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University teaching skills in ICT and disability. The case of the Autonomous Community of Madrid

Pedro Román-Graván[1] · José Fernández-Cerero[1] · Marta Montenegro-Rueda[1] · Miguel María Reyes-Rebollo[1]

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Abstract

Teachers must be prepared to serve all learners, regardless of their abilities or needs in this information and communication society. This implies developing the necessary competences to provide inclusive education to all students. The purpose of this study was to investigate the opinion of university teachers in the Autonomous Community of Madrid on their training in the use of technologies to support students with disabilities. To carry out this research, a descriptive approach combining both quantitative and qualitative methods was used. The final sample consisted of 106 university teachers (information collected through questionnaires) and 8 professionals from ICT Production Resource Centres and Services for People with Disabilities in the respective universities (information collected through interviews). Two data collection instruments were used: an ad-hoc questionnaire as a data collection instrument, and a semi-structured interview. The results of the study showed that university teachers have a low level of competence in the use of information and communication technologies (ICT) to support students with disabilities. The lack of teacher training negatively affects the inclusion process in university education institutions. Higher education institutions need to promote the training of teachers in the use of technologies to cater for diversity.

Keywords Information and communication technology · Disability · Teacher education · Higher education

✉ Marta Montenegro-Rueda
mmontenegro1@us.es

Pedro Román-Graván
proman@us.es

José Fernández-Cerero
jfcerero@us.es

Miguel María Reyes-Rebollo
mmreyes@us.es

[1] Department of Teaching and Educational Organization, University of Sevilla, C/ Pirotecnia s/n, 41013 Seville, Spain

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1 Introduction

Currently, digital technologies have enormous potential to generate significant changes, although we have not yet fully discovered how to take advantage of all their benefits (UNESCO, 2021). Specifically, in the field of education, it presents important opportunities to improve the quality, accessibility and equity of education (European Commission, 2012), but we are still far from achieving an effective integration of these technologies in education.Universities and higher education institutions cannot remain detached from this technological reality; instead, they must formulate, create, and implement educational and training policies and initiatives to avoid standing on the sidelines of technology. Consequently, higher education institutions should actively engage in teaching and learning processes facilitated by technology, ensuring that no one is left behind.

It's important to keep in mind that the quality of an education system is gauged by the quality of its educators (OCDE, 2018). Therefore, the cultivation of various skills, including digital proficiency, is deemed a fundamental element in achieving educational inclusivity. In this vein, various policies developed in recent years across Europe call upon higher education institutions to embrace inclusivity. Several international declarations underscore this point, including those of the European Union (2012), the United Nations (2015), The European Union Strategy 2020 (European Commission, 2010), and the 2030 Agenda, particularly Sustainable Development Goal (SDG) 4 on education (European Union, 2012). In light of this, the significance of inclusion and equity serves as the bedrock for delivering quality education and fostering learning opportunities for all students, including those with disabilities.In this context, this study stands out for its innovative approach focused on assessing the level of training in the use of Information and Communication Technologies (ICT) among university faculty, especially in relation to support for students with disabilities. Its relevance lies in the contribution it will make to shed light on the current situation of training in assistive technologies in higher education, specifically about the inclusion of students with disabilities. In addition, this study will raise the urgent need to implement concrete and specific measures to improve the training of university faculty in this crucial field. Its potential impact extends to promoting a more inclusive and accessible academic environment for all students, regardless of their abilities.

2 Research on ICT and disability in higher education

Scientific production in relation to the integration of ICT in higher education for students with has been growing steadily in recent years. Studies focus on two directions, on the one hand on the opportunities offered by ICTs to students with disabilities, and on the other hand, on the limitations encountered in their implementation (Montenegro-Rueda & Fernández-Cerero, 2021). According to the United Nations International Convention on the Rights of Persons with

Disabilities (2006), students with disabilities are those who have "long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others". In the educational context, this definition refers to those students who have special educational needs arising from their disability, and who require specific adaptations, support, and resources in order to access learning and participate fully in the educational environment.

In this sense, more attention should be paid to inclusion and equity as the foundations for quality education and learning, which requires not only the need to remove architectural barriers, but also virtual spaces and non-inclusive processes. This, many, many authors have identified the obstacles faced by these students during their trajectory in the education system (O'Byrne et al., 2019; Odame et al., 2021), where classroom practices are considered an obstacle to permanence (López Gavira et al., 2021).

