Quantitative-comparative research on digital competence in students, graduates and professors of faculty education: an analysis with ANOVA

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Abstract

Currently, the figure of the teacher is a key element to train students in the use of new information and communication technologies (ICT), which will positively influence the entire teaching-learning process. Therefore, it is an indispensable requirement in the initial training of the teacher the development of the digital teaching competence, understanding this construct as the set of knowledge, use and attitudes towards digital technologies. However, in the initial teacher training, the development of digital teaching competence may vary depending on the educational stage in which they carry out their teaching. For this work, the level of development of digital teaching competence of university teaching staff of the Faculty of Education, graduates of education, and students (future teacher of primary and child education) has been taken into consideration. Therefore, in this work we have tried: (1) to analyse the level of competence of the teachers regarding to three components which structure the term digital teaching competence; and (2) to compare the level of competence between the different types of teachers in each of the dimensions that make up the term digital teaching competence. For this purpose, an ex post facto investigation has been carried out with 715 participants, using one-way ANOVA technique by multiple comparisons. The results show that there are significant differences in attitudes towards digital technologies among students and graduates with respect to the university teaching staff. In relation to the knowledge and use dimensions, there are no differences between graduates and university teaching staff, but there are differences between both groups with the students.

Keywords Digital teaching competence · Digital technologies · ICT · University teaching staff · Students · Graduates

1 Introduction

In the last decade, there has been an increased growth in the number of new technologies in the field of education. In particular, numerous innovations that improve teaching-learning processes have been introduced (Bugawa and Mirzal 2018), that address the different learning needs of individual students (Skryabin et al. 2015).

When discussing the teaching of digital teaching competence, three important stakeholders must be considered: (1) future teachers or undergraduate students; (2) current teachers or graduates; (3) and university teaching staff. All of these individuals must be prepared to provide their future students with learning opportunities that are supported by ICT (Peciuliauskiene and Barkauskaite 2007; Muñoz-Repiso et al. 2015). In other words, they must be competent in the educational use of digital technologies, as these necessary skills and knowledge guarantee their excellence in professional practice (Gisbert and Esteve 2016).

Equally, it can be said that teachers' attitudes and perceptions towards technologies are determining factors for an adequate integration of digital technologies in the teaching-learning process, as well as for their effective and innovative use (Baturay et al. 2017; Eickelmann and Vennemann 2017). As Bamigboye et al. (2013) note, the successful integration of digital technologies in schools depends largely on the level of digital teaching competence that digital technologies play in educational processes.

This implies that the professional profile of teachers, whether they are undergraduate students, recent graduates or university teaching staff, should not be focused on a transmissive teaching style that uses traditional methodologies or digital projectors in theoretical classes. Instead, teachers must be prepared to design and promote environments of enriched, cooperative and autonomous learn- ing (Zhang et al. 2016; Tondeur et al. 2016). Therefore, they require to become digital competent teachers.

The European Commission (EC 2018) defines competence as a combination of knowledge, skills and attitudes needed by all for personal fulfilment and development, employability, social inclusion and active citizenship. Moreover, the European Commission (EC 2007) defines digital competence as one of the nine key competences that citizens need to participate in today's society.

The concept of digital competence is one of the most discussed in the literature, and many authors provide different approaches (Gutiérrez et al. 2015; Mirete Ruiz 2016; Rivera-Laylle et al. 2017). However, different authors agree that, although digital competence can be defined concisely, it is quite complicated to find a single term on the use of technological tools, such as digital competence, digital literacy, media literacy, digital ability, skills of Internet, among others (Janssen et al. 2013; Hatlevik and Christophersen 2013).

In the international context, for example, The European Commission (EC 2017) published the DigCompEdu project which assumed digital competence as the ability of users to make a safe, critical and creative use of ICT to meet objectives related to work, employability, learning, leisure and inclusion and / or participation in society. In other way, it can be defined as the use, knowledge and attitudes required to use digital technologies for learning and functioning in the information and communication society (Fernández-Sanz et al. 2017; Røkenes and Krumsvik 2014; Ruiz 2015; Gisbert and Esteve 2016).

In the Spanish context, the Ministry of Education and Vocational Training of the Government of Spain (MEFP 2018) provides a more complex definition, considering digital competence to imply a creative, critical and safe use of digital technologies, for which it is necessary to have knowledge based on a specific basic language, textual, numerical, iconic, visual, graphic or sound dimensions. It must also require attitudes and values that allow the user to adapt to the emerging needs of technologies, their appropriation and adaptation to one's own purposes, as well as the use of all these digital technologies. Therefore, we consider that not only digital competence requires knowledge in technological tools and their subsequent practical use, but also the teacher's attitude as a key factor for the integration of these technologies that it adopts with students (García-Valcarcel 2011; Kale and Goh 2014).

