Are primary education teachers trained for the use of the technology with disabled students?

José María Fernández-Batanero[*] , Marta Montenegro-Rueda and José Fernández-Cerero

*Correspondence:
batanero@us.es

Department of Teaching
and Educational
Organization, Faculty
of Education, University
of Seville, C/Pirotecnia s/n,
41013 Seville, Spain

Abstract

Incorporating information and communication technology (ICT) in inclusive class-rooms requires competent teachers, both technological and pedagogical. To contrast these theoretical assumptions, this study aims to identify the level of training and technical knowledge of primary school teachers in Spain regarding the use of ICTs for supporting students with special needs. The research methodology used was a mixed research design (quantitative and qualitative method), analysing 777 questionnaires supplied to primary school teachers and 723 interviews conducted with key inform-ants (members of management teams, ICT coordinators, directors and technological advisors of teacher training centres). The results informed teachers' knowledge about ICT and disability and barriers or obstacles to their training. Among the conclusions, teachers' inadequate training regarding ICTs for students with special needs stands out and the lack of training experiences in this field.

Keywords: Technology, Disability, Inclusion, Teacher training, Primary education

Introduction

Over the past 30 years, there has been significant development worldwide, particularly in scientific advances and social change. The impact in society, particularly in education, is increasingly evident, as it is in a permanent state of transformation and improvement due to the vertiginous proliferation of Information and Communication Technologies (ICT) (Cózar & De Moya, 2013). The United Nations approved the resolution drafted by the Convention on the Rights of Persons with Disabilities at its General Assembly on 13 December 2006, which establishes that ratifying states must undertake or pro-mote research and development of ICTs accessible to persons with disabilities, as well as their availability and use, including specific technical devices created to improve the daily life of this group. In addition to making information more accessible and empower-ing people, in the case of people with functional diversity due to disability, technologies have helped reduce their difficulties. In some cases, their limitations were reduced to the minimum. This interest in equality and equity is reflected in numerous international

initiatives (European Agency for Development in Special Needs Education, Organisation for Economic Cooperation and Development, etc.).

In the educational field, the project "Using ICTs to achieve the Education 2030 goals" of the UNESCO-Weidong Group Fund will, for four years, help the participating Member States to make use of the potential of ICTs to achieve Sustainable Development Goal 4 (ODS4). This Goal is the synthesis of education's ambitions to ensure inclusive, equitable and quality education. In this regard, one of the commitments of the roadmap is the use of ICTs to strengthen education systems for quality education for all students. Educational environments can open up to the world with these new resources and interact with other realities, thus providing a new space for access and production while eliminating barriers preventing all people from approaching education. Therefore, technologies can significantly help as an educational tool for admission and participation in the curriculum, especially for students with special needs (Bagon et al., 2018; Foley & Ferri, 2012). ICTs are used as tools and instruments to improve the teaching–learning process and improve students' basic skills in reading, writing, and arithmetic (Sierra Llorente et al., 2016).

Nowadays, there seems to be a growing interest in the subject generally. Thus, a search with the terms ICT and disability in Google Scholar revealed 139 results between 1988 and 1998, 3150 from 1998 to 2008 and a significant number of results, 15,900, between 2008 and 2018. Not all of these documents are linked to the use of ICT to support the learning of people with disabilities. Still, it is undoubtedly true that this interest has been under investigation for several decades in terms of education. Still, it has become an essential part of supporting students' learning with special needs over the last few years. Thus, a study carried out by Hegarty (2008) reviewing research topics published from 1998 to 2008 in the "European Journal of Special Needs Education", a medium for a wide range of research in special education, concluded that there is almost no research related to ICT and special education. All this, despite the high demands of ICT about educational transformation. In this regard, Istenic and Bagon (2014), in a review of Web of Science (WoS) indexed educational technology journals (1970 to 2011), highlighted the scarcity of ICT-related jobs in support of people with disabilities. More recently, another review study on the impact of ICTs on students with special needs (Sarasola Sánchez-Serrano et al., 2020) highlights the scarce development of high-impact scientific production internationally in this field of knowledge. Likewise, it is concluded that the results obtained show that most of the research that has been carried out is focused on empirical studies. This indicates that the potential of ICT-supported learning for the inclusion process has not been sufficiently explored.

To overcome this lack of research, initiatives have been developed in the European context to promote such research. In 2010, the project's initial results, "European Research Agenda for Disability Equality", were published, which encourages the participation of civil society organizations in research with academic institutions, where technology plays a significant role in supporting people with disabilities (Priestley et al., 2010).

Currently, the main lines of research within the field of ICT and disability show the existence of three prominent trends (Sarasola Sánchez-Serrano et al., 2020): (1) the interaction of educational technology with the use of programmes and computers, (2)

the relationship of technology with students with special needs, their educational needs and the learning environment, (3) the correspondence established between students with special needs, their participation and the teacher's involvement.

The teacher and their digital competence are a crucial element, as the response to the educational needs of these students will be determined, among other variables, by the design and the extent of training and knowledge of these technological resources (Shin, 2015; Wong, 2015).

In this regard, the professional development of teachers in the use of ICT and educational inclusion is an emerging field of action, as can be seen in studies that report on the development of competencies, both in initial training (Istenic, 2010; Pegalajar, 2017) and in lifelong learning (Roig et al., 2015; Valtonen et al., 2018), to design learning environments that respond to individual needs.

Previous research concluded that teachers feel competent in using ICTs as tools for personal use and/or as resources for transmitting and promoting information and knowledge (Prendes & Gutiérrez, 2013; Prentzas, 2016). However, this does not guarantee meaningful learning (Hatlevik, 2017; Lewthwaite & Nind, 2016; Uluyol & Şahin, 2016). Teachers also reveal a lack of systematized knowledge, not only about the programs and resources that can be used; instead on how to integrate technologies successfully within the classroom (Fernández Batanero et al., 2020; Tondeur et al., 2018; Wong, 2015). This means that there is a discrepancy between the technical abilities of ICT and the knowledge of sound pedagogical practices. This might be due to two main factors: firstly, the training provided is insufficient, and it does not affect the development of teaching practices (Hu & Yelland, 2017; Yusop, 2015). And secondly, the training model, most commonly used in the Spanish context, focuses on more instrumental than pedagogical (Tello & Cascales, 2015).