It is in this context, where technology and communication are fundamental, that teachers need to be prepared to serve all students, including those with disabilities (Sánchez et al., 2019). Technologies can constitute the framework that will allow them to carry out tasks adapted to their possibilities and interests, in such a way as to provide these university students with greater opportunities for labour market insertion and social autonomy. Hence, learning with ICT as support for people with disabilities has been receiving a strong boost in recent years, mainly through scientific publications and the development of assistive technologies (Fernández-Batanero et al., 2022a).

The digital training of university teaching staff is essential to adequately serve students with disabilities, as it allows them to adapt their teaching to the specific needs of each student (García-Sánchez et al., 2019). Their lack of training in the use of technologies negatively affects the inclusion process in university educational centres (Contreras et al., 2020). This training should not only focus on the use of technological tools, but also on the adoption of an inclusive perspective and attention to diversity, with the aim of fostering educational inclusion (Sandoval-Escobar et al., 2020).

Due to the importance of the inclusion of technology to cater for students with disabilities in the university environment, a priority line of action has been highlighted that has revolved around the "professional development of teachers" with the aim of training them in technological competences and educational inclusion (Fernández Batanero et al., 2021a), both in the international context, demonstrating the specific urgency of adjusting the digital teacher training of teaching staff in university institutions (Manaour Almutairi et al., 2020). In the Spanish context, studies on ICT in general are also abundant, but those in relation to technology and disability in higher education are very limited. It is true that, despite this, there is a growing concern on the part of teachers about their training, in order to improve the expectations of this type of students through ICT (Fernández Batanero et al., 2022a). Technological training is one of the main obstacles that teachers face when responding to the needs of students with disabilities (Kurt et al., 2016; Agreda Montoro et al., 2019; Sánchez et al., 2019; Montenegro-Rueda & Fernández-Cerero, 2021).

It is important to point out that the technological training of teachers has been very relevant after the health crisis caused by COVID-19, where it has become clear that, for example, the age of the teachers has been an important aspect when it comes to facing the technological challenges posed by ICT; different studies have even associated it with mental health problems (Gyampoh et al., 2020). In this sense, in this study we will focus on two main variables related to teachers: gender and age. Focusing the study on gender and age rather than years of experience is justified due to their relevance in the educational context, as gender and age can influence teachers' adoption and perception of information and communication technologies (ICT), particularly in the area of inclusion of students with disabilities. Furthermore, this gender perspective is important for identifying possible gender inequalities in digital competence and could lead to more targeted approaches to address gender technology gaps. In this specific local context of the Autonomous Community of Madrid, Spain, exploring how gender and age influence teachers' digital competence will provide valuable information for local educational policies and teacher training. Furthermore, by considering these factors along with others, such as training and perceived barriers, a multidimensional approach is created that will contribute to a better understanding of the situation and needs of teachers in relation to technology and the inclusion of students with disabilities, which in turn will allow for more targeted and effective recommendations to improve university education in this context.

In conclusion, university institutions are aware of the high positive impact that an effective integration of these tools can have as support for students with disabilities (Perera-Rodríguez & Moriña Díez, 2019; Montenegro-Rueda et al., 2023), not in vain, most universities have specific support services to respond to the needs of these students (Román Graván & Fernández Cerero, 2022), developing an inclusive culture by offering very interesting specific resources, preferential attention to students, raising awareness in the university community, with a centralised access system or programme in these specific services that allows immediate detection and support for these students (Moliner et al., 2019). In this context of technological training and disability, we propose the following study with the intention of further investigating and promoting an increasingly inclusive education.

3 Objectives and research questions

The general objective of the study was to investigate the level of training and technological knowledge that university teachers in the Faculties of Education Sciences in the Autonomous Community of Madrid (Spain) have regarding the application of ICT as a support for students with disabilities, The data will be based on questionnaires and semi-structured interviews to show what the real situation is. Obtaining this data will allow us to evaluate the situation and take effective measures to improve university education in the country.

This research has been carried out through the following three specific objectives:

a) To find out whether the level of training and technological knowledge is determined by the gender of teachers.
b) To find out whether the level of training and technological knowledge regarding the application of ICT in people with disabilities is the same or different depending on the age of the teachers.
c) To find out what factors are associated with the promotion and development of training experiences, as well as the barriers and obstacles encountered by teachers when it comes to inclusive digital training.

