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Sonia Casillas Martín, Marcos Cabezas González & Francisco José García Peñalvo

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ARTICLE

Digital competence of early childhood education teachers: attitude, knowledge and use of ICT

Sonia Casillas Martín [a], Marcos Cabezas González [a] and Francisco José García Peñalvo [b]

[a]Didactics, Organization and Research Methods, Universidad de Salamanca, Salamanca, Spain; [b]Computer Science and Automatics, Universidad de Salamanca, Salamanca, Spain

ABSTRACT

The main objective of the research described here was to learn how young learners self-evaluate their digital competence. A non-experimental and descriptive quantitative methodology was employed, an electronic survey being used to collect the data. Among the main results, we can highlight that these learners self-evaluate their attitude towards Information and Communication Technologies (ICT) as favourable, their handling of them as moderate and their knowledge of them as scarce. It became clear that they do not have a level of digital competence suitable for being called 'digital natives', nor sufficient ability to use ICT in their academic life or in their professional future.

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Curriculum; initial teacher training; information and communication technologies; digital competencies; early childhood education

Introduction

In less than a decade, the rapid development and growth of Information and Communication Technologies (ICT) have led to major changes that have also affected education. Not to address such changes would be a serious mistake, since it would involve students being educated unaware of the world they live in (Barrantes, Casas, and Luengo 2014). Twenty-first-century students need competences that enable them to adapt to a new type of individual-information and individual-knowledge relationship and, therefore, the education system should contemplate new ways for learners' development in accordance with this so-called information and knowledge society (Bas, Kubiatko, and Murat 2016; Chávez, Cantú, and Rodríguez 2016).

This background confirms the need for education centres to include new learning theories, methodologies, materials, resources and devices to replace the traditional classroom with digital classrooms where students can acquire competences appropriate to this century's network society (Roblizo, Sánchez, and Cózar 2015). This is why 'society demands well-trained teaching professionals that feel comfortable with ICT and are capable of integrating them into their regular educational practices' (Cózar, Zagala, and Sáez 2015, 150).

The impact of ICT on learning spaces depends on teachers' expertise to use them, their ability to put them at the service of new communication scenarios, and their skills to

CONTACT Marcos Cabezas González mcabezasgo@usal.es Didactics, Organization and Research Methods, Universidad de Salamanca, Salamanca, Spain

adapt them to their students' cognitive and social characteristics. It should not be forgotten that teachers play a major role in all educational reforms and innovations, since they are the ones in charge of adapting their classrooms to whichever elements they are offered, ICT being one of them. Thus, training in these technologies is crucial to ensure their implementation (Cabero 2014).

There is a wealth of scientific literature from recent years on the subject of teachers' perception of knowledge, attitude and usefulness of ICT in teaching practice, from the perspectives of both initial and in-service training (Cabezas, Casillas, and Pinto 2014; Casillas and Cabezas 2014; Fernández and Bermejo 2012; Fernández and Torres 2015; Rambousek, Stípek, and Vanková 2016).

To foster students' development of digital competences after completing their schooling, work on them should be started from the first school years. Although ICT is frequently used in early childhood education, they are neither integrated into daily classroom activities, nor applied to develop contents associated with the teaching units that are underway, their use being more recreational than educational. In short, they are mostly used at specific times rather than as regular tools in the teaching-learning process (Asorey and Gil 2009). Thus, it is necessary that those who are about to become teachers of children's education, are trained during their initial teacher education in order to integrate ICT systematically within the teaching-learning processes of the educative stages in which they are going to work.

The European Committee (2013) states that teaching staff's early studies should ensure digital training, especially in the area of methodology, with the purpose of maximising the potential of ICT, and it stresses that teacher training in the pedagogical use of these technologies is rarely compulsory.

Initial early childhood education teacher training, which involves the educational stage that is at the root of all education systems, currently includes certain trends that are reflected in and influenced by the complexity of the twenty-first-century society (Domínguez et al. 2015). As in most other European countries, educational policy in Spain over the last 30 years has fostered teachers' initial and in-service ICT training, which has become a compulsory part of initial early childhood and primary education teacher training, although the guidelines for implementation have been non-specific and the choice of contents and organisation has depended on each university (De Pablos 2013).

Krumsvik (2011, 44–45) provides a definition of digital competence specifically for teachers: 'Digital competence is the teacher/TE's (teacher educator's) proficiency in using ICT in a professional context with good pedagogic-didactic judgement and his or her awareness of its implications for learning strategies and the digital Bildung of pupils and students'.

There are different standards and indicators models to define teacher digital competence: Canada (Ministry of Education of Quebec, 2001), Australia (Cdest 2002), United Nations Educational, Scientific and Cultural Organisation (Unesco 2008), France (Mesr 2011). We identify with the model of Krumsvik (2007), 2011, Krumsvik (2014)). For this author, digital competence should address three levels: basic digital competences (use of ICT tools, access to information, communication, etc.); teaching approach competence in the use of ICT (technology at the service of pedagogy); and learning strategies (learning to learn using ICT competence).

Our research focuses on finding out how early childhood education teachers assess their digital competence. Diagnosing this competence at the beginning of the training of the future teachers of children's education is important and necessary to their training programs meet the needs that are identified Figure 1.