Teachers, especially in Primary Education, are poorly qualified in using technology and without training according to the classroom demands (Méndez Garrido & Delgado García, 2016). The differences with the teachers of higher educational stages may be due to insufficient resources (Méndez Garrido & Delgado García, 2016) in these centres. In this way, the digital training of teachers is one of the challenges of Primary Education centres.

Despite the concept of Technological Pedagogical Content Knowledge (TPACK), Koehler and Mishra (2009) suggested that teacher education should focus on using technology and examine how technology intersects with pedagogical and content knowledge. If the level of ICT teacher training is limited and ineffective, the studies regarding ICT training as a resource to support people with disabilities are insufficient. Teachers show even lower activity, regardless of the type of disability referred to hearing, visual, cognitive, motor, etc. (Kersten et al., 2018). Several variables have been identified within the framework of the lack of training for incorporating ICT in the classroom. These variables have been shown influential on teachers' training and use of ICT, such as gender, age, teaching experience, qualifications, technological mastery, teachers' attitude, financial support, beliefs about the meaning and significance of technologies in education (Uluyol & Şahin, 2016), as well as lack of time (Silva & Austillo, 2012).

Another factor has been the gender of teachers, where women perceive more obstacles than men to use technologies (Fernández de la Iglesia et al., 2016; Lane & Lyle, 2011),

as well as less digital training (Cabero & Martín, 2014). Another factor is age, because as Tanure et al. (2017) argues, younger teachers have superior knowledge. Studies such as Alqurashi et al. (2017) have shown that recent university graduates feel more confident when incorporating technology. This means that older teachers have a lower level of digital competence. Years of teaching experience are also revealed as a critical factor regarding competencies. In this case, teachers with less teaching experience show a higher level of knowledge for incorporating ICTs to people with disabilities (Fernández & Fernández, 2016).

In the Spanish context, research has been carried out to address the problem of ICT training, and the competencies teachers need (Cabero et al., 2016; Morales & Llorente Cejudo, 2016). Despite this, both studies analyse this training need, focusing their attention on the initial training of teachers, without including active teachers and their corresponding permanent training.

Because of this, it considers it relevant to carry out this study and offer information related to training issues, in which processes of discrimination and social exclusion in the people with disabilities are a matter for special consideration in schools and families. Therefore, it will notice the effectiveness and efficiency factors of ICT pedagogical practices. Thus, it increases communication and strengthens the abilities of people with disabilities, reducing their limitations. Furthermore, the research questions posed in this research were proposed by a group of experts in Special Education and ICT from the public universities of Granada, Jaen and Seville (Spain).

Purpose of the research and questions and hypotheses

This study aims to provide a general and comprehensive overview of the education and training of Spanish Primary Education teachers about the use of ICTs to support students with special needs and possible obstacles or barriers to their movement. The research problems it was considering are the following:

Q1 Are teachers enough prepared to use ICTs as a resource to support learning in students with special needs?

From this problem, a set of questions and hypotheses are identified below. It formulates the null hypotheses since, through the literature review, it is the ones that it intends to reject in principle.

Q1.1 Is there a relationship between the technical and didactic training that teachers indicate they have regarding audiovisual, computer and Internet technologies and the degree of training/knowledge the teachers have for using ICTs in students with special needs?

Null hypothesis1 (H0): There are no significant differences with an alpha risk of misunderstanding of 0.05 or less between the technical and didactic training that teachers indicate they have concerning audiovisual, computer and Internet technologies, and the degree of training/knowledge teachers have for the use of ICTs in students with special needs.

Q1.2 Is the level of training of teachers the same or different depending on the types of disability?

The hypothesis that is formulated for this problem has been:

Null hypothesis2 (H0): There are no significant differences, with an alpha risk of misunderstanding of 0.05 or less between the knowledge teachers have of the technologies applied to the different types of disability.

Q1.3 Is the level of training determined by personal variables such as gender and professional variables such as teaching experience?

Null hypothesis 3 (H0): There are no significant differences, with an alpha risk of error of 0.05 or less depending on the gender of the teachers.

Null hypothesis 4 (H0): There are no significant differences, with an alpha risk of error of 0.05 or less depending on their years of teaching experience.

Q2 What factors are associated with the promotion and development of training experiences on the use of ICTs in students with special needs?

Q3 What barriers or obstacles hinder the training of these teachers?

The research questions posed were proposed through the compilation of various opinions by the group of experts participating in the study and specialists in Special Education and ICT from the public universities of Granada, Jaen and Seville (Spain). Their work focused on providing accurate and unbiased technical information through their experience in technical tasks and ICT-based training and education. The experts simultaneously discussed the strengths and weaknesses of the initial list of proposed research questions, which were classified to make the final selection of those considered suitable to meet the study's objectives.

Method

To respond to the primary purpose of this study, a descriptive research design based on a mixed method (quantitative and qualitative) was chosen. A post-facto descriptive survey was carried out in the quantitative method with a non-probabilistic sample, where information was collected through a questionnaire. The qualitative part is supported from a paradigmatic interpretative perspective and an ontology and epistemology naturalistic (Grounded Theory), proposed by Glaser and Strauss (1967). The information-gathering strategy has been semi-structured interviews with key informants (members of management teams, ICT coordinators, directors and technological advisors of teacher training centres).

Participants

The total number of participants in this study was 1500, including teachers and other education professionals (Table 1). The questionnaire was completed by 777 teachers belonging to primary schools in the 17 regions of Spain, being the majority public schools ($n = 588$, 75.68%), followed by concerted schools (18.15%, $n = 141$) and private schools ($n = 48$, 6.18%). The sampling method used was proportional stratified sampling with a confidence level of 2 sigmas (95.5%) and an a priori estimated error of $\pm 2.35\%$, which meant surveying 1500 people. In the end, 777 valid questionnaires were used, which, when recalculated, gives an error of less than ± 5.