More specifically, questions have been addressed:

Q1. Are university teachers prepared to use information and communication technologies as learning aids for students with disabilities?
Q2. Does teacher gender have a significant influence on the level of digital competence?
Q3. Is there a relationship between the age of university teachers and their level of digital competence?
Q4. What factors are associated with the promotion and development of ICT training experiences for students with disabilities?
Q5. What barriers or obstacles hinder the training of these teachers?

4 Method

4.1 Design and sample

In order to meet the objectives of the study, a descriptive research design based on a mixed method (quantitative and qualitative) was chosen. A cross-sectional, descriptive, and predictive quantitative study was carried out, which included university teachers from the Autonomous Community of Madrid, and this information was collected by means of a questionnaire. Questioning teachers about their digital competence in teaching students with disabilities is valuable because it allows them to identify strengths and weaknesses, personalise training and improve digital inclusion in the classroom. The qualitative part is based on an interpretative paradigmatic perspective, and from a clearly naturalistic ontology and epistemology (Grounded Theory), proposed by Glaser & Strauss (1967). The information collection strategy was a semi-structured interview with key informants from university support centres (directors and managers of ICT Production Resource Centres and Services for People with Disabilities in the respective universities). It is important to interview the directors of the universities' digital resource centres and student disability services, as these professionals are responsible for providing the necessary support and resources for teachers to improve their digital competence and ensure inclusive and quality education for all students, including those with disabilities. Heads of these centres can provide information on the programmes and resources available to improve teachers' digital literacy, as well as the strategies and tools that are being implemented to ensure accessibility and inclusion in online learning. In addition,

service managers for students with disabilities can provide valuable information about the needs and demands of students with disabilities, and how teachers can adapt their teaching and materials to make it accessible and appropriate to the different needs of students. In short, interviews with these professionals can provide valuable insights into the level of digital readiness of university teaching staff and the measures needed to improve their digital competence and inclusion in learning.

With regard to the context of the study (Autonomous Community of Madrid), it must be said that it is home to the largest concentration of students in Spain and one of the largest in Europe. Located in the centre of the Spanish state, it contains in its territory (academic year 2021–2022) 6 public universities and 11 private universities, with more than 18,457 university teachers, of which more than 2000 are attached to education centres and faculties.

In order to collect data, a non-probabilistic purposive and snowball sampling was used, guaranteeing at all times the protection of the privacy of the participants. The subjects were recruited using non-probability, purposive, snowball sampling, since the aim is to obtain detailed information from a specific population that is difficult to reach or is not properly recorded in a database. Data collection took place during the academic year 2021–2022, during the months of November and January.

In this study we worked with a sample of 106 university teachers from the Community of Madrid, all of them belonging to the Faculties of Education Sciences of 4 public universities (Universidad de Alcalá, Universidad Autónoma, Universidad Complutense and Universidad Rey Juan Carlos) and 6 private universities (Universidad Alfonso X el Sabio, Universidad Antonio de Nebrija, Universidad Camilo José Cela, Universidad Europea de Madrid, Universidad San Pablo CEU and Universidad Pontificia Comillas). The sample consisted of 37 men (35%) and 69 women (65%). The number of teachers from public universities was 55 (51.94%) and 51 (48.06%) from private universities.

Figure 1 shows the percentage of teachers who completed the questionnaire according to age.

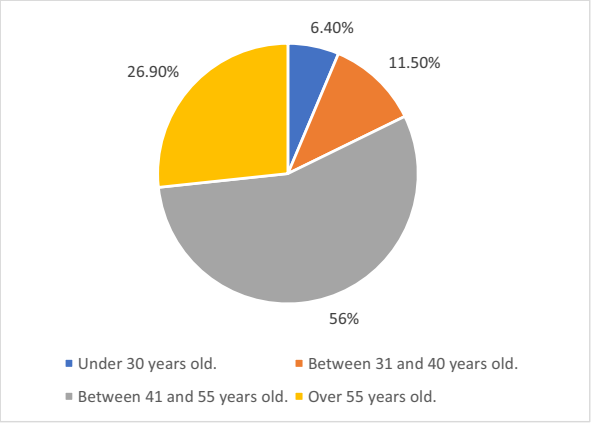


Fig. 1 Percentage of participants according to age

By age, teachers aged between 41 and 55 stand out ($n=59$, f=56%), followed by those over 55 ($n=28$, f=26,9%). To a lesser extent, teachers aged between 31 and 40 ($n=12$, f=11,5%), and the youngest: under 30 ($n=7$, f=6,4%).