Research design

We will now explain the methodological design of the research, first presenting the purpose of the study, and then describing the methodological approach followed, the population and sample characteristics, and those of the information-gathering instrument, to end with the statistical data analysis.

Purpose

The main purpose of this research is to find out how Spanish pre-service early childhood education teachers assess their digital competence. Additionally, the self-assessments provided by these future teachers will be compared according to the personal variable sex (male vs female).

The key research question is formulated as follows:

- What level of digital competence do future early childhood education teachers in Spain believe they have?

Methodology

Within the range of research methods, a quantitative, non-experimental and descriptive methodology was followed, using the questionnaire technique for data collection, designed on the basis of the criteria established by authors such as Lumsden (2007)

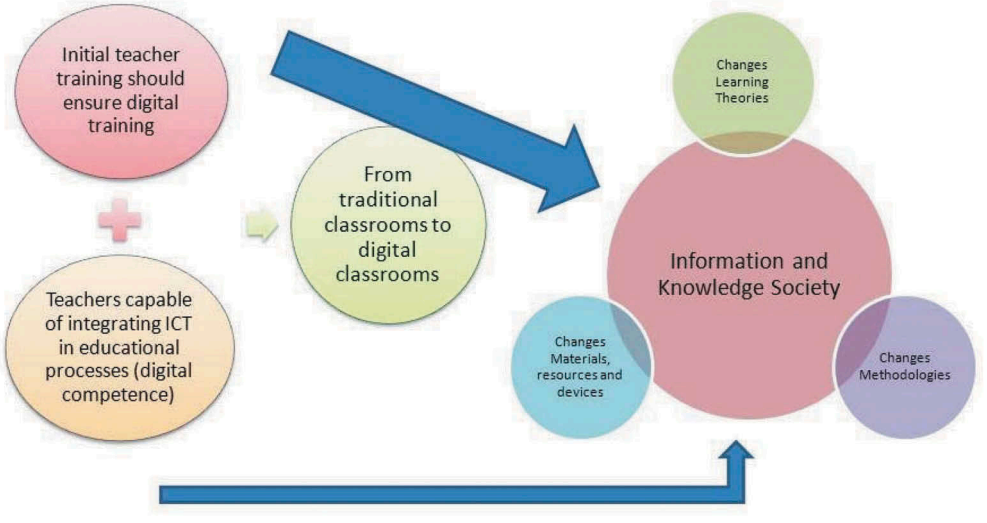

Figure 1. Outline review of the literature.

and Norman et al. (2001). A descriptive correlational method was used relying on an electronic survey study; in particular, an ex post facto design that sought to establish relationships among certain variables, while the subject of study remained unchanged.

The purpose of finding out students' level of digital competence when they begin their higher education studies was to conduct an initial assessment on their knowledge, attitude and history of ICT use, and to determine whether the digital native generational concept applies to them.

Additionally, we propose to establish differences according to the moderating variable gender of the pre-service teachers, based on the moderating variables introduced in the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003).

Population and sample

The study population was made up of 332 students who will be, in the near future, in-service teachers.

The sample was obtained through simple random sampling with a ± 1.5% margin of error for a 95% confidence interval. The final sample consisted of a total of 308 students, 1.4% men and 98.6% women, aged from 17 to 24. They all owned smartphones (100%), practically all of them had laptops and digital cameras (97.3% in both cases), 73% had GPS devices, and 67.6% owned desktop computers and tablets. Fewer owned digital camcorders (48.6%) and e-readers (40.5%), and only 2.7% owned wearable technology of some kind Table 1.

Instrument

A review of the instruments available for this purpose was carried out, but none of them seemed fully adequate to the variables to be measured, which is why we decided to produce a mainly direct answer, pre-coded and cross-sectional questionnaire, designed ad hoc for the analysis of knowledge, use and attitude towards ICT of university students.

It consists of 88 items, five of which are identifying variables. A 0 to 10 ordinal Likert-type scale was chosen, 0 being the lowest and 10 the highest. The average score (5) indicates that the student believes to be capable (fit) of performing the proposed tasks. This provides a clear picture of the technological and informational competences known and managed by the students of the Early Childhood Education degree. The original questionnaire was improved by conducting a pilot test and was subjected to a strict

Table 1. ICT devices owned.

Devices owned	%
Desktop computer	67.6
Laptop	97.3
Digital camera	97.3
Digital camcorder	48.6
Smartphone	100
Tablet	67.6
e-reader	40.5
GPS	73
Some sort of wearable	2.7

validation process conducted by a committee of experts to guarantee the instrument's validity at the global level, as well as the validity of each of the indicators included. The aim of this was to contribute to the scale validation process. Item reliability was tested by means of an analysis of standardised loading, and their high internal consistency reliability was confirmed using Cronbach's α both for each dimension (α knowledge = 0.92, α use = 0.83 y α attitude = 0.91) and for the whole scale (α = 0.91), with results above the recommended threshold of high reliability for all sections.

With regard to structure, the instrument is divided into five sections: the first gathers student's identification data (*ID*) (sex, age, degree and year), the second consists of the items related to devices they own (*OW*), the third is knowledge (*KN*), the fourth use (*US*) and the fifth is attitude (*AT*). Except for the first and second of these, focused on identification and ICT devices owned by the students and described in the sample section, the rest are the ones used to guide the data analysis described Table 2.