The primary education teachers answer the research questions Q1, Q1.1 and Q1.2 by answering the questionnaire. School directors, heads of studies, ICT coordinators, etc., answer the research questions Q2 and Q3 by interview.

Table 1 Distribution of teaching staff and other professionals by region and type of data collection instrument

Autonomous Community	Teachers/Questionnaire	Other professionals/ interviews
Andalusia	51	48
Aragon	42	39
Asturias	40	39
Cantabria	43	39
Castilla La Mancha	45	42
Castilla y Leon	46	45
Catalonia	51	51
Ceuta	15	15
Extremadura	44	39
Galicia	42	39
Balearic Islands	36	36
Canary Islands	37	36
La Rioja	38	36
Madrid	56	45
Melilla	18	18
Murcia	46	33
Navarra	39	39
Basque Country	42	42
Valencia	46	42
Total	777	723

The group of men was made up of 27.80% ($n = 216$), while the group of women was made up of 72.20% ($n = 561$). Regarding age, 25.48% (n = 198) were under 30 years of age, 37.84% ($n = 294$) were between 31 and 40 years of age, 30.89% ($n = 240$) were between 41 and 55 years of age and 5.79% ($n = 45$) were over 55 years of age. Among teachers were 35.14% ($n = 275$) between 1 and 5 years of teaching experience, followed by 18.15% ($n = 141$) between 16 and 25 years. In terms of employment category, (43.24%, $n = 336$) were permanent career civil servants, 19.31% ($n = 150$) were permanent and temporary teachers and substitute teachers (2.70%, $n = 33$).

Interviews were conducted with 723 professionals from the Spanish education system (members of management teams, ICT coordinators, principals and technical advisors of Teacher Training Schools). The distribution was the following: 47% to principals of schools ($n = 339$), 25% to heads of studies ($n = 183$), 12% to ICT coordinators ($n = 87$), 6% to principals of teacher training schools ($n = 45$), and 10% to technological advisors of teacher training schools ($n = 69$). Forty-four per cent ($n = 216$) of the key informants were men, and 56 per cent ($n = 561$) were women.

Sources of data collection

Questionnaire

The questionnaire was considered to be the most suitable to be answered by teachers who make up the sample study. To respond to the formulated objectives, it was supposed to design an "ad hoc" instrument called "DIFOTICyD" (Diagnostic and Teacher Training

for the Integration of ICTs Applied to Students with Functional Diversity) ("Appendix"). When the first draft of the questionnaire was constructed from a theoretical perspective, it was examined by a group of 36 judges, selected through a double selection process, first selecting people who met one or more of the following criteria:

- Have professional experience in special education, in the use of ICT for people with disabilities;
- They are teachers of ICT applied to education or special education;
- They are from different universities or work in an institution related to special education.

This led to an initial group of 52 expert evaluators who were willing to participate in constructing the instrument, an important aspect being that the process would have two shifts. Next, the coefficient of experts was obtained, also known as the "K coefficient" (Cabero & Barroso, 2013). Thus, the number of experts was reduced to 36.

Judges assessed the relevance and quality of each element, which meant modifying and deleting some items so that the questionnaire would be both valid and reliable, resulting in a second draft of the questionnaire.

This draft was implemented practically to a pilot group constituted by 36 primary education teachers, obtaining a high internal consistency (Cronbach's alpha), both generally ($\alpha = 0.993$) and for each of the dimensions that composed it. Subsequently, to analyse the dimensionality of the instrument, an exploratory factorial analysis was carried out, employing the method of extraction of analysis of principal components and a Varimax rotation with Kaiser normalization (Pardo Merino, 2002), confirming the grouping of the items in the six factors that had been initially foreseen. Thus, a third and definitive questionnaire was obtained consisting of 53 items distributed in 6 dimensions: general perception of the use of ICT with persons with disabilities (10 items); ICT for persons with visual disabilities (12 items); ICT for persons with hearing disabilities (9 items); ICT for persons with motor disabilities (7 items); and ICT for persons with cognitive disabilities (8 items), and accessibility (7 items). The questionnaire was structured on a Likert scale with ten response options (from 0 = Nothing developed to 10 = Very developed) in overall perception and six response options in the remaining six dimensions (from Strongly Agree to Strongly Disagree). Finally, once all the questionnaires had been validly completed (777), Cronbach's alpha was again carried out, and a very high coefficient was also obtained ($\alpha = 0.897$).

Varimax rotation, a method of orthogonal rotations, was used, since we assume that there is no relationship between the factors as they target people with different educational needs.

Interviews

The interviews, to key informants (members of management teams, ICT coordinators, directors and technological advisors of teacher training centres), were semi-structured, with the initial script being organized around five dimensions: teacher awareness and preparation; development of training experiences; promotion of training; barriers to the development of training plans; and priority in training (Table 2).

Table 2 Category system

Awareness and teacher qualification:	Conscientious and qualified
Awareness: perception of the importance of training activities	Conscientious, unqualified
Qualification: Level of teacher training	Neither conscientious nor qualified
Development of training experiences: training programmes elaborated and carried out in primary schools	Development or not of formative experiences in Primary Education schools
Promotion of training: encouraging the development of an action or increasing its positive impact	Promotion or not of training programs (courses, working groups, projects or work-plans, meetings, seminars)
Priority in training	To know specific technological materials To know different software To know how to apply didactic strategies and curricular adaptations To locate websites with educational resources To be able to adapt computer equipment To know institutions related to the accessibility of websites
Barriers to the development of training plans: obstacle that prevents or impedes the implementation of training activities	Teacher Attitude
	Quality of teaching training
	Geographic Range
	Economy
	Scarce formative offering
	Shortage of students with special needs
	Lack of time

For validation, it was decided to apply the expert judgment strategy, using the Delphi method (Linstone & Turoff, 1975), which was carried out through a document annexed to the interview, including a set of open questions delivered to the experts. The participants in the expert trial were the 36 judges initially selected.

