a sample of 140 teachers of the Lifelong Learning stage in the Autonomous Community of Andalusia (Spain). To this end, a transversal methodological design of a quantitative nature was advocated, based on the configuration of an ad hoc questionnaire developed from the European conceptual frameworks on teaching digital competence. The results showed that the level shown by teachers is low, especially in terms of creation, information literacy and problem solving, although they did show optimal skills in communication and collaboration of digital content. The findings also determined the importance of factors such as age, teacher training and school type in further developing this compendium of skills.

1. Introduction

In recent years, the dizzying advance of society has promoted a modification in the demands it makes on citizens. The irruption of Information and Communication Technologies (ICT) has led to many changes at the social, economic and therefore educational level (Starkey, 2020). In this sense, the Digital Agenda for Europe 2020, approved by the European Council of Parliament, enshrines the principle of ensuring the acquisition of digital skills and literacy for all citizens (Durán et al., 2019). In this line, The Future Jobs Report, prepared by the World Economic Forum (2018), as well as the OECD (OECD, 2014), predicts that the large number of professions that exist today and in the coming years will require digital skills to be able to perform their work. Thus, technology is very present in today's and tomorrow's society, and it is pertinent to promote a digital literacy that provides the citizen with the necessary skills required by today's Information Society (From, 2017).

If we look at the educational landscape, ICT has gone from being a simple support tool in the classroom to becoming an inseparable part of today's pedagogical processes (López, Pozo, Morales y López, 2019b). The emergence of these tools has caused a great deal of concern among teachers, whose mission is to adapt to a context that is unusual for them, and of which most have no previous training. Consequently, they have to face a training process that includes new methodological skills and pedagogical strategies that allow them to integrate these digital tools into their regular teaching (Li et al., 2019). Along these lines, the different editions of the Horizon Report outline the need for teachers to develop these types of skills in order to establish real integration in the teaching-learning process, since a large part of the teaching staff is unaware of the potential that resides in these resources, limiting themselves to making superficial use of them (Adams et al., 2017; Gisbert and Esteve, 2016).

In this sense, the future of education turns towards a modification of the ecologies of learning (Díez-Gutiérrez and Díaz-Nafria, 2018) the development of good practices from the application of emerging methodologies that incorporate these tools. According to objective number 4 of the Agenda 2030 of objectives to achieve sustainable development, technology must be standardized when carrying out teaching processes, and for this, it will be pertinent to promote initial and continuous training of teachers and an improvement of their digital competence (Alonso et al., 2019).

2. The digital teaching competence

The concept of digital competence has its origin in a new vision of learning in formal studies that starts from the need to classify those skills and aptitudes that the individual must acquire and consolidate as an...
essential means to advance in his or her academic career and, subsequently, throughout life (Gisbert et al., 2016). This type of learning, called through the term key competence, is justified by the European Higher Education Area (EHEA) which advocates the need to promote in students a compendium of basic skills that make the student a competent figure to meet the demands that society demands today.

The European Commission (2006) understands digital competence as the safe and critical use of ICT in the Information Society for work, leisure and communication. It is based on basic ICT skills: the use of computers to obtain, evaluate, store, produce, present and exchange information, communicate and participate in collaborative networks (p.15). If we look specifically at the concept of digital teaching competence, according to Flores and Roig (2019) it is a type of multidimensional competence, and can be defined as the ability to mobilize those skills and abilities that allow you to search, critically select, obtain and process relevant information using ICT to transform it into knowledge, while being able to communicate such information through the use of different technological and digital media, acting responsibly, respecting the socially established rules and taking advantage of these tools to inform, learn, solve problems and communicate in different scenarios of interaction.

Based on this concept, several international institutions have had the objective of developing a conceptual framework around this term, in order to constitute a common reference for all educational plans and curricula. Among the most prominent is the common European framework of digital competence for citizens, also known as DigComp, which was published in 2013 by the European Commission. It is a tool to improve the digital quality of citizens, to help develop policies that support digital training and to plan education and training initiatives to improve digital citizenship in citizenship (Ferrari, 2013). This report presents the version 2.0 of the Digital Competence Framework for citizens (Vuorikari, Punie, Carretero and Van den Brande, 2016), which includes an update of the conceptual reference model, a revision of the vocabulary and an establishment of more rational descriptors. There are also other organizations that have been in charge of measuring the development of digital competence, such as the National Educational Technologies and Teacher Training (INTEF) of Spain, which is an adaptation of the DigComp in the Spanish context (Cabero, Romero y Palacios, 2020). All of them, as shown in Table 1, understand the concept of digital competence around a compendium of competence dimensions of a similar nature. Likewise, they aim to classify individuals around a compendium of levels, which assign a different nomenclature based on the degree of digital skill acquired (Quiroz et al., 2016).