However, we agree with the statements of Van Laar et al. (2017), it is not enough that teachers have a correct digital competence, understood as the minimum set of skills that allow a user to operate effectively with software tools, access the Internet or perform basic tasks with a computer. Nowadays, it is necessary to go a step beyond digital literacy towards digital competence, which is understood as the domain of ICT in a professional context with good pedagogical-didactic judgment (Krumsvik 2011). Specifically, Lázaro-Cantabrana et al. 2019, p.1) understand this concept as "a set of skills, abilities and attitudes that the teacher must develop to incorporate digital technologies into their practice and professional development". From (2017) deepens this concept even further, stating that it refers to the ability to constantly apply the attitudes, knowledge and skills necessary to plan, research as well as to continuously evaluate and review, teaching supported by ICT. Therefore, in this study we will use the structure of digital teaching competence from three dimensions.

Regarding the construction of instruments to evaluate and accredit the level of digital teaching competence, in recent years different instruments have been developed (Alfonso et al. 2018; Martín and González 2018). Specifically, González Martínez et al. (2018) created a self-perception questionnaire called INCOTIC allowing to determine the level of use of ICT, the level of self-perception of digital competence and the nature of attitudes towards ICT. In similar lines, the National Institute of Educational Technologies and Teacher Training (INTEF 2017) develops a rubric based on dimensions, indicators and levels of skills development in digital teaching competence. On the other hand, Porlan and Sanchez (2016) use a questionnaire called DIGCOM created by the European Commission (EC 2013) with five blocks on self-perception in digital competition, structured by the blocks: digital technologies for information search, to communicate, for content creation, security and problem solving. Finally, Ruiz et al. (2015) and Ruiz et al. (2015) developed a questionnaire called ACUTIC for the study the level of self-perception of attitudes towards ICT, technological knowledge about digital technologies, as well as the use of these technologies, focused on university professors and university students.

In previous research carried out on the perception that future teachers (students still) have regarding their level of digital teaching competence, it is noteworthy that, although they claim to have a basic technological knowledge, they do not have a high level of development of said competence, since they do not integrate ICT effectively in their teaching practice (Gutiérrez Castillo and Cabero Almenara 2016; Rodríguez et al. 2018; Rubio et al. 2018).

Equally, Esteve-Mon et al. (2016) explored the digital competence of future teachers based on their self-perception, with a sample of 149 students from different Education degrees. They concluded that most of them, specifically 55%, were considered innovative teachers in their classrooms, quite capable of demonstrating their ICT knowledge. In the same context, Roblizo Colmenero and Cózar Gutiérrez (2015) analysed the knowledge and use towards ICT of 224 students who were completing a bachelor's degree in Pre-School or Primary Education at the University of Albacete. They found that although the levels of ICT knowledge in students was high, they were actually quite similar to those of the population in general. Roig-Vila et al. (2012) conducted a study at the University of Alicante, with a total of 61 Pre-School students. These authors determined that the students possessed high digital teaching competence on resources to search for information on the internet, but low competence in statistical programmes.

Regarding graduate teachers in practice, Pérez Escoda and Rodríguez Conde (2016) explored self-perception in digital competences of 63 primary school teachers in Castilla y León. They found that most currently had a shortage of digital skills for pedagogical use. Equally, Barrio et al. (2017) explored a sample of 75 primary and secondary education teachers from the Community of Madrid. They discovered that teachers' perceptions of their management of ICT is sufficient (39%) and that they were used to creating digital content for their students (61%). Nonetheless, most tended to use general software, such as Word, PowerPoint or Movie Maker. The main obstacle encountered was insufficient support in pedagogical training and a lack of pedagogical models on how to integrate ICT in the teaching-learning process. Moreover, Fernández Batanero and Rodríguez Martín (2017) analysed the perceptions of 342 primary school teachers. Their findings not only confirmed the previous results of other research, but also emphasised the lack of positive attitudes that teachers have towards ICT. In summary, according to different studies, it can be stated that primary school teachers have not developed sufficient digital teaching competence and make an insufficient use of ICT in the classroom to contribute to the development and generation of knowledge in their students (López 2018; Llamas-Salguero and Gomez 2018; Guillén-Gámez et al. 2019).