With regard to the interviews, 6 professionals from the support services (ICT Production Resource Centres and Services for People with Disabilities) were interviewed. 37.5% ($n=3$) of the key informants were men and 62.5% ($n=5$) were women.

4.2 Sources of data collection

4.2.1 Questionnaire

The instrument consisted of two blocks. The first block is made up of data concerning the teachers (gender, age). The second block is made up of a total of 61 items distributed in 7 dimensions (general (G), visual (V), auditory (AU), motor (M), cognitive (C), accessibility (ACC) and services (S)) (Annex 1).This part of the instrument consists of a Likert-type scale with 6 scores where value 1 referred to "you feel completely ineffective" and value 6 referred to "I master it completely". Table 1 presents the dimensions and associated items.

The validation of the questionnaire (content validity) was carried out using the expert judgment technique. For this, a group of 56 judges was initially selected who have professional experience in educational technology, professional experience in the context of special education, experience in the use of technologies with students with disabilities and have worked in an educational institution related to the field of education. area of special education. To select the judges we used the "Expert Competence Quotient" or "K-Quotient", which was calculated using the following formula: $K = 1/2\ (Kc + Ka)$, where Kc is the "Knowledge Coefficient" or the information the expert has about the topic or problem posed; and Ka is the "Argumentation Coefficient" or the substantiation of the experts' criteria (Cabero Almenara et al., 2016). These data are obtained directly from the

Table 1 Dimensions and associated items

Dimensions	Descriptions	Items
General	General aspects of accessibility and regulations	1,2,3,4,5,6,7,8,9,10,11,12
Visual	Accessibility for individuals with visual impairments	13,14,15,16,17,18,19,20,21,22,23,24,25
Auditory	Accessibility for individuals with hearing impairments	26,27,28, 29, 30, 31, 32
Motor	Accessibility for individuals with motor impairments	33,34,35,36,37,38,39,40
Cognitive	Accessibility for individuals with cognitive impairments	41,42,43,44,45,46,47,48,49
Accessibility	Overall accessibility for everyone	50,51,52,53,54,55,56
Services	Support services and resources for disabilities	57,58,59,60,61

evaluation offered by the expert in question A for Kc "Knowledge Coefficient" and in question B for Ka "Argumentation Coefficient" in Annex 2.The values used to determine the expert's position are (Cruz Ramírez & Martínez Cepena, 2020):

- $0.8 < K < 1.0$ high competition coefficient.
- $0.5 < K < 0.8$ average competition coefficient
- $K < 0.5$ low coefficient of competence

In our study, the K coefficient was higher than 0.8 in 36 of the 56 experts initially selected, and it was this sample that was finally used to validate the questionnaire. The experts made their estimates in successive, anonymous rounds, trying to reach a consensus, but maintaining maximum autonomy on the part of the participants (Delphi Method). The reliability of the instrument was determined using Cronbach's alpha and McDonald's Omega (Ventura-León & Caycho-Rodríguez, 2017; Montenegro-Rueda & Fernández-Batanero, 2023), whose values are shown in Table 2.

The values obtained, according to O'Dwyer & Bernauer (2013), indicate high levels of reliability for both the whole instrument and its different dimensions.

A total item correlation was also performed to assess whether the elimination of any item increased the reliability of the instrument, but this was not the case. The instrument had not been previously analysed to confirm its exploratory and confirmatory validity, so an analysis was carried out to check this. Exploratory factor analysis (EFA) was used under the maximum likelihood method with varimax rotation.

The KMO (Kaiser-Meyer-Olkin) test was 0.934 and Bartlet's test was significant ($\chi^2 = 4213.824$, $p < 0.05$). The final version explained 84.25% of the true variance. In addition, confirmatory factor analysis (CFA) showed that the teachers' data fitted the proposed theoretical model adequately. The coefficients met the thresholds established by Bentler (1989) and Schumacker and Lomax (2004).

This model corroborated the factor structure formulated in the CFA, which consisted of six correlated latent variables. AMOS V.24 software was used to make the structural equation model. After validation, it was complemented by a pilot study, with the participation of 18 subjects with similar characteristics to

Table 2 Reliability index

Dimension	Alpha	Omega
General (G)	0.965	0.970
Visual (V)	0.975	0.978
Auditory (AU)	0.968	0.971
Motor (M)	0.974	0.979
Cognitive (C)	0.979	0.981
Accessibility (ACC)	0.958	0.959
Services (S)	0.978	0.974
Total	0.991	0.998

the main study population, under informed consent via Google Drive through an electronic form. The results obtained in the pilot test confirm that the instrument is highly reliable and stable ($\alpha = 0.948$).