Data analysis

The organisation, analysis and statistical processing of data were performed using Statistical Package for the Social Sciences (SPSS v.21) software. They were processed focusing on a descriptive and inferential analysis where the means of the technological capacities of future early-childhood education teachers at the beginning of their training was calculated. An inferential analysis based on a comparison of means and correlation was also carried out. After checking the parametric assumptions of normality and with the purpose of choosing the most suitable analysis technique, the normality of the sample was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests and homoscedasticity was measured using Levene's test. The results of these prior analyses showed normal distribution for all dimensions, which involved the use of parametric hypothesis comparison testing. Precisely, Student's t-test was chosen for independent samples, using the variable sex, which allowed us to confirm whether a certain sample comes from a population where the variable concerned has a specific mean. Likewise, the general sections of the questionnaire were tested for correlation using Pearson's r test, which allowed us to establish relationships among the different sections assessed in the questionnaire.

As a supplementary measure, effect size was calculated converting Cohen's d to R2 (variance explained by the model) to estimate the size of the differences found.

Table 2. Structure of the questionnaire.

Block		Block description	Items
Block 1	ID	Identification data such as gender, age, qualifications, etc.	1-4
Block 2	OW	ICT **devices** they **own**	39-48
Block 3	KN	Self-assessment on **degree/level of knowledge about ICT related concepts**	5-32
		Self-assessment on **degree/level of knowledge about ICT devices**	33-38
Block 4	US	Self-assessment on competence in the **use of ICT devices**	49-56
		Self-assessment on competence in the **use of ICT tools**	57-65
		Self-assessment on competence in the **use of ICT services**	66-81
Block 5	AT	Assessment of **ICT** based on **needs and relevance** for **the future of professional development in education**	82-88

Results

The descriptive analysis conducted, organised into various phases, and the inferential analysis, are provided to facilitate assessment of the digital competence of students of the Undergraduate Degree in Early Childhood Education, which will determine the level of proficiency in the use of technologies in their future teaching career.

Descriptive analysis

Below is a descriptive analysis that takes into account the three general sections for which the information is gathered (knowledge, use and attitude towards ICT), arranged into general basic descriptive statistics and descriptive statistics for each individual section.

General basic descriptive statistics

Future teachers assess their attitude towards ICT very positively, their use of ICT more moderately and their knowledge as scarce Figure 2.

When focusing on usage, there are differences between the means obtained in its different aspects. They believe they have a remarkable ability to manage tools and devices, but assess their use of services below the passing score (in a 0–10 scale, a 5 is considered a 'pass') (Figure 3).

Basic descriptive statistics by blocks

Students' self-assessment of their level of knowledge of ICT concepts and devices (block 3). The table below shows the means, standard deviation, lowest and highest scores students give to each competence of this block on knowledge of ICT-related concepts Table 3.

As shown, self-assessment scores for most concepts are below five, which means that concepts related to ICT are generally unknown to students. We consider that they are only aware of those whose means are above five. Only 14.3% of the concepts chosen for this research are known to students at the beginning of their initial training. Additionally, standard deviation is very high, indicating that homogeneity of responses is very low because of the existence of very different levels.

When asked about device knowledge, the answer is unanimous, 100% are familiar with tablets, smartphones, eBooks, IWB and GPS. However, only 30% know what a wearable is.*3.1.2.2.*

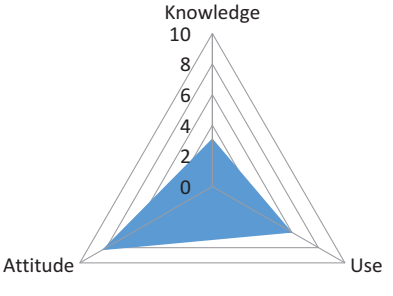

Figure 2. Means of the questionnaire's three general blocks.

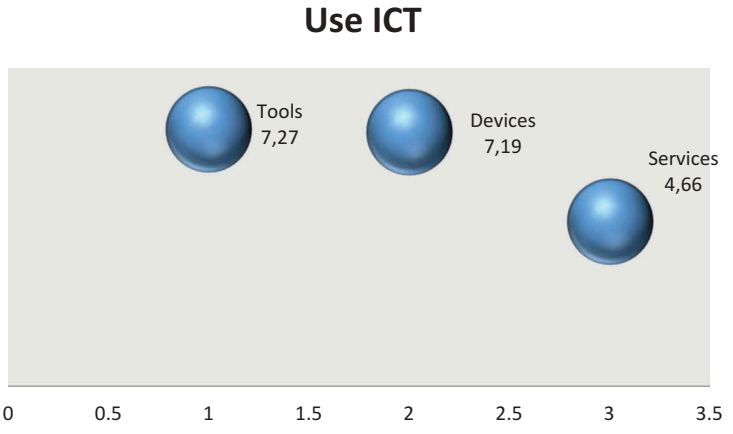

Figure 3. Means for the ICT use sections.

Table 3. Descriptive statistics for knowledge of ICT.