On the other hand, it is noteworthy that, although higher education institutions have recognised the importance of incorporating ICT into their educational programmes at different levels (Chouit et al. (2017), few investigations have been conducted on an international (e.g. Buarki 2016; Joshua Chukwuemeka and Iscioglu 2016; Kunda et al. 2018; Agufana et al. 2018) or national level (Gutiérrez Porlán 2014; Cabero-Almenara and Barroso-Osuna 2016; Capilla et al. 2016) that focus on assessing the digital teaching competence of university teachers.

Regarding the ICT training of university teachers, Agreda Montoro et al. (2016) analysed the digital teaching competence of 1145 teachers belonging to different Education Sciences faculties in Spain. They concluded that the training of university teachers is average (M = 2.4/4), although their attitudes towards ICT are higher (2.93/4). Muñoz-Repiso et al. (2015) went further by investigating the training of university teachers at the University of Salamanca (USAL) for the curricular integration of ICT. They stated that, although said teaching staff understand the technological possibilities available to them at their university and positively value the importance of ICT, their level of training in programmes and technological applications was low in general

terms. Similar results were found by Mercader and Sallán (2017), who conducted an investigation of 527 university teaching staff from four Catalan universities. They found that teachers integrate tools, such as visual presentations or video platforms, but social networks, blogs and interactive software are used by less than a third of teachers. Furthermore, those that integrate resources as virtual learning platforms tend to underuse them, as they tend to use them primarily as a repository of documents.

Based on the premise that there are currently few studies focused on exploring the level of digital teaching competence in the Education Sciences faculties of universities, and that existing research focuses mainly on students, as well as the way in which digital teaching competence is structured, this article aims to assess digital teaching competence (the measurement of knowledge, use of digital technologies and attitude towards ICT in the same study; this is the first contribution that the authors make in the scientific field of ICT and education) by carrying out a comparative analysis of three different samples: future primary and child teacher (still students); graduates; and university teaching staff belonging to the Faculty of Education Sciences (this is the second contribution, taking a step beyond previous studies). Its second objective is to determine whether there are significant differences between the different established samples. The findings found are useful for the scientific community, since with this study the level of self-perception of each group of participants is known, in each of the ICT resources analyzed. With the results found, the institution itself will have the moral obligation to propose a minimum, solid and permanent training in order to gradually achieve the objectives of the Horizon 2019 EDUCASE report, whose most emerging technologies that will have a greater impact on higher education in the next five years (2019–2023) are: movile Learning, analytics technologies, mixed reality, artificial intelligence, blockchain and virtual assitantt (Alexander et al. 2019).

2 Design and procedure

Design for this study, a non-experimental research design, ex post facto, has been proposed, during the 2017/2018 academic year (Kerlinger et al. 2002; Bisquerra 2004). First, a descriptive analysis has been carried out followed by an inferential analysis. The level of significance established has been 0.05. The test was completed through google forms. To do this, a first email was sent to the students explaining the objectives of the work. Regarding the confidentiality of the participants' responses, the survey was filled out anonymously, guaranteeing the privacy of the data, as well as the explanation of the purposes of the investigation.

Participants A non-probabilistic intentional sample has been selected from the Faculty of Education at the Pontifical University of Salamanca (UPSA, Spain). The sample consisted of a total of 675 students, specifically 416 students, 259 graduates and 40 university teaching staff. In order to ensure that the results are not influenced by the breadth of the sample of students in comparison with the university teaching staff since this sample was inferior, a random selection has been made in SPSS of the samples of the groups of students and graduates. For students, 11% of the total (47 students) has been randomly selected, and for graduates, 21% of the total (54 graduates) has been randomly selected.

According to the UPSA teaching guide, the university curriculum in teacher training integrates the ICT subject in the Educational Field, in the first course of the educational degree, in order for students to become familiar with it throughout their preparation as a future teacher. Through this subject it is expected that the student will be able to analyze, synthesize and manage the information through the correct use of the tools and resources provided by ICT, such as word processors, data analysis software, graphic representations, interactive tools for creating and presenting information, concept maps, electronic presentations, information search and retrieval, multimedia content editing, interactive whiteboard (PDI), among others. Likewise, the student must be able to design and evaluate teaching materials whose incorporation improves the teaching-learning processes.

On the other hand, from the development of the competences of this subject in students, teachers can use these resources in a transversal way in the different subjects of the educational degree. Moreover, the university institution is committed to the continuous training of its university teaching staff, offering training courses in ICT within its strategic plan "Training actions 2017-2018", highlighting some of them, such as: Course 1: Second Cycle of online training of the Web of Science; Course 2: Teaching use of the Moodle platform (basic and medium level); Course 3: Online teaching with Blackboard Collaborate Ultra: Teaching use and management; Course 7: Basic statistical analysis in SPSS in the research process; Course 11: Pedagogical use of Google Apps to innovate in the teaching practice of Higher Education (see all the training courses in UPSA 2018).