4.2.2 Interviews

The key informant interviews were semi-structured and were based on an initial script organised around 5 dimensions: awareness and teacher preparation; development of training experiences; promotion of training; barriers to the development of training plans; priority in training. The selection of interview topics was based on a review of the existing literature on teacher education in the field of disability. From this review, the most relevant themes and dimensions of teacher education in this area were identified and an initial script of questions for the semi-structured interviews was organised. These topics were considered relevant to address the objectives of the main study, which sought to analyse the level of training of university teaching staff in the use of ICT and attention to diversity, particularly for students with disabilities.For its validation of the interview, the expert judgment strategy was obtained, using the Delphi method (Linstone & Turoff, 1975). The validation was carried out through a document attached to the interview, which arose from a set of open questions delivered to experts, initially selected by 36 judges.

For the elaboration of the categories and the evaluation of deciding the answers as correct or incorrect of the interviewees, it has been conditioned by criteria of consistency and reliability. In this sense, after the construction process of the category system (matching between coders), and from the moment in which the coders (6 researchers) have made use of the category system (reliability), an adequate kappa coefficient has been obtained above of 0.75 (Fleiss, 1981).

4.2.3 Procedure

Contact with the centres was made by means of a telephone call to those responsible, together with a letter of invitation to participate voluntarily in the research. The questionnaire was administered online and can be consulted at the following web address: https://bit.ly/fopticydis-cuestionario

In relation to the interviews, it was decided to interview key informants (heads of ICT Production Resource Centres and Services for People with Disabilities in the respective universities), also because of our interest in understanding their perception, as professionals in management and training in education, of teacher training in ICT and disability, as well as the possible indicators that determine this training. It is important to know the opinion of these professionals, because through it it is possible to detect the real needs of teachers, since the supply of training depends on the demand made by them. The interviews were conducted by telephone by members of the working team, with an average duration of 15 min. The selection procedure was carried out randomly, based on the invitation made in the first telephone contact with the university centres.

4.2.4 Data analysis

The analysis of the questionnaire data was carried out using SPSS statistical software 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) logistic regression to examine whether independent variables such as teachers' gender and age have a significant impact on the level of digital competence in teaching.

To establish a cut-off, point to determine whether an individual has a low or high level of digital competence, the researchers used an approach based on the probability estimated by the logistic regression model. This probability may vary from 0 to 1, where 0 indicates a high probability of having a low level and 1 indicates a high probability of having a high level. Researchers can set an arbitrary cut-off point: individuals with a probability of less than 0.5 will qualify as "low level", between 0.5 and 0.8 will qualify as "medium level", and with an estimated probability of 0.8 or higher will be classified as "high level" of digital competence.

The interviews were transcribed in their entirety, even though authors such as Gibbs (2013) do not believe this to be entirely necessary. Their words have been taken into account in this task: "The question is not whether the transcription is accurate at the last level, but whether it represents a good and careful attempt to capture some aspects of the interview" (p. 32). In the process of analysis, the researchers have tried not to lose or adulterate the essence of the stories given to us by our participants. However, the transcription of interview data has forced researchers to reflect on the ethical responsibility of their work. This responsibility implies avoiding harming the people who participate in the research, ensuring their integrity, autonomy, and dignity, in accordance with three principles: informed consent, confidentiality of information and respect for anonymity (Abad Miguélez, 2016).

After the interview transcription process, data reduction and coding were carried out with the help of NVivo 12 software, using a system of categories derived from the dimensions of the interview script and the analysis process itself.

5 Results

5.1 Questionnaire

The results obtained from the questionnaire are presented below, in order and according to the research questions posed. With regard to the first research question (Q1) on the level of training of university teachers to integrate ICT to support the learning of students with disabilities, the results indicated by the participating teachers show a low level of digital training of the teachers, as can be seen in the analysis of the means and standard deviations obtained in the instrument and in each of the dimensions analysed (Table 3).