	Knowledge			
Concepts	$\bar{X}$	Sx	Lowest	Highest
Information and communication technologies (ICT)	7.28	1.86	3	10
Learning and knowledge technologies (LKT)	4.41	2.64	0	10
Empowerment and participation technologies (EPT)	2.27	2.11	0	9
Web 2.0	2.51	2.85	0	10
Web 3.0	1.78	2.04	0	7
Wikipedia	9.49	1.29	1	10
Blogosphere	3.35	3.03	0	10
Podcast	3.36	3.01	0	10
Social bookmarking	2.51	2.56	0	10
Web syndication	1.59	2.22	0	10
Mashup	1.54	2.11	0	10
Learning Object (LO)	5.62	3.02	0	10
E-learning	2.45	2.94	0	10
M-learning	1.39	2.16	0	10
B-learning	1.32	1.96	0	10
MOOC	1.14	1.84	0	10
Cloud storage	7.36	2.55	0	10
Virtual Reality (VR)	4.50	3.15	0	10
Augmented reality (AR)	3	3.11	0	10
Copyleft	1.66	2.24	0	10
Creative Commons licence	2.58	3.13	0	10
Digital divide	1.84	2.34	0	10
E-exclusion	1.26	1.88	0	8
E-inclusion	1.19	1.72	0	8
Digital literacy	3.46	2.97	0	10
Cyberactivism	3.24	3.32	0	10
E-participation	1.46	1.91	0	7
Empowerment	1.22	1.70	0	7

Students' self-assessment on their abilities to use ICT devices, tools and services (block 4).

With regard to competence in the use of ITC devices, students rate their skills very highly. Outstanding among these results are their great ability to use smartphones as opposed to their lower capacity to use wearables (Table 4).

Table 4. Descriptive statistics for the use of ICT devices.

	Use			
Devices	$\bar{X}$	Sx	Lowest	Highest
Computers	7.62	1.65	3	10
Digital camera	8.19	1.57	3	10
Digital camcorder	6.96	2.04	2	10
Smartphone	9.23	1.11	4	10
Tablet	8.46	1.51	2	10
e-reader	7.39	2.22	0	10
GPS	7.35	1.85	4	10
Wearable	2.36	2.67	0	10

Table 5. Descriptive statistics for the use of ICT tools.

	Use			
ICT tools	$\bar{X}$	Sx	Lowest	Highest
Office software	6.80	1.97	1	10
Editing	7.16	1.75	3	10
Search and documentation	7.36	1.81	3	10
Collaborative work	6.96	2.05	0	10
Time management	6.95	2.04	2	10
Communication	9.36	1.01	6	10
Training	5.18	2.92	0	10
Cloud storage	6.20	2.31	0	10
Social networks	9.51	0.79	6	10

Based on competence in the use of ICT tools, all the means obtained were above pass, which leads to affirm that students believe that they are able to use all those included in Table 5. The highest scores are given to capacities for using social networks (Facebook, Twitter, LinkedIn, Instagram, YouTube, etc.) and communication tools (WhatsApp, email, videoconference, chat, forums, etc.); and the lowest scores correspond to the management of training tools (e-learning platforms, Moodle, etc.) Table 6.

With regard to the use of ICT services, their ratings are more dispersed, with very heterogeneous distributions. Standard deviation is often near or above 3, which shows that students allocate widely differing scores to each variable. In general, they use the Internet, although not to publish or share presentations, nor to upload and store contents; they do not have their own blog or website, and neither do they publish on wikis.

Table 6. Descriptive statistics for the use of ICT services.

	Use			
ICT services	$\bar{X}$	Sx	Lowest	Highest
Twitter	6.89	3.46	0	10
Facebook	8.14	3.05	0	10
WhatsApp	9.85	0.42	8	10
Internet to upload and share pictures	8.07	2.79	0	10
Internet to upload and share videos	6.57	3.35	0	10
Internet to upload and share presentations	4.61	3.20	0	10
Internet to upload and share audio	5.28	3.56	0	10
Chat, communication, videoconference	6.62	3.09	0	10
I have my own blog	1.20	2.92	0	10
I have my own website	0.31	1.27	0	8
I search wikis	4.66	3.84	0	10
I publish on wikis	0.49	1.71	0	10
Internet to upload and store contents	0.74	1.62	0	7
Cloud storage	5.05	3.16	0	10

Students attitudes towards ICT according to need and relevance for the professional future of education (block 5). The attitudes stated are highly positive. They acknowledge that ICT are necessary for their future career. Observing the means for each of the attitude towards ICT items, it is clear that they believe them to be a requirement in their professional career (item 1: mean = 8.47), and even that they will help towards economising professional efforts (item 2: 8.35). Likewise, they consider that the use of such technologies is a useful means for continuing their training, as well as helping in their professional development (item 4: 8.46 and item 5: 8.19), showing their intention to acquire ICT competence for their future career (item 6: 8.28). In all cases, mean scores are above the absolute central (5) on a 1 to 10 scale (Table 7).

Inferential analysis

Variance analyses (Student's t-tests) were performed for one sample, which allows us to verify whether it could come from a population whose interest variable shows a specific mean. To be able to perform such test, parametric conditions of homogeneity and normality had been previously checked.