Instrument For the collection of information for this study, the ACUTIC instrument was used (Ruiz et al. 2015; Ruiz 2015), which has been used in different educational stages as well as with different types of samples (Charris Franco 2016; Mirete Ruiz 2016; López et al. 2017; Guillén-Gámez and Perrino 2020), providing good results of validity and reliability for its subsequent application. This instrument is a self-evaluation tool which measures the three dimensions that make up the concept of digital teaching competence, structured in this way by a multitude of authors in the scientific literature (Røkenes and Krumsvik 2014; Gisbert and Esteve 2016; Fernández Batanero and Rodríguez Martín 2017; From 2017; EC 2018). It measures the level of self-perception about knowledge of digital technologies, didactic use of these technologies and attitudes towards ICT.

The ACUTIC questionnaire is composed of 33 5-point Likert questions in which participants must answer according to their degree of agreement with the proposed statement (from completely disagree, value 0 points to completely agree, value 4 points). The instrument is made up of three subscales or dimensions: attitude dimension (maximum 28 points), which includes 7 items on thoughts, beliefs or attitudes towards ICT; the knowledge dimension (maximum 52 points), composed of 13 items on knowledge towards digital technologies; and the use dimension (maximum 52 points), composed of the same 13 items as the previous scale but focused on the use made of them. The maximum score to be obtained in the instrument is 132 points.

In order to verify the reliability of the instrument in this studio, the Cronbach's alpha test has been used with each of the participants' samples, in order to check the internal consistency of the instrument. Table 1 shows that the levels obtained are very satisfactory in each dimension and for each sample of participants, close to the value 1. In

Table 1 Instrument reliability analysis

Participants	Dimensions		
	Attitude	Knowledge	Use
Students	0.81	0.89	0.83
Graduates	0.92	0.92	0.89
University teaching staff	0.94	0.88	0.91

Source: Authors

addition, an exploratory factor analysis (EFA) was carried out using the main components analysis with oblimin rotation. The results obtained with the sample adequacy index (KMO) were 0.84 and Bartlet's sphericity test was significant (sig = 0.000), indicating that the correlation matrix exceeded the conditions for carrying out this analysis. It has been found that the three dimensions explain 54.02% of the total variance.

3 Analysis of results

3.1 Descriptive and comparative analysis of each dimension of the instrument

In Tables 2, 3 and 4, each dimension of the instrument between both groups of participants is analyzed. These tables include the mean and standard deviation. Regarding attitudes towards ICT (Table 2), we could highlight some interesting results; for example, the item "It is essential to incorporate ICT in university classrooms" is the most valued by students (M = 3.36), with a similar average in graduates (M = 3.35); however, university teaching staff do not consider it so important, with a much lower

Table 2 Comparison in attitudes towards ICT

	Ítem	Students	Graduates	Faculty
Attitudes	ICT encourages involvement in teaching-learning processes	3.02 ± 0.79	3.44 ± 0.63	2.95 ± 0.85
	Teachers must use ICT to improve teaching-learning processes	3.21 ± 0.62	3.30 ± 0.72	2.93 ± 0.99
	It is essential to incorporate ICT in university classrooms	3.36 ± 0.67	3.35 ± 0.73	2.70 ± 1.04
	Classes improve as are incorporated ICT	3.06 ± 0.76	3.09 ± 0.76	2.50 ± 0.99
	ICT facilitates class development	3.26 ± 0.74	3.31 ± 0.80	2.73 ± 0.91
	ICTs allow the achievement of competences	2.70 ± 0.91	2.98 ± 0.94	2.45 ± 1.11
	ICT provides flexibility of space and time for communication between members of the educational community	3.21 ± 0.98	3.46 ± 0.77	3.03 ± 1.02
Total attitude dimension towards ICT		21.83 ± 3.76	22.94 ± 4.46	18.00 ± 7.47