The Delphi technique used was the so-called modified Delphi, in which two rounds were used (Cabero, 2014), one of the main reasons being to maintain the interest of the participants in an easier way. The execution of the Delphi method was carried out using an electronic version created "ad hoc" for the work. In this version, the questions were articulated around the dimensions of the questionnaire and participants were asked to rate them on a rating scale of 1 to 5, where 1 was not important at all, and 5 was very important. They were also asked for their opinions on several aspects: questions that they would eliminate or include or suggest eliminating or adding more.

Finally, it should be mentioned that the elaboration of the categories and the decision to take the interviewees' answers as either correct or incorrect have been conditioned by criteria of consistency and reliability. That is, the analysis carried out, both for the process of building the category system (inter-coders matching) and for the time when the coders (6 researchers) have made use of the category system (reliability), has produced an excellent kappa coefficient above 0.75 (Fleiss, 1981). In the present study, the results are presented in 4 dimensions.

Procedure

The administration of the "DIFOTICyD" questionnaire to teachers was carried out online using the Google Forms Platform, whose link can be found at: https://docs.google.com/forms/d/e/1FAIpQLSfux6m1cU6Nf-69eiiMS28LjcSom38yqe2OmS-Jy4mXAgJVnA/viewform.

The contact with the schools was made through a telephone call to the principals, together with a letter of invitation to participate in the research. Participation was voluntary.

It was decided to interview key informants, also, due to the interest in understanding their perception, as management and training professionals in education, about teacher training in ICT and disability and the possible indicators that determine this training. Knowing the opinion of these professionals is essential because it is possible to detect the real needs of teachers since the supply of training depends on the demand made by teachers. The interviews were carried out by members of the working team from the research team by telephone, with an average duration of 20 min. The selection procedure was carried out randomly, based on the invitation made in the first telephone contact with the schools.

Analysis of data

Analysis of the questionnaire data was performed using the statistical software SPSS version 23.0 for Windows and included: (a) descriptive statistics (mean scores and standard deviations) for the distribution of total scores on the instrument; (b) Pearson correlation coefficient to determine the existence of a relationship between variables; (c) the Levene test, to analyse the equality of variances (homoscedasticity); (d) Student's ANOVA and t tests for independent samples to verify the existence of significant differences between mean test scores according to sex, years of teaching experience.

The interviews were transcribed as a whole, even though authors such as Gibbs (2012) do not believe it necessary. Their words have been taken into account in this task: "*The question is not whether the transcript is accurate in the last level, but rather whether it represents a good and careful attempt to capture some aspects of the interview*" (p. 32). In the analysis process, the researchers have tried not to lose or degrade the essence of the participants' stories. However, the transcription of interview data has forced researchers to reflect on the ethical responsibility of their work. This responsibility involves avoiding harm to the people who participate in the research, ensuring their integrity, autonomy and dignity, following three principles: informed consent, confidentiality and respect for anonymity (Abad Miguélez, 2016).

After transcribing the interviews, data reduction and coding were carried out with the help of the Nvivo 12 program, from a system of categories derived from the dimensions of the script of the interviews and from the analysis process itself.

Results

Questionnaire

The results will be presented according to the research questions posed:

Are teachers sufficiently prepared to use ICT as a resource to support the learning of students with special needs?

$M = 3.70$; SD $= 1.15$); Visual ($M = 3.02$; SD $= 1.42$); Hearing ($M = 3.20$; SD $= 1.48$); Motor ($M = 3.29$; SD $= 1.54$); Cognitive ($M = 3.45$; SD $= 1.54$); Accessibility ($M = 2.85$; SD $= 1.44$); and Total ($M = 3.26$; SD $= 1.28$). It can be observed that the mean score reached in the overall instrument was 3.26, with a standard deviation of SD $= 1.28$. A score indicates that the surveyed teachers were regularly qualified in ICT and functional diversity. Concerning the mean squares, with a higher level of training, in terms of a "general" perspective (3.70) and used with students with cognitive (3.45), motor (3.29) and hearing (3.02) limitations, by contrast, the lowest scores were obtained in knowledge, which indicated having for accessibility (2.85) and in the use of technologies for people with "visual" limitations (3.02).

Is there a relationship between the technical and didactic training that teachers indicate they have in audiovisual, computer and Internet technologies and the degree of training/knowledge that teachers have in using ICT for students with special needs?

When asked if the teachers scored from 0 to 10 regarding the knowledge they believed they had regarding the technical and educational handling of audiovisual, computer and Internet media, the results indicate that teachers show that they have some knowledge regarding the use of ICTs, although their use is greater on the Internet ($M = 7.05$; SD $= 1.90$) than in audiovisual and computer resources ($M = 6.44$; SD $= 1.87$) and higher in technical management ($M = 6.58$; SD $= 1.92$) than in educational management. The level of training/knowledge indicated for the use of ICTs and students with special needs and the perception.

Regarding the existence of a relationship between the level of training/knowledge indicated for the use of ICTs and students with special needs, and the teachers' perception with the qualification in technical management and educational use of audiovisual and computer technologies and Internet, the Pearson correlation coefficient was applied (Table 3).

Pearson's correlation coefficient was used since it is a statistical index that measures the linear relationship between two quantitative variables, independent of their measurement scale. The results point in three directions: first, that there are mainly significant relationships between the technical and educational domain of audiovisual media, computers and the Internet, and the domain that teachers indicate about the educational use of ICTs and students with special needs, both in general and for their different types; second, that the correlations are positive and, consequently, it can be indicated that one variable increases the other in the same direction; and, third, and according to Mateo (2004), that such correlations are very low.

Is the level of teacher training the same or different according to the types of disability?

Regarding the existence of significant relations between the knowledge indicated by the teachers, in the different dimensions, regarding which respect to those which the teachers were asked about questionnaire (general, visual, hearing, etc.), the Pearson Correlation Coefficient was applied again. The results indicate that all the relationships are positive, significant at the level of $p \leq .001$ and high. Therefore, the teachers, who stated that they were qualified in one of the dimensions, were also trained in the others.