Taking into account the Spanish educational context, INTEF is in charge of ensuring the development of a practice that promotes the inclusion of ICT in the classrooms of the different educational spaces, as well as initial and permanent training in five specific competence areas: 1- Information and information literacy; 2- Communication and collaboration; 3- Creation of digital contents; 4- Security; 5- Problem solving (INTEF, 2017) (Table 2):

### Table 1. Conceptual frameworks of digital teaching competence.

| Conceptual framework | Institution | Dimensions | Levels |
|----------------------|-------------|------------|--------|
| ICT Competency Standards for Teachers | UNESCO | - Policy and vision  
- Curriculum and evaluation Pedagogy  
- ICT  
- Organization and administration  
- Professional training of teachers | Acquisition of basic notions  
Deepening of knowledge  
Knowledge generation |
| DigComp | European Commission | - Information  
- Communication  
- Content Creation  
- Security  
- Problem solving | A1 (newcomer)  
A2 (browser)  
B1 (integrator)  
B2 (expert)  
C1 (leader)  
C2 (pioneer) |
| NETS-S | ITSE | - Student learning and creativity  
- Learning experiences and evaluations of the digital age  
- Work and learning characteristic of the digital age  
- Digital citizenship and responsibility  
- Professional growth and leadership | Beginner  
Medium  
Expert  
Transformer |
| Common framework for digital teaching competence | INTEF (Spanish Ministry of Education) | - Information and Information Literacy  
- Communication and collaboration  
- Digital content creation  
- Security  
- Problem solving | Basic  
Medium  
Advanced |

3. The lifelong learning stage

The aim of Lifelong Learning for adults is to offer all people over the age of eighteen the opportunity to acquire, complete or expand their knowledge and skills in order to promote their personal or professional development (Fernández Batanero and Torres González, 2015). Currently, the autonomous community of Andalusia has more than 600 public centers dedicated to adult education (Hinojo et al., 2019).

The specific public centers for the Permaneni Education of adults are the Centers and Sections of Permanent Education (CEPER-SEPER), the institutes and provincial sections of Permanent Education (IPEP-SIPEP), the institutes of Secondary Education (IES), the official schools of languages (EOI) and the institutes of distance education of Andalusia (IEDA).

In this region, Continuing Education for adults is structured in several actions, which cover the different needs of the students according to the objectives and needs to be fulfilled. Thus, the following modalities can be distinguished:

- **Educational plan for basic training:** it is aimed at people with reading and writing difficulties or difficulties in understanding and expression who wish to acquire the necessary training for access to Compulsory Secondary Education (ESO). This option is organized in two levels of one school year each. Depending on the number of students, it can constitute a single generic educational plan or several specific ones, with the following objectives: a) Preparation of the test to obtain the ESO graduate degree for those over 18 years old; b) Preparation of the test to obtain the high school degree for those over 20 years old and; c) Study support tutoring for the follow-up of the semi-attendance modality in Secondary Education for adults.
There were works that especially indicated that teachers have a good educational area. Thus, there are studies that evaluated the level of literacy (Trujillo Torres et al., 2020; Nowak, 2019) or content creation (Rodríguez-García, Sánchez and Peña, 2020; Cano et al., 2017; Moreno and Delgado, 2013) that determined that men were more familiar with ICTs, or that women showed higher levels of creativity when it came to producing digital materials. However, there is also research that affirms the non-existence of significant differences in the development of digital competence around the gender variable (Sanchez et al., 2020; Gomez and Peña, 2020; Cano et al., 2017; Moreno and Delgado, 2013).

The analysis about the development of the digital teaching competence has been studied by distinguished experts belonging to the educational area. Thus, there are studies that evaluated the level of digital competence perceived by students who were in educational degrees (Valera and Valenzuela, 2020; Rodriguez-Garcia, Aznar, Cáceres and Gómez-García, 2019a; Rodríguez-Garcia, Sánchez and Palmero, 2019b; Cabero and Gimeno, 2019; López, Pozo, Fuentes and Trujillo, 2019a; Llorente and Iglesias, 2018; Gutiérrez-Portlán and Serrano-Sánchez, 2016) which determined that future teachers possess a basic level of digital knowledge, but insufficient to create content or solve problems of this nature.