Table 3 Comparisons in knowledge in ICT resources

	Ítem	Students	Graduates	Faculty
Knowledge	Office tools	3.06 ± 0.70	3.35 ± 0.76	3.25 ± 0.87
	Web search engines	3.00 ± 0.83	3.33 ± 0.73	3.30 ± 0.94
	Comunication system (email, skype, hangout)	2.81 ± 0.88	3.06 ± 0.79	3.13 ± 0.97
	Libraries and digital databases	1.81 ± 1.19	2.24 ± 1.18	2.93 ± 0.97
	ICT tools 2.0 (blogs, Youtube, PDI, prezi)	2.72 ± 0.95	2.81 ± 0.99	2.22 ± 1.19
	Social interaction spaces	3.23 ± 0.84	2.78 ± 1.14	2.33 ± 1.37
	Video editing tools image and audio	1.96 ± 1.12	2.15 ± 1.19	1.75 ± 1.10
	Learning management system (LMS)	2.13 ± 1.06	2.61 ± 1.05	3.00 ± 0.82
	Data analysis programs (SPSS)	0.62 ± 1.01	1.11 ± 1.22	2.15 ± 1.27
	Podcast	1.77 ± 1.05	2.31 ± 1.16	2.23 ± 1.14
	E-porfolios & wikis	1.15 ± 1.27	1.74 ± 1.26	1.72 ± 1.30
	JClic & Hot Potatoes educational tools	0.77 ± 1.11	1.57 ± 1.34	1.35 ± 1.23
	Creation of interactive questionnaires	0.98 ± 1.19	1.59 ± 1.39	1.93 ± 1.31
Total knowledge dimension		26.00 ± 8.76	30.67 ± 10.36	31.28 ± 9.42

average perception (M = 2.70). With similar results, the students' perception of the item "Classes improve as are incorporated ICT" (M = 3.06) is slightly lower and almost similar to the graduate (M = 3.09), however, university teaching staff do not consider it so important to use ICT in the classroom to improve the teaching process (M = 2.50). In general, the attitude dimension towards ICT is lower in university teaching staff (M = 18.00; ± 7.47) than university students (M = 21.83; ± 3.76), and graduates (M = 22.94;

Table 4 Comparisons in the use of ICT resources

	Ítem	Students	Graduates	Faculty
Use	Office tools	3.49 ± 0.80	3.70 ± 0.69	3.33 ± 0.92
	Web search engines	3.32 ± 0.86	3.59 ± 0.74	3.28 ± 0.91
	Comunication system (email, skype, hangout)	2.55 ± 1.14	3.07 ± 1.18	3.13 ± 0.97
	Libraries and digital databases	1.28 ± 1.14	1.80 ± 1.34	2.82 ± 1.03
	ICT tools 2.0 (blogs, Youtube, PDI, prezi)	2.30 ± 1.10	2.59 ± 1.12	2.10 ± 1.24
	Social interaction spaces	3.06 ± 1.13	2.52 ± 1.33	1.97 ± 1.37
	Video editing tools image and audio	1.60 ± 1.25	1.89 ± 1.21	1.57 ± 1.11
	Learning management system (LMS)	1.96 ± 1.27	2.59 ± 1.19	2.88 ± 1.20
	Data analysis programs (SPSS)	0.45 ± 0.83	0.87 ± 1.12	1.98 ± 1.23
	Podcast	1.51 ± 1.00	2.20 ± 1.35	2.03 ± 1.25
	E-porfolios & wikis	0.81 ± 1.06	1.48 ± 1.30	1.43 ± 1.22
	JClic & Hot Potatoes educational tools	0.47 ± 0.86	1.22 ± 1.33	1.13 ± 1.22
	Creation of interactive questionnaires	0.79 ± 1.14	1.15 ± 1.20	1.58 ± 1.28
Total use of ICT		23.58 ± 7.86	28.69 ± 10.12	29.20 ± 10.47

± 4.46). It can be observed that the standard deviation is lower in university students and graduates compared to university teaching staff.

Table 3 shows the perception of knowledge in ICT resources in each group of participants. Among the results to highlight, it is observed that the greatest domain in ICT resources is in word processors, mainly in graduates (M = 3.35) and very similar in university teaching staff (M = 3.25), being lower in students (M = 3.00). Similar results are found in knowledge in web search engines. Regarding the knowledge of databases and digital libraries, they are little known and dominated by students (M = 1.81), being superior in graduates (M = 2.24) and even greater in university teaching staff (M = 2.93). With similar results in this order they are found in the communication systems or in the LMS. With very low levels of knowledge, software for data processing appears, in students (M = 0.62), in graduates (M = 1.11) and in university professors (M = 2.15). Similar data is found in the knowledge on how to create online questionnaires. Regarding the total knowledge dimension, university teaching staff (M = 31.28; ± 9.42) and graduates (M = 30.67; ± 10.36) show higher cognitive perceptions than students (M = 26.00; ± 8.76).