Table 3 Correlations between the technical and educational domain of the audiovisual, computer and Internet media, and the domain for the educational use of ICTs with students with special needs

	D.T.AV-Inf	D.E.AV-Inf	D.T.Int	D.E.Int
General				
C.C.Pearson	.106**	.149**	.192**	.209**
Sig.(bilateral)	0.003	0.000	0.000	0.000
Visual				
C.C.Pearson	0.036	.080*	.099**	.111**
Sig.(bilateral)	0.314	0.026	0.006	0.002
Hearing				
C.C.Pearson	.090*	.130**	.140**	.156**
Sig.(bilateral)	0.012	0.000	0.000	0.000
Motor				
C.C.Pearson	.072*	.088*	.111**	.101**
Sig.(bilateral)	0.044	0.015	0.002	0.005
Cognitive				
C.C.Pearson	.084*	.097**	.140**	.152**
Sig.(bilateral)	0.019	0.007	0.000	0.000
Accessibility				
C.C.Pearson	0.053	.088*	.134**	.123**
Sig.(bilateral)	0.144	0.014	0.000	0.001
Total				
C.C.Pearson	.079*	.115**	.148**	.156**
Sig.(bilateral)	0.027	0.001	0.000	0.000

* $p \leq ,.05$; ** $p \leq ,.01$)

Table 4 Student *t*-value between the different dimensions of the questionnaire

Dimensions	*t*
General-visual	19,529**
General-hearing	14,617**
General-motor	10,846**
General-cognitive	6855**
General-accessibility	21,973**
Visual-hearing	− 5766**
Visual-motor	− 8164**
Visual-cognitive	− 11,349**
Visual-accessibility	5028**
Hearing-motor	− 3170**
Hearing-cognitive	− 7952**
Hearing-accessibility	9683**
Motor-cognitive	− 5093**
Motor-accessibility	12,375**
Cognitive-accessibility	15,380**

** $p \leq 0.01$

The following hypotheses were formulated to know the possible relationships between training in the different dimensions included in the questionnaire.

Null hypothesis (H0): There are no significant differences with an alpha risk of making a mistake of 0.05 or less between the contrasting dimensions.

Alternative hypotheses (H1): If there are significant differences…

For this purpose, the student statistic t was applied. The values reached for 776 degrees of freedom are presented in Table 4.

Consequently, it can be concluded that statistically significant differences have been found as an alpha risk of error of $p \leq .001$, concerning the knowledge shown by teachers, about the different types of knowledge of ICT application for subjects with different types of functional diversity due to disability.

Is the level of training determined by personal variables such as gender and professional variables such as teaching experience?

To analyse whether the differences found were significant from a statistical point of view, Student's t for independent samples was applied. However, the Levene test was initially carried out to analyse the equality of the variances (homoscedasticity) and, depending on the value of significance obtained, determine the t-value and the t-value to be adopted. The results obtained can reject the H0 referred to the non-existence of statistically significant differences to $p \leq .05$ or less in the following dimensions: general knowledge, application of ICT for people with motor limitations and accessibility. On the other hand, significant differences were found in the visual, auditory and cognitive dimensions. It should be noted that H0 was also rejected in the scores found for the instrument as a whole. They showed in all cases the women with greater knowledge than men for the application of ICT for people with functional diversity due to disability.

An ANOVA was again carried out to analyse the existence of possible differences according to years of teaching experience (Table 5).

The results indicate significant differences, depending on the years of teaching experience. Re-applying the "post hoc" test of multiple comparisons, for all responses, the results indicated that the most significant differences occur among teachers, who have fewer years of teaching experience, compared to teachers who have more, showing the first greater type of knowledge, for the incorporation of ICTs with students with special needs.

Interviews

What are key informants' perceptions of teachers' preparedness to use ICT as a resource to support the learning of students with special needs?

The interviewees with key informants show the need for more specific primary education teacher training on students with special needs and ICT in general. According to the number and percentage of textual references (45.9%; $N = 334$), the interviewees acknowledge that, for several reasons, teachers of primary education in Spain are not prepared to work using ICTs to support learning in students with special needs, while a lower percentage (25.82%; $N = 186$) assure that teachers are conscientious and qualified.

After categorizing and analysing all the categories, it was found that school improvement with ICT was the axis around which all other types were articulated. In addition to the classes defined, the context of the schools emerged as a mediating factor for the rest categories. As can be seen in the following diagram (Fig. 1), to improve school improvement using ICT, it is necessary to raise awareness and train teachers, develop and promote training experiences and the educational context and address the barriers that impede its implementation development.

Table 5 ANOVA based on years' teaching experience

| Source	Sums of squares	df	Mean square	F	Sig
General					
Among groups	42.200	4	10.550	8.350	.000**
Within groups	975.416	772	1.263		
Total	1017.616	776			
Visual					
Among groups	58.564	4	14.641	7.491	.000**
Within groups	1508.887	772	1.955		
Total	1567.452	776			
Hearing					
Among groups	126.760	4	31.690	15.450	.000**
Within groups	1583.506	772	2.051		
Total	1710.266	776			
Motor					
Among groups	111.808	4	27.952	12.410	.000**
Within groups	1738.894	772	2.252		
Total	1850.702	776			
Cognitive					
Among groups	107.671	4	26.918	12.048	.000**
Within groups	1724.761	772	2.234		
Total	1832.432	776			
Accessibility					
Among groups	18.116	4	4.529	2.183	.000**
Within groups	1601.545	772	2.075		
Total	1619.661	776			
Among groups	68.063	4	17.016	10.926	.000**
Within groups	1202.299	772	1.557		
Total	1270.362	776			

**$p \leq ,.01$)

The reasons that reinforce the low level of awareness and qualification, in the opinion of the key informants, are related to aspects such as the age of the teaching staff; the quick updating of technological tools; lack of interest from the teaching staff; outdated means and resources and the consideration of this topic as belonging to the specialist teaching staff (therapeutic pedagogy or hearing and language). Aspects that are shown in comments such as:

"Not really. We don't have specific training, because the career doesn't give us that training. Then, each one is formed on his initiative, but truly at the pace of advancing technologies and with the age that we have the majority we need more training" (E.523).