According to the results, the means are 8.34 for attitude, 6.02 for use and 3.14 for knowledge. These means differ from the sample value, which is 10. Using Student's t-test on a sample assuming a 5% level of significance justifies rejection of the assumption of the sample coming from a population group that is perfectly familiar with ICT. However, use and attitude acquire higher valuations. The differences between the means obtained from the sample and those obtained from the tested population are identical for the three competence blocks. At a 95% confidence level, the population's ICT use scores between 5.91 and 6.36, attitude between 8.2 and 8.77, and knowledge between 2.95 and 3.66.

Further analysis of the data yields statistically significant differences in 30 of the 80 items of the instrument for the variable sex ($t < 0.05$). In all cases, men score higher than women do, except for the attitude section (AT), which leads to the assumption that men's willingness is slightly lower (Table 8).

To verify the level of significance of the differences, based on the indicated variables, the effect size of the variables was calculated using Cohen's d (Cohen 1988). Cohen's effect size

Table 7. Descriptive statistics for attitude towards ICT.

	Attitude			
Attitude towards ICT	$\bar{X}$	Sx	Lowest	Highest
ICT is necessary/useful for my future career	8.47	1.40	3	10
ICT will help to economise academic effort/work	8.35	1.50	2	10
ICT will help to economise professional effort/work	8.34	1.30	6	10
ICT is a useful means for further training	8.46	1.27	6	10
ICT is required for professional development	8.19	1.55	3	10
Teacher, professional with expertise in ICT	8.28	1.60	5	10

Table 8. Student t-test for the sex variable.

	KN	US	AT
t	17.730	53.227	58.955
Sig	.000	.000	.000

establishes that relationships with values below 0.02 are not sufficiently significant to be taken into account. In this research, the effect sizes of all the contrast variables of knowledge (KN) (d = 1.50), use (US) (d = 2.51) and attitude (AT) (d = 2.10) are extremely large according to the values established by Cohen. This is further proof that differences regarding the sex variable are highly significant.

After confirming the existence of differences among sections, the hypotheses posed were checked to measure the degree of connection among the general blocks. This was done by applying Pearson's correlation coefficient, which yielded a positive correlation at the 0.01 level between the knowledge and use blocks (r = 0.383 p = 0.001). Those who believe their knowledge is higher are those who score highest in their use of ICT, especially tools (r = 0.440 p = 0.000), rather than devices (r = 0.297 p = 0.01) and services (r = 0.246 p = 0.034), although correlation is significant at the 0.05 level in both cases. However, better knowledge and better use does not correlate with better attitude towards ICT ($p > 0.05$).

There is no correlation between owning more devices and greater conceptual knowledge. There is no confirmation that the more devices the students own, the greater their conceptual knowledge or the better their ability to use them.

Finally, there is a significant correlation at the 0.01 level among the use of ICT devices, tools and services. The more they use of devices, the more they use of tools (r = 0.527 p = 0.000) and services (r = 0.361 p = 0.002). The higher the use of tools, the higher the use of services (r = 0.446 p = 0.000).

Discussion and conclusions

This study illustrates the level of digital competence of students of the Undergraduate Degree in Early Childhood Education of the University of Salamanca (Spain), with special focus on the variables of knowledge, use and attitude towards ICT.

As in other researches, the results obtained show that students' digital competence level is not in keeping with their being 'digital natives' (Ottestad, Kelentri, and Guðmundsdóttir 2014). We agree with the author of the term (Prensky 2001) that our students are part of a generation born and raised in the digital era, mainly characterised by a high integration of ICT in daily activities and where they do not perceive technology as hostile, since they use it quite skilfully in their everyday life. However, there is much evidence that dismantles the 'digital native' myth (Akçayir, Dündar, and Akçayir 2016; Bennett, Maton, and Kervin 2008; Brown and Czerniewicz 2010; Helsper and Eynon 2010; Kennedy et al. 2010; Li and Rainieri, 2010; Porto et al. 2016). This notion is generally limited to the home setting and activities or tasks conducted in idle moments and free or leisure time (Gómez 2015; Merino 2010; Muros, Aragón, and Bustos 2013). We are convinced that they do not have sufficient digital competence to use ICT in their academic life and for their professional career.

Most of the participants in the survey own technological devices, mainly smartphones, laptops, digital cameras and GPS devices.

Considering the variables analysed, students believe they fail in knowledge of ICT-related concepts and assess their knowledge of devices as very good. With regard to use, self-assessment results increase to excellent in devices, especially smartphones, while falling to very good in tools, excepting social networks and communication tools, the use

of which they rate as excellent, and training tools, where they only manage a pass. Where the use of services is concerned, results differ widely, as has been already observed in other studies (Roblizo, Sánchez, and Cózar 2015; Roig and Pascual 2012; Ruiz, Anguita, and Jorrín 2006). The assessment of attitudes towards ICT is very positive. They acknowledge the need and importance of ICT for their future career and state their desire to become proficient in their use. This is in contrast with the conclusions reached in other studies. Domínguez et al.'s (2015) study aimed at defining the most valuable dimensions upon which early childhood teachers' initial training is based. Their study concluded that digital competence was the least relevant. In these same lines, in a research project on the assessment of students of the Undergraduate Degree of Early Childhood Teacher Training on the digital competences required for them to become education professionals, the results for digital competence, which the authors believed to be crucial, were below expectations (Ramírez, Gutiérrez, and Corpas 2012).