Table 4 shows the perception of the use of ICT resources in each group of participants. Among the most striking results, the most used ICT resources are the office tools, in university teaching staff (M = 3.33) and in students (M = 3.49), with higher perceptions in graduates (M = 3.70). Similar results in this order are found in the use of web browsers or 2.0 tools or Video editing tools image and audio. Regarding more complex ICT tools, for example, the use of software for data analysis, students barely make use (M = 0.45), with slightly higher results in graduates (M = 0.87), as well as in university teaching staff (M = 1.98). Similar results are found in the use of interactive test creation or Jclik & Hot potatoes. Regarding the total use of ICT, a similar pattern to the data obtained in the knowledge dimension can be observed: university teaching staff (M = 29.20; ± 10.47) use more ICT than students (M = 23.58; ± 7.86), although university teaching staff maintain an average slightly similar to the group of graduates (M = 28.69; ± 10.12). In addition, each group has a higher average in the knowledge dimension than in the use dimension.

In relation to the final score of the entire instrument (sum of the three dimensions: attitude, knowledge and use), it can be observed that the total level of digital teaching competence of the students is medium (M = 71.40; ± 16.60), taking into account the 132 maximum points of the instrument. Regarding university teaching staff, this trend is maintained, since they also show a mean level (M = 78.48; ± 18.88). Finally, in relation to graduates, it can be seen that the level shows a slight increase, being mean - high (M = 82.23; ± 22.45), although still quite far from the 132 total points.

3.2 Unifactorial ANOVA according to the different samples

This section has analysed whether there are statistically significant differences regarding the level of digital teaching competence based on the three dimensions of the instrument (attitude, knowledge and use in relation to ICT), based on the different established samples (students, graduates and university teaching staff). Having verified the normality of the sample, the data indicates that this assumption is met (KS = 0.052; gl = 141; p. > 0.05). Analyses of each dimension in relation to each of the sample groups are presented below.

3.2.1 Attitude dimension towards ICT

To verify the significance of the model proposed in relation to the different samples, a one-way ANOVA has been used, specifically by multiple comparisons using Bonferroni. Once the homoscedasticity has been verified, F (2, 138) = 10.442, p. <0.05, it can be observed that the variations are significantly different. This indicates that the assumption of variance homogeneity has not been fulfilled. Therefore, the Games-Howell contrast was used for multiple comparisons. The Brown-Forsythe statistics, F (2, 81.180) = 6876, p. <0.05 and Welch, F (2, 83.136) = 9.600, p. <0.05 have determined that the proposed model is significant.

Partial eta-squared was calculated to determine the size of the effect. According to Richardson (2011), the partial eta square values of approximately 0.01, 0.06 and 0.14 indicate small, medium and large effects, respectively. In this sense, a large effect has been found ($\eta 2 = 0.132$).

As seen in Table 5, there are statistically significant differences in attitudes towards ICT between students and university teaching staff (p. = 0.013), as well as between graduates and university teaching staff (p. = 0.001). Nonetheless, there were no differences between students and graduates (p. = 0.365).

3.2.2 Knowledge dimension towards ICT

For the knowledge dimension, Levene's homoscedasticity assumption is fulfilled, F (2, 138) = 1.103, p. > 0.05, so multiple comparisons have been made by Tukey. ANOVA determined that the proposed model was significant in the intergroup variable, F (2, 138) = 4182, p. <0.05, with a medium effect size ($\eta 2 = 0.057$). Table 6 shows that multiple comparisons determined that there were significant differences in ICT knowledge between students and graduates (p. = 0.042), as well as between students and university teaching staff (p. = 0.031). However, there were no differences between graduates and university teaching staff (p. = 0.950).

Table 5 Multiple comparisons about attitudes towards ICT

(I) Category	(J) Category	Mean difference (I-J)	Standard error	Sig.	95% confidence interval	
					Lower limit	Upper limit
Students	Graduates	−1.115	0.818	0.365	−3.062	0.832
	University teaching staff	3.830	1.303	0.013	0.693	6.967
Graduates	Students	1.115	0.818	0.365	−0.832	3.062
	University teaching staff	4.944	1.328	0.001	1.751	8.138
University teaching staff	Students	−3.830	1.303	0.013	−6.967	−0.693
	Graduates	−4.944	1.328	0.001	−8.138	−1.751