To a lesser extent, research was carried out on active teachers, whose results determined that they do not have sufficient digital skills to meet the current demands of the information society (Chandrasena, 2019; Loureiro and Rodríguez, 2019), especially in areas such as information literacy (Trujillo Torres et al., 2020; Nowak, 2019) or content creation (Amhag et al., 2019; del-Moral-Pérez et al., 2019). On the other hand, there were works that especially indicated that teachers have a good level, especially in the skills related to communication and collaboration (López et al., 2020; Vázquez et al., 2017).

Also noteworthy is the analysis of possible predictors or variables that influence the development of this competence such as age (Navarro, 2020; Garzon et al., 2020), training and type of center (López, Fuentes, Pozo and Domínguez, 2020) or teaching experience (Hinojo et al., 2019). Likewise, concerning the gender variable, there are also relevant works (Pozo et al., 2020; Moreno et al., 2019; Cabezas and Casillas, 2018) that determined that men were more familiar with ICTs, or that women showed higher levels of creativity when it came to producing digital materials. However, there is also research that affirms the non-existence of significant differences in the development of digital competence around the gender variable (Sanchez et al., 2020; Gómez and Peña, 2020; Cano et al., 2017; Moreno and Delgado, 2013).

Hence, as evidenced in the literature review, the development of digital teaching competence is a concern to be addressed by educational researchers. Therefore, the objective of this work was to identify the level of development of digital competence in the teaching staff of Continuing Education. From this, the following research questions can be differentiated:

- What is the level of digital competence of Lifelong Learning teachers?
- Are there significant gender differences in the level of self-perceived development by participants?
- What is the relationship of statistical dependence established between the different competence areas of digital competence, as well as with the socio-demographic factors of the subjects analyzed?
- What is the statistical relationship between the dimensions of digital teaching competence and the socio-demographic variables of the subjects?

### Table 2. Areas that make up the digital teaching competence. Source: INTEF (2017).

| Information and Information Literacy | Identify, locate, obtain, store, organize and analyze digital information, data and digital content, assessing their purpose and relevance to teaching tasks |
|--------------------------------------|--------------------------------------------------------------------------------------------------|
| Communication and collaboration      | Communicating in digital environments, sharing resources through online tools, connecting and collaborating with others through digital tools, interacting and participating in communities and networks; intercultural awareness |
| Digital content creation             | Creating and editing new digital content, integrating and reworking previous knowledge and content, making artistic productions, multimedia content and computer programming, knowing how to apply intellectual property rights and licenses for use. |
| Security                             | Protection of information and personal data, protection of digital identity, protection of digital content, security measures and responsible and safe use of technology. |
| Problem solving                      | Identify needs to use digital resources, make informed decisions about the most appropriate digital tools according to the purpose or need, solve conceptual problems through digital media, use technologies creatively, solve technical problems, and update their own competence and that of others. |

### 5. Method

To this end, the work was framed within a quantitative methodological design with a transversal scope. The use of different descriptive and inferential statistics was used to analyze the reality perceived by the participating subjects and to extract useful inferences for the research community (Asencio et al., 2017; Hernández et al., 2016).

### 6. Participants

The population was composed of the teaching staff of the Adult Continuing Education stage of the autonomous community of Andalusia. The final sample of the study was made up of 140 teachers chosen through a convenience sampling (n = 140). The questionnaire was disseminated online several times to all Andalusian lifelong learning centres, and participants responded to it on a voluntary basis. The participating teachers came from different provinces of Andalusia (Huelva, Cadiz, Seville, Cordoba, Granada and Almeria). Some more characteristics of the participants are detailed in Table 3 below.