Considering the gender variable, there are indeed statistically significant differences, which agrees with the results of recent research on the topic by other authors (Barrantes, Casas, and Luengo 2014; Meelissen and Drent 2008; Schumacher and Morahan 2001). Men self-assess their knowledge and use of ICT more positively than women who, on the other hand, score higher in attitude.

The results show positive correlation between knowledge and use, the more knowledge about ICT, the better the use made of it, especially regarding tools, rather than devices and services. However, knowledge and use do not correlate with a better attitude towards ICT, since women score lower in knowledge and use, but higher in attitude. There is also no correlation between knowledge and the owning of devices.

The results obtained show that digital competence is a yet to be achieved by students beginning their training in the Undergraduate Degree in Early Childhood Education. We believe the development of this competence should be strongly promoted in the current curricula for education degrees, since we are aware that this is not yet a reality (Gudmundsdottir, Loftsgarden, and Ottestad 2014; Haugerud 2011; Instefjord and Munthe 2015; Lavonen et al. 2007; Tømte 2015). It is necessary for the initial training of these future professionals to include work on developing this competence (Angeli and Valanides 2009; Harris, Mishra, and Koehler 2009; Mishra and Koehler 2006), even though research conducted by Losada, Valverde, and Correa (2012), focused on the analysis of the situation of educational technology in undergraduate degrees of education offered by Spanish universities after the implementation of the European Higher Education Area (EHEA), concludes that the presence of educational technology has not increased in relation to previous study plans. The implementation of the EHEA has caused ICT to lose force in the development of the digital competence of future education professionals. Accordingly, there has been a decline in comparison with the former diploma degree study plans (3-year degrees), since there is currently no guarantee that all students will receive specific training in educational technologies, as had been the case before.

Taking into account the results obtained, ICT training is a crucial requirement in the initial teacher education of early childhood teachers. It is necessary to reinforce the pedagogical knowledge dimension of technology to know, understand and apply its didactic and methodological use in the teaching-learning processes in the early stages of schooling.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Sonia Casillas Martín: Doctor in Pedagogy. Professor in the Department of Didactics, Organization and Research Methods at the University of Salamanca. Member of the Research-Innovation in Educational Technology Group of the University of Salamanca (GITE-USAL).

Marcos Cabezas González: Doctor of Pedagogy. Professor in the Department of Didactics, Organization and Research Methods at the University of Salamanca. Member of the Research-Innovation in Educational Technology Group of the University of Salamanca (GITE-USAL).

Francisco José García Peñalvo: Doctor in Computer Science. Professor in the Department of Computer Science and Automation at the University of Salamanca. Director of the InterAction and eLearning Research Group (GRIAL) of the University of Salamanca.

ORCID

Sonia Casillas Martín http://orcid.org/0000-0001-5304-534X
Marcos Cabezas González http://orcid.org/0000-0002-3743-5839
Francisco José García Peñalvo http://orcid.org/0000-0001-9987-5584

References

Akçayir, M., H. Dündar, and G. Akçayir. 2016. "What Makes You a Digital Native? Is It Enough to Be Born after 1980?" *Computers in Human Behavior* 60: 435–440. doi:10.1016/j.chb.2016.02.089.

Angeli, C., and N. Valanides. 2009. "Epistemological and Methodological Issues for the Conceptualization, Development, and Assessment of ICT-TPCK: Advances in Technological Pedagogical Content Knowledge (TPCK)." *Computers and Education* 52 (1): 154–168. doi:10.1016/j.compedu.2008.07.006.

Asorey, E., and J. Gil. 2009. "El placer de usar las tic en el aula de infantil." *Participación Educativa* 12: 110–119.

Barrantes, G., L. M. Casas, and R. Luengo. 2014. "Competencias tecnológicas de los profesores de infantil y primaria de extremadura en función del género." *Revista Iberoamericana De Informática Educativa* 19: 33–48.

Bas, G., M. Kubiatko, and A. Murat. 2016. "Teachers Perceptions Towards ICT in Teaching-learning Process: Scale Validity and Reliability Study." *Computers in Human Behavior* 61: 176–185. doi:10.1016/j.chb.2016.03.022.

Bennett, S. J., K. A. Maton, and L. K. Kervin. 2008. "The Digital Natives Debate: A Critical Review of the Evidence." *British Journal of Educational Technology* 39 (5): 775–786. doi:10.1111/bjet.2008.39.issue-5.

Brown, C., and L. Czerniewicz. 2010. "Debunking the Digital Native: Beyond Digital Apartheid, Towards Digital Democracy." *Journal of Computer Assisted Learning* 26 (5): 357–369. doi:10.1111/j.1365-2729.2010.00369.x.

Cabero, J. 2014. *La formación del profesorado en TIC: modelo TPACK (conocimiento tecnológico, pedagógico y de contenido)*. Sevilla: Secretariado de Recursos Audiovisuales y Nuevas Tecnologías Universidad de Sevilla.