"Older teachers have found it very difficult to adapt to new technologies" (E.417).

This is because older primary school teachers find it more difficult to continuously adapt to the operation of new technologies (Morsink et al., 2010). Many of the teaching staff have a positive perception of using ICTs with disabled students, pointing out that it generates great motivation. However, teachers acknowledge that they have not received sufficient training to change how they teach and learn, adapting to ICTs. Also, there is a general idea of attributing pedagogical innovation to the specialist teaching staff due to

Fig. 1 Diagram of categories
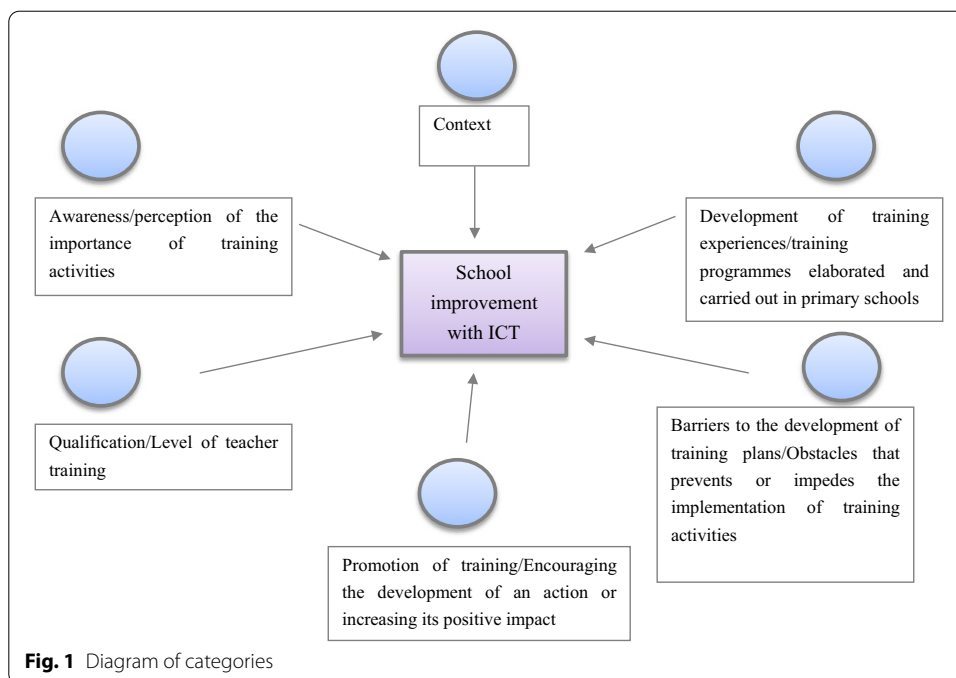
the lack of time and high demands of the generalist classroom teaching staff. In this way, teachers not only require the training and skills to use digital tools but also an appropriate attitude is necessary to be able to apply ICT (Spiteri & Rundgren, 2020).

What factors are associated with the promotion and development of training experiences on ICT use for students with special needs?

"I believe that educational measures are generally implemented to work with ICT taking into account the diversity of the classroom, but not specifically given to a group of students" (E.046).

It is also pertinent to determine whether schools facilitate training experiences and promote this training. Numerous interviewees show that educational schools and teacher training institutions encourage and try to offer ICT training activities for Primary Education teachers:

"From the teachers' institute, they promote these initiatives and help us a little, but here in Aragon, the teachers' institutes used to perform a complete task. Although there is currently a wide offer, we can say it has decreased a little. From the management of the school, we are very aware of what teacher training is" (E. 409).

However, teachers also recognize that teaching is relegated to the volunteerism of each teacher because it is undertaken outside school timetables. Regarding the issue of training programmes, there is a trend towards courses. Particularly the courses that address ICTs generically; minority courses include ICTs to support students with special needs. Likewise, meetings are also highlighted at which teachers are informed of all the activities published in which information is disseminated, or knowledge is shared related to the theme.

"We mainly promote and carry out training courses; even so, we also usually organize some workshops on ICT knowledge for children with needs" (E.622).

What barriers or obstacles hinder the training of these teachers?

2019). In this respect, manifestations such as:

"Some barriers such as the availability of teachers or the time available. Often teachers do want to, but they don't have enough time, particularly in primary schools" (E.013).

Many Autonomous Communities share the economic barriers and lack of time except Galicia and the Balearic Islands, who consider that the main obstacle is the "attitude of the teaching staff".

"The main barrier is teacher awareness. Teachers are often aware of the problem they have, but they are also selfish when requiring training initiatives" (E.225).

Discussion and conclusions

The study was initiated with three main research questions on primary education teachers' level of knowledge about ICT and disability (Q1), factors linked to the promotion and development of training experiences (Q2) and barriers or obstacles to teachers training in primary education (Q3).

Regarding these teachers' level of knowledge about ICT and disabilities (Q1), it should be noted from the analysis of the results that the teachers do not feel sufficiently qualified. These findings are consistent with other studies (Hatlevik, 2017; Hollier, 2017; Tondeur et al., 2018; Uluyol & Şahin, 2016). This insecurity could be related to teachers' lack of preparation and knowledge about the integration of ICT in the classroom, especially in primary education (Tandika & Ndijuye, 2019).

In this regard, and to advance the achievement of Sustainable Development Goal 4 (ODS4) in the 2030 Agenda, the need to adopt urgent measures to ensure that these professionals are trained to incorporate ICT in their daily practice with students with special needs is highlighted. Both initial and continuous training is required. This includes knowledge of materials, software and websites, promoting the application of strategies and adaptations. This training must consider the accessibility of institutions to facilitate the creation of learning environments suited to the schools' reality, the teachers' demands and mainly to the students' individual needs.