### 7. Instrument

The instrument used was an ad hoc questionnaire based on the existing dimensions of digital teaching competence determined by INTEF. In addition, similar instruments were taken into account in the configuration (Tourón et al., 2018; Agreda, Hinojo y Sola, 2016). It consists of 91 items, distinguished as follows: 16 of information and information literacy; 31 of communication and collaboration; 16 of digital content creation; 13 of digital security; and 15 of problem solving. The scale is a Likert type with 10 answer options (1 = never, 10 = always). The following is the codification that will follow the different dimensions and the competencies that encompass them:

- B.1. Information and Information Literacy (INF).
  - B.1.1. Navigation, search and filtering of information
8. Data analysis

For the data analysis, SPSS statistical software version 25 and Rstudio version 1.1383 were used. First, the descriptive statistics were calculated in order to know the subjects’ perceptions about the level of digital competence. Later, and after knowing that the distribution did not follow a normal character through the Kolmogorov-Smirnov and Shapiro-Wilk and Levene tests (p > .05), the Mann-Whitney inferential U test was applied, in order to know if significant differences could exist between the subjects depending on the independent variable “Gender”. Finally, Pearson’s test was applied to determine the correlation between the different quantitative constructs of the research. On the other hand, factor analysis of mixed data (FAMD) is a main component method that allows the analysis of similarity between individuals taking into account mixed types of variables. In this case, it will be applied to explore the association between quantitative and categorical research variables.

9. Results

In the first place, the results of the application of the descriptive statistics allowed elucidating a difference in the degree perceived by the teachers around the dimensions of the digital teaching competence (Table 4). Thus, a very positive result was observed in the area of communication and collaboration, although with a very high variability, as indicated by its standard deviation. In contrast, the other dimensions obtained values barely above the minimum acceptable (scale 1–10). After this, the dimension of digital content creation obtained a very low score.

Regarding the reliability of the instrument, it was analyzed through Cronbach’s alpha coefficient (α = 0.87) and the two Guttman halves (0.74), recording both optimal values, thus ensuring the proper conduct of research.

Table 3. Socio-demographic characteristics of the sample.

| Region          | N   | Mean (SD) or % |
|-----------------|-----|---------------|
| Almería         | 28  | 20            |
| Cádiz           | 16  | 11.43         |
| Córdoba         | 17  | 12.15         |
| Granada         | 49  | 35            |
| Huelva          | 15  | 10.71         |
| Sevilla         | 15  | 10.71         |
| Center          |     |               |
| CEPER and SEPER | 97  | 69.28         |
| IES             | 43  | 30.72         |
| Age             | 140 | 35.4 (8.56)   |
| Gender          |     |               |
| Male            | 66  | 47.14         |
| Female          | 74  | 52.86         |
| Previous ICT training |     |               |
| Yes             | 100 | 71.42         |
| No              | 40  | 28.58         |
| Training        |     |               |
| Degree          | 83  | 59.28         |
| Diploma or degree | 41 | 29.29         |
| Postgraduate    | 16  | 11.43         |
| Teaching experience | 140 | 4.98 (3.06)  |
| Professional category |     |               |
| Permanent employee | 88 | 62.85         |
| Interim         | 52  | 37.15         |
Thus, to find out the degree of statistical dependence between the quantitative cut variables, the Pearson test was used, which allowed finding the correlations between the constructs of the research (Figure 1). In this way, the results showed considerable proportional relations as was the case of Age-Experience, B.3–B.5., B1–B.5. or weaker Age-B.4. or Age-B.3.

With reference to factorial analysis of mixed data, the interpretation of the biplots described in the following sections should be carried out as follows:

1. Rows (columns) with a similar profile are grouped together. The distance between any row or column category is a measure of its similarity (or dissimilarity). Row categories with a similar profile are close together in the graph. The same is true for the column categories.

2. The negatively correlated rows (columns) are placed on opposite sides of the chart origin. In opposite quadrants.

3. The distance between each row category (column) and the origin (point 0.0) measures the quality of the category on the factor map. Row points that are far from the origin are well represented on the factor map.

Thus, the elaboration of the GFMD model by main components differentiated two dimensions that explained 15.28% and 13.72% of the total variance (Figure 2). As for the relationships between variables, the following should be highlighted:

- B.1 and B.4 are weakly correlated with all independent variables
- The center variable is positively correlated with B3.
- There does not seem to be a high correlation between the different predictors.
- The strongest (positive) correlation is 'Training' and B2.