Source: Authors

Table 6 Multiple comparisons of basic ICT knowledge

(I) Category	(J) Category	Mean difference (I-J)	Standard error	Sig.	95% confidence interval	
					Upper limit	Upper limit
Students	Graduates	−4.667	1.912	0.042	−9.198	−0.136
	University teaching staff	−5.275	2.062	0.031	−10.161	−0.389
Graduates	Students	4.667	1.912	0.042	0.136	9.198
	University teaching staff	−0.608	1.999	0.950	−5.347	4.130
University teaching staff	Students	5.275	2.062	0.031	0.389	10.161
	Graduates	0.608	1.999	0.950	−4.130	5.347

Source: Authors

3.2.3 Use dimension towards ICT

As in the knowledge dimension, multiple comparisons for the ICT use dimension have been made by Tukey due to Levene's homoscedasticity assumption, F (2, 138) = 2076, p. > 0.05. The proposed model has been significant, F (2, 138) = 4928, p. <0.05 with significant differences determined between the sample groups analysed, with a medium effect size ($\eta 2 = 0.067$).

Table 7 shows that there are differences in the use of ICT between students and graduates (p. = 0.022), as well as between students and university teaching staff (p.= 0.019). However, there are no significant differences between graduates and university teaching staff (p. = 0.964).

Table 7 Multiple comparisons on the educational use of ICT

(I) Category	(J) Category	Mean difference (I-J)	Standard error	Sig.	95% confidence interval	
					Upper limit	Upper limit
Students	Graduates	−5.111	1.902	0.022	−9.618	−0.604
	University teaching staff	−5.626	2.051	0.019	−10.486	−0.766
Graduates	Students	5.111	1.902	0.022	0.604	9.618
	University teaching staff	−0.515	1.989	0.964	−5.228	4.198
University teaching staff	Students	5.626	2.051	0.019	0.766	10.486
	Graduates	0.515	1.989	0.964	−4.198	5.228

Source: Authors

4 Discussions

The objective of this study has been to measure and compare the self-perceived level of knowledge, use and attitude towards digital technologies, dimensions that make up the digital teaching competence, in three types of samples (students, graduates, university teachers staff of the Faculty of Education).

In relation to the group of students, it is observed that they have a positive attitude towards the integration of ICT in the classroom, however, they have little knowledge of specific software and make a majority use of office tools, these results are similar to the results obtained by (Guillén-Gámez et al. 2018; Rodríguez et al. 2018; Rubio et al. 2018; Cabezas Gonzalez and Casillas, 2018; Gutiérrez Castillo and Cabero Almenara 2016). The group of Graduates also has a positive attitude towards the integration of ICT in the classroom, results contrary to those obtained by Fernández Batanero and Rodríguez Martín (2017). Regarding the domain of ICT resources, they have greater knowledge in office tools, although little in specific software, as well as little pedagogical use of ICT resources, according to the results obtained by Pérez & Rodríguez et al. (2018) and Barrio et al. (2017). On the other hand, university teachers staff have a positive attitude towards ICT, results coinciding with those obtained by Agreda Montoro et al. (2016), but despite this, although they have a medium level of knowledge of ICT resources, they continue to underuse their use in teaching, as Mercader and Sallán (2017) already stated. In general, it can be stated that each of the groups participating in the study has a limited level of development of these dimensions, which makes it difficult to incorporate these technologies transversally in the teaching-learning processes.

After conducting the study, the results show that, in relation to the attitude towards ICT, university teaching staff have a lower attitude than students and graduates, while there are no great differences between the attitude of students and graduates. These results are not in accordance with those obtained by Fernández Batanero and Rodríguez Martín (2017), since according to their study, teachers in practice or graduates, as they are named in the present work, possessed a lack of positive attitudes towards the use of ICT. Equally, they also are not in accordance with the results of Agreda Montoro et al. (2016), since, according to these authors, despite having an average level of development of digital teaching competence, the university teaching staff did have superior attitudes towards ICT. It should be emphasised, therefore, that as the professional category increases, the attitude of use with respect to the incorporation of ICT in the teaching-learning process decreases.

Regarding knowledge, it should be noted that both graduates and university teaching staff have a similar level of knowledge, although there are differences between them and students, with students having a lower level of knowledge. These data are corroborated with those obtained by Roblizo Colmenero and Cózar Gutiérrez (2015) who stated that, despite having obtained a high level of digital technologies knowledge, students are very similar to those of the general population. Therefore, their knowledge can be considered normal rather than superior. On the other hand, the results of the present study differ from those obtained by Gutiérrez Castillo and Cabero Almenara (2016), Esteve-Mon et al. (2016), Guillén-Gámez et al. (2018), Rodríguez et al. (2018) and Rubio et al. (2018), since according to these investigations, undergraduate students possess an adequate level of digital technologies knowledge. In relation to university teaching staff,

this paper shows that they have a good knowledge of digital technologies, which goes against the conclusions of Muñoz-Repiso et al. (2015) who concluded that university teaching staff had a low level of training in ICT programmes and applications.