In terms of technical and didactic training, regarding audio visual, computer and Internet technologies and the level of training/knowledge in ICT and disability (Q1.1), it is concluded that technical knowledge and didactic use are insufficient. The limitations in knowledge are similar in all diversity categories. As a result, it is necessary to establish teacher training programmes where knowledge, the use and the development of ICT resources are included as a priority. These programmes are designed to work with students with special needs in the classroom, both initial and permanent training. Since primary education teachers showed very little training regarding the application of ICT for people with disabilities, it would be necessary to solve this situation by adopting teacher training measures, giving the teacher the possibility of acquiring skills and competencies so that they can incorporate these tools in the classrooms (Toledo Morales & Llorente Cejudo, 2016).

The level of primary education teachers training is the same or different depending on the disability categories (RQ1.2). The low level of training shown is most evident in the specific use of technologies in the student's learning-oriented processes

with visual disabilities, followed by hearing, motor and cognitive disabilities and accessibility.

Teachers differ in their competence levels according to gender. Female teachers are perceived with more knowledge than male teachers (RQ1.3). This aspect is not shared by other studies such as Cabero and Martín (2014), where this difference favours male primary education teachers. Years of experience impact the level of ICT knowledge and disability. However, teachers with less experience indicate that they have more knowledge. Previous research has confirmed these findings (Alqurashi et al., 2017). This could be explained by the fewer experienced teachers being closer to completing their studies. These teachers have recently acquired more training in ICT and disability.

Among the factors associated with the promotion and development of training experiences on ICTs in students with special needs (RQ2). It is concluded that the lack of training plans conditions the promotion and development of experiences. The inadequate training is promoted in two ways. On the one hand, it is mainly towards the realization of courses. On the other hand, it is promoted through formal information meetings. Insufficient training does not lead to changes in the development of teaching activity in primary education schools, as shown in previous studies (Hu & Yelland, 2017; Yusop, 2015).

Finally, regarding the possible obstacles that hinder the training of these teachers (RQ3) to say that they are determined by economic factors, time and attitude of the teaching staff. These data align with those obtained by Silva and Austillo (2012). Improving the infrastructure of primary schools (provision of ICT facilities and resources and more classrooms) and increasing training courses could encourage primary school teachers to use digital resources more frequently (Tandika & Ndijuye, 2019).

In short, the use of ICT in the school environment contributes significantly to the performance of students and teachers. However, if its introduction is not for didactic purposes or is not subject to good teacher planning, its effect on students can be damaging, especially for students with special needs.

Limitations

Although highly important, the results are likely to be applicable both locally and in the medium term; however, it shows the need for fast and continuous adaptation to the ever-changing scenario of technologies. There are three limitations in this study: (a) it is an exploratory study, and to confirm the results, research should be carried out with samples stratified by provinces and regions, (b) the instrument used to collect information from primary education teachers is the self-perception shown by the teachers, and its confirmation would require the use of another type of information collecting instruments such as observation and in-depth interviews. Similarly, the interviews carried out with school directors and heads of studies would have to complement other instruments and techniques for collecting information. And c) the selection of the sample is particularly relevant for the validity of the results of the factor analysis. However, despite the undoubted importance of size, a limitation of this study may be the small sample size.

It is proposed as further research: to take up a new article with a larger sample for the validation of the questionnaire and to carry out studies of good practice in incorporating

ICTs for people with disabilities, studying in-depth specific problems teachers face to integrate ICTs for people with disabilities.

The practical applications of this study are immediate. On the one hand, to give a clear message to those responsible for training, the need to draw up urgent action plans to strengthen digital teaching skills about student diversity based on valid and reliable competence frameworks. And on the other hand, the educational administration promotes, encourages and develops initial and permanent training plans about ICT and its didactic component in contexts of diversity. The study has shown teachers' lack of specialized training concerning students with special needs. If quality and inclusive education system are to be achieved, trained and motivated teachers will be needed.

Appendix

"Diagnostic and training of teachers for the use of the ICT with students with disabilities" (DIFOTICyD)
The present questionnaire is part of R&D research project financed within the State Plan for the Development of Scientific and Technical Research of Excellence 2013–2016 (DIFOTICYD EDU2016 75232-P). The plan's objective was to gather information on the level of training and technological knowledge that the Primary Education teachers possess with respect to the use of the ICT with people with different types of disabilities. Therefore, a questionnaire was constructed for obtaining this information. The questionnaire will be used to collect information on the general aspects as referring to the use of the ICT with people with different types of specific disabilities. The dimensions from which the questionnaire will collect information are:
General (G)
Visual (V)
Hearing (H)
Motor (M)
Cognitive (C)
Accessibility (ACC)
We ask you to answer the questions with sincerity, as the answers will be used to establish teacher's training and improvement plans

PERSONAL DATA

a) Autonomous community where your centre is located at.

b) Gender: Male ( ) Female ( )

c) Age
( ) younger than 30
( ) between 31 and 40
( ) between 41 and 55
( ) older than 55

d) Years of teaching experience:
( ) 1 to 5
( ) 5 to 10
( ) 10 to 15
( ) from 15 to 25
( ) more than 25

e) Employment status
( ) Civil servant
( ) Civil servant, probationer
( ) Interim
( ) Substitute
( ) Permanent contract
( ) Temporary contract
( ) Other: _____

f) Academic degree
( ) 4-year degree in Primary Education
( ) 4-year degree in Early Childhood Education
( ) 3-year degree in General Basic Education Teaching
( ) Others

g) Specialization
( ) Physical Education
( ) Special Education
( ) English Language
( ) Music Education.
( ) Other

h) Type of work place
( ) Public.
( ) Public/Private
( ) Private.

i) Educational level taught: _____

In a general manner, from 0 (nothing) to 10 (a lot)

j) How do you rate your training on the technical handling of the computer and audiovisual technologies?_____
k) How do you rate your training for the educational use of computer and audiovisual technologies: _____
l) How do you rate your training on the technical handling of the Internet? _____
m) How do you rate your training on the educational use of the Internet? _____
n) Throughout your years of experience as a teacher, have you received information on subjects referring to the use of the Information and Communication Technologies used with people with disabilities?
( ) Yes   ( ) No
o) In Yes, could you indicate the name of the organization or institution that provided it? _____
p) Throughout your years of experience as a teacher, have you received information on the universal design and accessibility for the educational use of the ICT?
( ) Yes   ( ) No
q) In Yes, could you indicate the name of the organization or institution that provided it? _____
r) From 4 (not agreed at all) to 10 (completely agree), score your degree of agreement with the following phrase: "I believe the ICT are a resource for the support of people with disabilities": _____

Next, we will ask you to evaluate the significance of the following questions found below, based on your agreement with them:

VP = Very positive/Very much in agreement/Very relevant.