10. Discussion

The current educational scenario requires teachers with digital attitudes and skills that allow them to perform a dynamic and appropriate work for students who require a current and innovative teaching (Cabero and Gimeno, 2019). Based on this idea, the present work set as an objective to measure the degree of development of digital competence presented by the teaching staff of the Lifelong Learning stage of the Autonomous Community of Andalusia, focusing mainly on describing the observed reality and knowing which socio-demographic variables could significantly influence its development. This is one of the few existing studies in the scientific literature on this stage of education, so it is considered a study which, despite its small sample size, can be a first step towards establishing a solid theoretical framework for promoting digital development in this group of teachers.

Thus, the results found in the study indicated, with the exception of the “communication and collaboration” dimension, a low level of knowledge on the part of the sample of teachers. The low level presented in the dimension “creation of digital content” is especially worrying. This dimension denotes the idea that teachers have a minimum set of skills to make a superficial use of ICT, but do not have the necessary skills to promote methodological tasks or strategies that require a greater knowledge of the infrastructure or its didactic potential. In this line, the results show a coincidence with other studies whose results denote the

| Dimension | Mean | S.D. | Skewness | Kurtosis |
|-----------|------|------|----------|----------|
| INF       | 5.183| 8.340| 1.221    | 1.637    |
| CONT      | 9.181| 11.724| 0.628    | 9.049    |
| CRE       | 2.949| 6.764| 2.046    | 5.885    |
| SEC       | 5.141| 6.013| -0.199   | -2.587   |
| SOL       | 5.543| 4.457| 0.592    | 0.134    |

| Dimension | Mean | S.D. | U Mann-Whitney | p       |
|-----------|------|------|----------------|---------|
| INF       |      |      | 1254.126       | .247    |
| COM       |      |      | 1242.510       | .034    |
| CRE       |      |      | 1715.147       | .134    |
| SEC       |      |      | 1924.038       | .177    |
| SOL       |      |      | 1914.713       | .212    |

Table 4. Descriptive statistics.

Table 5. U Mann-Whitney based on the 'gender' variable.
existing deficit in the area referring to the elaboration and creation of contents (Amhag et al., 2019; del-Moral-Pérez et al., 2019). We find teachers who do not assume that they do not have the necessary knowledge to create their own digital content, which should be a challenge to be met in teacher training (Cabero et al., 2020).

As for the possible variance of responses around the gender of the teacher, the results determined that there were no significant differences in the responses collected from the teachers. This result differs from some previous studies (Pozo et al., 2020), and is in line with others (Sánchez et al., 2020). Therefore, this is an area still to be researched in order to be able to provide solid arguments to the scientific community.

With reference to the existing relations between the constructs of the research, the results showed relations of interest that invite reflection. Thus, the existing links between age and the digital security dimension contribute especially to the need to cover through training in this matter at early ages. Similarly, the information and information literacy dimension needs to be addressed, since through its promotion, it could constitute the improvement of digital content creation skills, as shown by the correlational links. If we make a comparison with studies from the international literature, we can see that the level of digital competence presented by teachers is similar to that obtained. We find ourselves in a situation in which teachers have difficulties in generating their own content, as well as in solving problems in the digital domain (Pettersson, 2018; Blau and Shamir-Inbal, 2017).

Finally, the model obtained from the FAMD analysis extracted some determining factors in the development of the digital constructs, as it was the case of the teachers’ formation, which was decisive when the teachers presented a greater degree in the communication and collaboration through digital resources, result that goes in the same line that previous studies (López et al., 2020). Similarly, the relationship between the center and the creation of digital content could refer to the idiosyncrasies of each educational center regarding teaching innovation and the use of ICT, as well as the development of coordinated collective practices that, hence, encourage the creation and development of digital materials. In this sense, these are incident factors that have also been observed in other populations such as: gender (Sánchez et al., 2020), age (Navarro, 2020; Garzón et al., 2020), the type of educational centre (Moreno et al., 2019; Cabezas and Casillas, 2018), home conditions or cultural aspects (Hellevik and Christophersen, 2013). Therefore, our study elucidates that in the Lifelong Learning stage these factors are also incident, and therefore, they should be studied, with the aim of, through them, promoting the development of teachers’ digital competence in this educational stage.

11. Conclusions

The development of digital teacher competence continues to be a challenge to be addressed by the educational community. In the current context in which we find ourselves, the educational system requires teachers who are competent in digital matters, who integrate the emerging technological resources into their teaching work and promote quality teaching in accordance with today’s students, who make assiduous use of technology. Therefore, it is advocated the need to promote a permanent training of teachers, which allows them to be updated in the current educational trends and challenges and in the didactic opportunities offered by ICT. It is also necessary to promote training in ICT at the Higher Education stage, especially in the area of digital content creation, so that future professionals have references and notions about how to innovate and develop content in their professional future.