Cabezas, M., S. Casillas, and A. M. Pinto. 2014. "percepción de los alumnos de educación primaria de la universidad de salamanca sobre su competencia digital". *EDUTEC. Revista Electrónica De Tecnología Educativa*, no. 48. doi:10.21556/edutec.2014.48.156.

Casillas, S., and M. Cabezas. 2014. "Percepción de los alumnos de educación primaria de la universidad de salamanca sobre su competencia digital." *Revista Didáctica, Innovación y Multimedia*, 29. http://dim.pangea.org/revista29.htm

Cdest. 2002. *Raising the Standards: A Proposal for the Development of an ICT Competency Framework for Teachers*. Australia: Department of Education, Science and Training.
Chávez, F. H., M. Cantú, and C. M. Rodríguez. 2016. "competencias digitales y tratamiento de información desde la mirada infantil." *Revista Electrónica De Investigación Educativa* 18 (1): 209–220.
Cohen, J. 1988. *Statistical Power Analysis for the Behavioral Sciences*. Mahwah, NJ: Lawrence Erlbaum.
Cózar, R., J. Zagala, and J. M. Sáez. 2015. "Creando contenidos curriculares digitales de ciencias sociales para educación primaria. una experiencia TPACK para futuros docentes." *Educatio Siglo XXI* 33 (3): 147–168. doi:10.6018/j/240921.
De Pablos, J. 2013. "La Formación E Investigación En El Campo De La Tecnología Educativa." *Revista Fuentes* 13: 9–16.
Domínguez, M. C., R. González, M. Medina, and A. Medina. 2015. "Formación Inicial Del Profesorado De Educación Infantil: Claves Para El Diseño Innovador De Planes De Estudio." *ENSAYOS, Revista De La Facultad De Educación De Albacete* 30 (2): 227–245.
European Committe. 2013. "Monitor Education and Training 2013." http://educalab.es/documents/10180/14921/monitor13_en.pdf/23d54070-3136-4d22-8a95-9eb73123ad81
Fernández, J. M., and B. Bermejo. 2012. "Actitudes Docentes Hacia Las TIC En Centros De Buenas Prácticas Educativas Con Orientación Inclusiva." *Enseñanza Y Teaching. Revista Interuniversitaria De Didáctica* 30 (1): 45–61.
Fernández, J. M., and J. A. Torres. 2015. "Actitudes Docentes Y Buenas Prácticas Con TIC Del Profesorado De Educación Permanente De Adultos En Andalucía." *Revista Complutense De Educación* 26 (3): 33–49.
Gómez, H. 2015. "Jóvenes Y La Vida Digital: De Hacer Vida (Pos) Moderna." *Entretextos* 19: 1–9.
Gudmundsdottir, G. B., M. Loftsgarden, and G. Ottestad. 2014. *Nyutdannede lærere. profesjonsfaglig digtal kompetanse og med erfaringer IKT*. I lærerutdanningen: Senter de IKT i utdanningen.
Harris, J., P. Mishra, and M. Koehler. 2009. "Teachers' Technological Pedagogical Content Knowledge and Learning Activity Types: Curriculum-based Technology Integration Reframed." *Journal of Research on Technology in Education* 41 (4): 393–416. doi:10.1080/15391523.2009.10782536.
Haugerud, T. 2011. "Student Teachers Learning to Teach: The Mastery and Appropriation of Digital Technology." *Nordic Journal of Digital Literacy* 4 (6): 226–239.
Helsper, E. J., and R. Eynon. 2010. "Digital Natives: Where Is the Evidence?" *British Educational Research Journal* 36 (3): 503–520. doi:10.1080/01411920902989227.
Instefjord, E., and E. Munthe. 2015. "Preparing Pre-service Teachers to Integrate Technology: An Analysis of the Emphasis on Digital Competence in Teacher Education Curricula." *European Journal of Teacher Education* 39 (1): 77–93. doi:10.1080/02619768.2015.1100602.
Kennedy, G., T. Judd, B. Dalgarno, and J. Waycott. 2010. "Beyond Natives and Immigrants: Exploring Types of Net Generation Students." *Journal of Computer Assisted Learning* 26 (5): 332–343. doi:10.1111/j.1365-2729.2010.00371.x.
Krumsvik, R. J. 2007. *Skulen Og Den Digitale Læringsrevolusjonen*. Oslo: Universitetsforlage.
Krumsvik, R. J. 2011. "Digital Competence in Norwegian Teacher Education and Schools." *Högre Utbildning* 1 (1): 39–51.
Krumsvik, R. J. 2014. "Teacher Educators' Digital Competence." *Scandinavian Journal of Educational Research* 58 (3): 269–280. doi:10.1080/00313831.2012.726273.
Lavonen, J., M. Lattu, K. Juuti, and V. Meisalo. 2007. "Strategy-based Development of Teacher Educators' ICT Competence through a Co-operative Staff Development Project." *European Journal of Teacher Education* 29 (2): 241–265. doi:10.1080/02619760600617433.
Li, Y., and M. Ranieri. 2010. "Are Digital Natives Really Digitally Competent? A Study on Chinese Teenagers." *British Journal of Educational Technology* 41 (6): 1029–1042. doi:10.1111/j.1467-8535.2009.01053.x.
Losada, D., J. Valverde, and J. M. Correa. 2012. "La Tecnología Educativa En La Universidad Pública Española." *Pixel-Bit, Revista De Medios Y Educación* 41: 133–148.
Lumsden, J. 2007. "Online-questionnaire Design Guidelines." In *Handbook of Research on Electronic Surveys and Measurements*, edited by R. A. Reynolds, R. Woods, and J. D. Baker, 44–64. Hershey, PA: Idea.
Meelissen, M., and M. Drent. 2008. "Gender Differences in Computer Attitudes: Does the School Matter?" *Computers in Human Behavior* 24 (3): 969–985. doi:10.1016/j.chb.2007.03.001.