P = Positive/In agreement/Relevant.

N+ = Normal positive /Moderately in agreement/Normal relevant.

N- = Normal negative/Moderately in disagreement/Moderately inappropriate.

N = Negative/In disagreement/Inappropriate.

VN = Very negative/Very much in disagreement /Very inappropriate.

	VP	P	N+	N-	N	VN
1. I have general knowledge on the possibilities that the ICT offer to people with disabilities. (G)						
2. I know the difficulties created by the different types of disabilities for the use of the ICT. (G)						
3. I would be able to select specific ICT as a function of the physical, sensory and cognitive characteristics of the different individuals. (G)						
4. I know about the different resources and documents that are exclusively dedicated to the analysis the possibilities of the ICT for individuals who have different types of disabilities (G)						
5. I know educational experiences on the use of the ICT with people who have different types of disabilities (G)						
6. I know about applications for mobile phones that can be used with individuals who have special education needs. (G)						
7. I know the main limitations that can condition the use of the ICT by part of the student body with disabilities (G)						
8. I consider myself competent enough for localizing educational materials on the web for people with specific educational needs. (G)						
9. In general, I feel prepared to help students with certain disabilities, on the use of technical supports and the use of the ICT. (G)						
10. I know how to design activities with generalized educational software for student with special education needs (G)						
11. I know how to explain the possibilities offered by a Braille typewriter system (V)						
12. I know the possibilities that Kurzweil reading machines offer to visually impaired students. (V)						
13. I know the possibilities offered by the electronic magnifiers for students with visual impairment. (V)						
14. I recognize the different computer software that are specifically designed for people with visual impairment. (V)						
15. I know the different screen magnifying programs for easing the access of students with visual impairment. (V)						
16. I know different screen reading software such as JAWS, Tiflowin, etc. (V)						
17. I know how to make didactic materials in a word processor, eliminating aspects that make difficult its use by people with visual impairment. (V)						
18. I can number different tiflotechnological materials that allow access of visually impaired individuals to calculations. (V)						
19. I know specific browsers for individuals with visual impairment. (V)						
20. I know different websites where different educational resources for people with visual impairment can be found. (V)						
21. I am able to apply didactic strategies and curricular adaptations supported by the ICT to facilitate the inclusion of students with visual impairment. (V)						
22. I know the possibilities that the ICT offer to students with visual limitations. (V)						
23. I am able to use sign language. (H)						
24. I am able to express messages using sign language (H)						
25. I am able to identify different computer resources for amplifying voice and speech. (H)						
26. I know different educational software programs that stimulate language and the acquisition and development of oral and written linguistic abilities. (H)						
27. I am able to identify different websites where different educational resources can be located for people with hearing impairment. (H)						
28. I am able to use didactic strategies based on the ICT to facilitate the inclusion of the student body with a hearing impairment. (H)						
29. I am able to use didactic strategies based on the ICT to facilitate the inclusion of students with a hearing impairment (H)						
30. In general terms, I know the possibilities that the ICT offer students with hearing impairment. (H)						
31. I know different programs for speech re-training. (H)						

	VP	P	N+	N-	N	VN
32. I know different types of keyboards for individuals with different types of mobility limitations. (M)						
33. I know the use of switches, commutators and pointers. (M)						
34. I know computer programs that control the computer with a voice. (M)						
35. I know the fundamental of alternative systems of augmentative software to facilitate the communication with individuals who have a motor disability. (M)						
I can find websites that have educational resources for people with a motor disability. (M)						
37. I am able to apply didactic strategies supported by the ICT to facilitate the inclusion of the student body with motor limitations. (M)						
38. I know the possibilities that the ICT offer to students with motor disabilities. (M)						
39. I can cite some educational programs used for rehabilitation of cognitive abilities. (C)						
40. I am able to cite different websites where I can find educational resources for people with cognitive disabilities. (C)						
41. I know how to use specific software to create materials for a concept keyboard (C)						
42. I am able to apply didactic strategies supported by the ICT to facilitate the inclusion of students with cognitive disabilities. (C)						
43. I am able make adaptations to the curriculum supported by the ICT for subjects with cognitive disabilities. (C)						
44. I am able to describe the main limitations that multimedia materials can have for their use with people with cognitive disabilities. (C)						
45. I can locate websites that contain educational resources for people with cognitive disabilities. (C)						
46. I know the possibilities that the ICT offer to students with cognitive disabilities. (C)						
47. I know the possibilities that operating systems and browsers offer for modifying specific performance levels of the program (speed, size of the font, type of pointer,…), and make the program more accessible to people with different types of disabilities. (ACC)						
48. I know that the accessibility test are for websites. (ACC)						
49. I know the general guidelines of WAI/W3C that serve to make accessible websites. (ACC)						
50. I am able to create websites with high parameters of accessibility. (ACC)						
51. I am able to adapt a computer system to the educational needs of any person with disability. (ACC)						
52. I know different institutions that are related to the study and research on the accessibility of websites. (ACC)						
53. I am able to cite different accessibility tests. (ACC)						

Availability of data and materials
All data are available.

Declarations

Competing interests
The authors declare that they have no competing interests.

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