Thus, the path lies in encouraging teachers to increase their digital knowledge, but, above all, to integrate emerging technological resources, and not for digital practice in the classroom to fall into a superficial use of these resources.

In this way, this research has shown a descriptive approach to the self-perception of the level of teaching digital competence presented by dual vocational training teachers in Andalusia (Spain). In addition, we present some factors involved in the development of these constructs that may be of interest for further analysis in subsequent research. We are aware that
this study presents a small sample and, therefore, the results cannot be
generalisable.
With respect to the limitations of the study, they refer to the tech-
nique of selection of research participants, which, since it is sampling for
convenience, does not allow for a clear explanation of the inference,
limiting itself to describing the perceptions of the observed reality.
Likewise, the application of an instrument with a wide range of response
also implies, on the one hand, that the participant can respond in a more
specific way. However, it also increases the variability of responses, en-
courages the appearance of outliers, and proportionally shifts the
meaning of the coefficients expressed by the mean. On the other hand,
with regard to the typology of the scale, it is a scale of self-perception, not
one that examines the level of digital competence. Although it is a sub-
jective conception, it has been of interest to the author of this manuscript,
one that examines the level of digital competence. Although it is a sub-
jective conception, it has been of interest to the author of this manuscript,
which they are not.
On the other hand, as to future lines of research, it turns to the need to
continue analyzing the degree of digital teaching competence shown by
the different active teaching bodies, especially in those stages that are not
yet so well known, as was the case of Lifelong Learning. It advocates the
need to promote empirical studies in this line and to verify the effec-
tiveness of digital resources when putting them into practice in the
classroom.
Therefore, digital training is one of the most important educational
challenges to be met by the educational community. There is a need for
teaching professionals who can carry out their work in an innovative
manner and in accordance with the technological advances that society is
experiencing. For this reason, the capacity digital is one of the desafios
educativos más importantes que debe enfrentar la comunidad educativa.
Se necesitan profesionales de la enseñanza que puedan llevar a cabo su
trabajo de manera innovadora y de acuerdo con los avances tecnológicos
que experimenta la sociedad.

Declarations

Author contribution statement
Esther Garzón Artacho: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.
Tomás Sola Martínez: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data.
José María Romero Rodríguez: Performed the experiments; Analyzed and interpreted the data.
Gerardo Gómez García: Analyzed and interpreted the data; Wrote the paper.

Funding statement
This work the Scientific research project (I+D+i): Study and analysis on technological resources and innovation in teacher training in the field of Higher Education and its applicability in the development of the region of Santander (Colombia) (ISPR2017-7202).

Data availability statement
Data included in article SUPPLEMENTARY MATERIAL/REFERENCED IN article.

Declaration of interests statement
The authors declare no conflict of interest.

Additional information
No additional information is available for this paper.