In the third dimension analysed, the didactic use of digital technologies, the results are very similar to the knowledge dimension, which may indicate that both dimensions have a direct relationship. Regarding the use, there are differences between students and university teaching staff and students and graduates, but no significant differences were found between graduates and university teaching staff. This study shows that students use these technologies to a lesser extent than the rest of the sample groups, and its use is due to the fact that they simply focus on seeking information for the realisation of academic work, as indicated by Roig-Vila et al. (2012). Regarding graduates, they have a higher level of use than students, very similar to the use made by university teaching staff. These results contrast with those obtained by Pérez Escoda and Rodríguez Conde (2016), Guillén-Gámez & Fernández-López et al. (2017), Llamas-Salguero and Gomez (2018) and López (2018), who all found that the professors in practice, or graduates, have an insufficient use of digital technologies because they show little digital skills for pedagogical use. Equally, there are studies that consider that both graduates and university teaching staff do not use these technologies to a large extent (Mercader and Sallán 2017) and when they do, it tends to be general software (Barrio et al. 2017).

Finally, following the results found regarding knowledge and use of ICT resources, it is observed that there is less use compared to the level of domain. Maybe, the problem can be justified in two possible causes: in the first place, because from the curriculum of the ICT subject is only focused on knowing the range of ICT resources that a person can use in their teaching process and very little in performing procedural tasks with these resources; and on the other hand, in the lack of pedagogical training of university teaching staff on how to efficiently use these technologies with their university students, as well as the lack of creative and innovative skills on how these technologies can improve not only the learning of their students (future graduate), but the learning of children in the classrooms of Infant and primary education, since as stated by Barrio et al. (2017) and Llamas-Salguero and Gomez (2018), the real use of ICT in schools, continues being insufficient.

5 Conclusions

Currently, the development of digital teaching competence is a powerful skill for any education professional and, therefore, universities must consider such development as a challenge for the professionalisation of their graduates. Therefore, it is necessary to commit to the planning, design and evaluation of the process of acquiring said competence throughout degrees, as well as once university teaching staff are employed and have a responsibility for the training of future teachers.

This paper shows that the different constituent dimensions of digital teaching competence are not acquired by those involved in the teaching-learning process in the same way. Moreover, using the lines of innovation and technological development of the Horizon report on Higher Education (Horizon 2017), it can be observed that the groups of subjects involved in this research only have a basic level in terms of knowledge and procedures in digital technologies. This is evidence of a cognitive,

attitudinal and procedural lack that prevents them from adapting to such technological advances. Therefore, it is necessary to promote an even more positive attitude, mainly from university teaching staff towards digital technologies, directly from the university itself. This could be done by motivating professionals to attend training courses that show them the opportunities and possibilities that these tools possess to facilitate their teaching work.

Another conclusion that is evident from this study is that the knowledge and use dimensions are closely related, and that it is both graduates and university teaching staff who have a higher level in both dimensions. This indicates that the teaching work itself requires them to be up to date in new digital technologies. However, it is necessary to explore whether such knowledge and use is not limited to a simple instrumental and timely use of technologies. On the other hand, it is necessary for students to increase both their knowledge and use of digital technologies that in the future they can respond to the needs of their future students, and ensure that their knowledge and use is not limited to specific programmes that help them accomplish academic tasks.

5.1 Limitations of the study and future lines of research

This paper demonstrates the limitations that a self-assessment process of the perceptions of the degree of acquisition of digital teaching competence can have. Nonetheless, it offers a helpful starting point to demonstrate the level of initial training of students, graduates and university teachers level regarding to their digital competence. Similarly, it can serve as a guide for the university itself when designing and developing training actions aimed at improving the level of development of said competence.

From this study, there are several possible different lines of future research that could be conducted:

- A longitudinal study that analyses the evolution of the level of digital teaching competence of the three participating groups in this study using a larger sample.
- An investigation of how students, graduates and university teaching staff have acquired their level of digital teaching competence through the triangulation of qualitative and quantitative research, where the perceptions of the different subjects involved in the study can be investigated.
- Implementation of programs to improve the competence of teachers in those digital technologies where they have less acquired level, creating a pre and post-test with the objective of measuring the level of improvement.

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