Merino, L. 2010. *Nativos digitales: una aproximación a la socialización tecnológica de los jóvenes*. Madrid: Injuve.

Mesr. 2011. "Certificat informatique et internet de l´enseignement supérieur". http://www.enseignementsup-recherche.gouv.fr/pid20536/bulletin-officiel.html?cid_bo=54844

Ministère De L´Éducation Du Québec. 2001. "*La formation a l´enseignement. les orientations. les compétences professionnelles*." Québec: Gouvernement du Québec, Ministère de l´Éducation. http://www.education.gouv.qc.ca/fileadmin/site_web/documents/reseau/formation_titularisation/formation_enseignement_orientations_EN.pdf

Mishra, P., and M. J. Koehler. 2006. "Technological Pedagogical Content Knowledge: A Framework for Integrating Technology in Teacher Knowledge." *Teachers College Record* 108 (6): 1017–1054. doi:10.1111/j.1467-9620.2006.00684.x.

Muros, B., Y. Aragón, and A. Bustos. 2013. "La ocupación del tiempo libre de jóvenes en el uso de videojuegos y redes." *Comunicar, Revista Científica De Comunicación Y Educación* 40: 31–39. doi:10.3916/C40-2013-02-03.

Norman, K. L., Z. Friedman, K. Norman, and R. Stevenson. 2001. "Navigational Issues in the Design of Online Self-administered Questionnaires." *Behaviour and Information Technology* 20 (1): 37–45. doi:10.1080/01449290010021764.

Ottestad, G., M. Kelentri, and G. Guðmundsdóttir. 2014. "Professional Digital Competence in Teacher Education." *Nordic Journal of Digital Literacy* 9 (4): 243–249.

Porto, C. G., M. M. Isoni, P. J. de Moura, and R. C. de Faria. 2016. "Self-efficacy and Anxiety of Digital Natives in Face of Compulsory Computer-mediated Tasks: A Study about Digital Capabilities and Limitations." *Computers in Human Behavior* 59: 49–57. doi:10.1016/j.chb.2016.01.015.

Prensky, M. 2001. "Digital Natives, Digital Inmigrants." *MCB University Press* 9 (5): 1–6. http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf

Rambousek, V., J. Stípek, and P. Vanková. 2016. "Contents of Digital Literacy from the Perspective of Teachers and Pupils." *Procedia, Social and Behavioral Sciences* 217: 354–362. doi:10.1016/j.sbspro.2016.02.101.

Ramírez, A., M. P. Gutiérrez, and C. Corpas. 2012. "Valoración por parte del alumnado de grado de maestro en educación infantil de las competencias que se les exige para convertirse en profesionales de la educación." In *Las Competencias Básicas. Competencias Profesionales Del Docente*, edited by E. Nieto, A. Callejas, and O. Jerez, Coords, 179–186. Ciudad Real: Universidad de Castilla-La Mancha.

Roblizo, M., M. C. Sánchez, and R. Cózar. 2015. "El reto de la competencia digital en los futuros docentes de infantil, primaria y secundaria: los estudiantes de grado y máster de educación ante las tic." *Prisma Social, Revista De Ciencias Sociales* 15: 254–295.

Roig, R., and A. M. Pascual. 2012. "Las competencias digitales de los futuros docentes. un análisis con estudiantes de magisterio de educación infantil de la universidad de alicante." *@tic. Revista D'innovació Educativa* 9: 53–60.

Ruiz, I., R. Anguita, and I. M. Jorrín. 2006. "Un estudio de casos basado en el análisis de competencias para el nuevo maestro/a experto en nuevas tecnologías aplicadas a la educación." *Revista Latinoamericana De Tecnología Educativa* 5 (2): 357–368.

Schumacher, P., and J. Morahan. 2001. "Gender, Internet and Computer Attitudes and Experiences." *Computers in Human Behavior* 17 (1): 95–110. doi:10.1016/S0747-5632(00)00032-7.

Tømte, C. 2015. "Educating Teachers for the New Millennium? Teacher Training, ICT and Digital Competence." *Nordic Journal of Digital Literacy* 10: 138–154.

Unesco. 2008. "*Estándares de competencia en TIC para docentes*." París: Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura. http://eduteka.icesi.edu.co/pdfdir/UNESCOEstandaresDocentes.pdf

Venkatesh, V., M. G. Morris, G. B. Davis, and F. D. Davis. 2003. "User Acceptance of Information Technology: Toward a Unified View." *MIS Quarterly* 27 (3): 425–478. doi:10.2307/30036540.