References
Adams, S., Cummins, M., Davis, A., Freeman, A., Hall, C., Ananthanarayanan, Y., 2017. NMC Horizon Report: 2017 Higher Education Edition. The New Media Consortium, Austin, Texas.
Ágreda, M., Hinojo, M.A., Sola, J.M., 2016. Design and validation of an instrument for assess digital skills of teachers in Spanish higher education. Pixel-Bit-Revista De Medios Y Educacion 49, 39–56.
Alonso, S., Aznar, I., Cáceres, M.P., Trujillo, J.M., Romero, J.M., 2019. Systematic review of good teaching practices with ICT in Spanish higher education. Trends and challenges for sustainability. Sustainability 11 (24), 7150.
Amba, I., Hellstrom, L., Stigmar, M., 2019. Teacher educators’ use of digital tools and needs for digital competence in higher education. J. Digit. Learn. Teach. Educ. 35 (4), 203–220.
Azcuingo, E.N., García, E.J., Redondo, S.R., Ivanov, R.T., 2017. Fundamentos de la investigación y la innovación educativa. UNIR Editorial.
Blau, I., Shamir-Inbal, T., 2017. Digital competences and long-term ICT integration in school culture: the perspective of elementary school leaders. Educ. Inf. Technol. 22 (3), 769–787.
Cabra, J., Gimeno, A., 2019. Information and Communication Technologies and initial teacher training. Digital models and competences. Profesorado 23 (3), 247–268.
Cabra, J., Romero, R., Palacios, A., 2020. Evaluation of teacher digital competence frameworks through expert judgement: the use of the expert competence coefficient. J. N. Approaches Educ. Res. 9 (2), 275–293.
Cabezás, M., y Casillas, S., 2018. Social Educators: a study of digital competence from a gender differences perspective. Croat. J. Educ. 20 (1), 1–32.
Cano, E.V., Díaz, V.M., Berra, G.A.M., Garzón, E.G., 2017. La competencia digital del alumnado universitario de Ciencias Sociales desde una perspectiva de género. Prisma Soc.: revista de investigación social 19, 347–367.
Chandraesan, M., 2019. Lack of digital competence: the hump in a university - English for
specific purpose - Classroom. Int. J. Sci. Technol. Res. 8 (10), 948–956.
Comisión Europea, 2006. Recomendación 2006/962/CE del Parlamento Europeo y del Consejo, de 18 de diciembre de 2006, sobre las competencias clave para el aprendizaje permanente.
Del Moral Díez, M.E., Villalba-Martínez, L., Neira-Pineiro, M.D.R., 2019. Teachers’ perception about the contribution of collaborative creation of digital storytelling to the communicative and digital competence in primary education schoolchildren. Comput. Assist. Lang. Learn. 32 (4), 342–365.
Díez-Gutiérrez, E., Díez-Nafria, J.M., 2018. Ecologías de aprendizaje ubicuo para la cibereducadánia crítica. Comunicar 54, 49–58.
Durán, M., Prendes, M.P., y Gutiérrez, I., 2019. Teaching digital competence certification: a proposal for university teachers. AIED. Revista Iberoamericana de Educación a Distancia 22 (1), 187–205.
Ferrari, A., 2013. DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe. Publications Office of the European Union, Luxembourg.
Fernández Batanero, J.M., Torres González, J.A., 2015. Actitudes docentes y buenas prácticas con TIC del profesorado de Educación Primaria de Adultos en Andalucía. Rev. Complut. Educ. 26, 33–49 (especial).
Flores, C., Roig, R., 2019. Factores personales que inciden en la autovaloración de futuros maestros sobre la dimensión pedagógica del uso de TIC. Rev. Iberoam. Educ. Super. 10 (27), 151–171.
From, J., 2017. Pedagogical digital competence-between values, knowledge and skills. High Educ. Stud. 7 (2), 43–50.
Gámez, I.D.G., Peña, M.P., 2020. Análisis Univariante de la Competencia Digital en Educación Física: un estudio empírico. Retos nuevas tendencias en educación física. deporte y recreación 37, 326–332.
Garzón, E., Sola, T., Ortega, J.L., Martín, J.A., Gómez-García, G., 2020. Teacher training in lifelong learning—the importance of digital competence in the encouragement of teaching innovation. Sustainability 12 (7), 2852.
Gisburt, M., Esteve, F., 2016. Digital Leaners: la competencia digital de los estudiantes universitarios. La cuestión universitaria (7), 48–59.
Gisburt, M., Gonzalez, J., Esteve, F.M., 2016. Competencia digital y competencia digital docente: Una panorámica sobre el estado de la cuestión. Revista Interuniversitaria de Investigación en Tecnología Educativa, pp. 74–83.
Gutiérrez-Porlán, I., Serrano-Sánchez, J.L., 2016. Evaluación y desarrollo de la competencia digital de futuros maestros en la Universidad de Murcia. New Approach. Educ. Res. 5 (1), 53–59.
Hatlevik, O.E., Christophersen, K.A., 2013. Digital competence at the beginning of upper secondary school: identifying factors explaining digital inclusion. Comput. Educ. 63, 240–247.
Hernández, R., Fernández, C., Baptista, P., 2016. Metodología de la investigación [Investigation methodology]. McGraw-Hill, Mexico.
Hinojo, F.J., Aznar, I., Cáceres, M.P., Trujillo, J.M., Romero, J.M., 2019. Factors influencing the development of digital competence in teachers: analysis of the teaching staff of permanent education centres. IEEE Access 7, 178744–178752.
INTEF, 2017. Marco de Competencia Digital. Ministerio de Educación, Ciencia y Deportes, Madrid.
López, J., Fernández, A., Pozo, S., Domínguez, N., 2020. El nivel de competencia digital en profesionales de la educación: el caso de los educadores físicos españoles. Zona Prox. (33), 33.
López, J., Pozo, S., Fuentes, A., Trujillo, J.-M., 2019a. Analytical competences of teachers in big data in the era of digitalized learning. Educ. Sci. 9 (3).

Li, S., Yamaguchi, S., Sukhbaatar, J., y Takada, J., 2019. The influence of teachers' professional development activities on the factors promoting ICT integration in primary schools in Mongolia. Educ. Sci. 9 (2), 1–18.

Llorente, P.A., Iglesias, E.C., 2018. Development of digital competence in the initial teacher education of early childhood education. Pixel-Bit, Revista de Medios y Educacion 52, 97–110.

López, J., Pozo, S., Morales, M., López, E., 2019b. Competencia digital de futuros docentes para efectuar un proceso de enseñanza y aprendizaje mediante realidad virtual. Edutec. Revista Electrónica De Tecnología Educativa 67.

Loureiro, C., Rodríguez, J., 2019. Analysis of the digital education project (E-DIXGAL): the views of primary school teachers. Digit. Educ. Rev. 36, 171–189.

Moreno, A.J., Fernandez, M.A., Alonso, S., 2019. influencia del género en la competencia digital docente. Revista ESPACIOS 40 (41).

Nowak, B.M., 2019. The development of digital competence of students of teacher training studies-Polish cases. Int. J. High. Educ. 8 (6), 262–266.

Pettersson, F., 2018. On the issues of digital competence in educational contexts—a review of literature. Educ. Inf. Technol. 23 (3), 1005–1021.

OCDE, 2014. TALIS 2013 Results: An International Perspective on Teaching and Learning. OECD Publishing, Paris.

Pozo, S., López, J., Fernández-Cruz, M., López, J.A., 2020. Análisis correlacional de los factores incidentes en el nivel de competencia digital del profesorado. Rev. Electron. Interuniv. Form. del Prof. 23 (1), 143–159.

Quiróz, J.S., Miranda, P., Gisbert, M., Morales, J., Onetto, A., 2016. Indicadores para evaluar la competencia digital docente en la formación inicial en el contexto Chileno-Uruguayo. Revista Latinoamericana de Tecnología Educativa-RELATEC 15 (3), 55–67.

Rodriguez-García, A.M., Aznar Díaz, J., Cáceres Reche, P., Gómez García, G., 2019a. Digital competence in higher education: analysis of the impact of scientific production indexed in Scopus database. Espacios 40 (21).

Rodríguez-García, D., Sánchez, P.R., Ruiz-Palmero, J., 2019b. Digital competence, higher education and teacher training: a meta-analysis study on the Web of Science. Puebl. Inf., Revista de Medios y Educación 54, 65–81.

Sánchez, J., Trujillo, J.M., Gómez, M., Gómez-García, G., 2020. Gender and digital teaching competence in dual vocational education and training. Educ. Sci. 10 (3), 84.

Starkey, L., 2020. A review of research exploring teacher preparation for the digital age. Camb. J. Educ. 50 (1), 37–56.

Tourón, J., Martín, D., Navarro, E., Pradas, S., Sifón, V., 2018. Validación de constructo de un instrumento para medir la competencia digital docente de los profesores (CDD). Rev. Española Pedagog. 76 (269), 25–54.

Trujillo Torres, J.M., Gómez García, G., Ramos Navas-Parejo, M., Soler Costa, R., 2020. The development of information literacy in early childhood education teachers. A study from the perspective of the education center's character. JOTSE: J. Technol. Sci. Educ. 10 (1), 47–59.

Varela, S.A., Valenzuela, J.R., 2020. Use of information and communication technologies as a transversal competence in teacher training. Rev. Electrón. Educ. 24 (1).

Vázquez-Cano, E., Martín, V., Maldonado, G.A., García-Garzín, E., 2017. The digital competence of social sciences college students from a gender perspective. Prisma Social 19, 347–367.

Vuori, R., Punie, Y., Carretero Gomez, S., Van den Brande, G., 2016. DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: the Conceptual Reference Model. Luxembourg Publication Office of the European Union, pp. 2791–11517. EUR27948 EN. 10.

World Economic Forum, 2018. The Future of Jobs Report 2018. World Economic Forum, Geneva.