Some dimensions have a low score in terms of standard deviation, which shows a low dispersion of responses. This indicates that the majority of higher education teachers report low ability to use information and communication technologies

Table 3 Average teacher knowledge in each dimension, and in total, of the instrument

Dimension	Mean (M)	Standard Deviation (SD)
D1. General	2.90	1.28
D2. Visual	2.20	1.03
D3. Auditory	2.39	1.30
D4. Motor	2.56	1.18
D5. Cognitive	2.43	1.25
D6. Accessibility	2.47	1.04
D7. Services	2.22	1.18
Total	2.45	1.18

(ICT) with students with disabilities. Moreover, in all dimensions assessed, the average scores are lower than 3.

Continuing with the results and focusing on the second and third research questions (Q2 and Q3), which refer to whether variables such as the gender and age of the teachers significantly explain the level of teaching digital competence, we proceeded to perform logistic regression (predicting the presence or absence of a characteristic or result according to the values of a set of predictors), where the assumptions that allow logistic regression to be carried out (verification tests) were checked. The assumption of independence of observations was not significant (sig. = 0.838), so the observations are independent of each other. The Hosmer and Lemeshow test (Monotonicity assumption) correctly fitted the data (sig. = 0.834), which indicates the goodness of fit of the proposed model.

The Omnibus test, which checks the significance of several parameters in a model at the same time, verified that the estimation of the proposed model was correct and significant ($p. < 0.05$) between the two independent variables (gender and age) and the dependent variable (level of digital competence). The goodness-of-fit of the model was assessed through the Nagelkerke (0.375) and Cox and Snell (0.260) regression coefficients, indicating that the model explains approximately 30–40% of the total variability.

The two regression coefficients provide a measure of the amount of variation in the level of digital competence (dependent variable) explained by the model (ranging from a minimum value of 0 to a maximum of approximately 1). The model was also found to be able to predict correctly in 71.8% of cases, indicating that the model was acceptable. Furthermore, the specificity and sensitivity of the model was evaluated (Table 4), with very satisfactory results.

The results show that the variables gender and age are not relevant for predicting the level of digital competence. In the table, the p-value of each coefficient is plotted. This indicates that the coefficient of gender is not significant ($p > 0.05$), suggesting that the gender variable does not have a significant effect on the dependent variable. The coefficient for age is also not significant ($p > 0.05$), suggesting that age does not have a significant effect on the dependent variable.

Table 4 Overall and per dimension means according to participants' gender

Method	Unstandardised coefficients		Standardised coefficients		
	B	Std. Error	Beta	t	Sig
(Constant)	3.556	0.299		11.60	0.000
Gender	0.155	0.097	0.031	1.59	0.110
Age	0.031	0.056	0.011	0,0.60	0.559

Also, subsequently, and in relation to the gender of the respondents, the total and dimension averages were compared, as can be seen in Table 5. The analysis of the mean and standard error per dimension according to the variables can provide us with valuable information about the distribution of results and variability in participants' responses. By comparing the means and standard errors per dimension between different groups or categories of participants, we can identify possible patterns or trends in the perception of each dimension according to the variables analysed. In this case, it will allow us to determine whether there are significant differences in the perception of each dimension between men and women, or between teachers of different age groups. These results may be useful to identify possible areas for improvement in digital competence and to design specific interventions for different groups of teachers. In addition, the analysis of the mean and standard error per dimension according to the variables can help us to assess the reliability and validity of the survey or measurement instrument used. If the means and standard errors per dimension are consistent and stable across different groups or categories of participants, we can infer that the survey or measurement instrument has good reliability and validity. In this regard, in Table 5, we can see that the overall average score for men is 2.61, while for women it is 2.36. This indicates that, on average, men score slightly higher than women in all dimensions combined. Looking at the scores per dimension (D1 to D7), some interesting differences can be noted. For example, in Dimension 2 (D2), women have a higher mean score than men (2.93 versus 2.79), suggesting that women feel more confident or competent in that specific dimension. However, in Dimension 3 (D3), men have a higher mean score than women (2.22 vs. 2.05), indicating a perception of greater competence in that aspect. The standard errors provided are small overall, suggesting reasonable precision in the estimates of mean scores. Standard errors are smaller for men on most dimensions, which could indicate greater consistency in men's responses on these dimensions.

Table 5 Overall and per dimension means according to participants' gender

Gender		Total	D1	D2	D3	D4	D5	D6	D7
Male	Mean	2.61	2.79	2.22	2.54	2.67	2.45	2.53	2.37
	Standard error	0.309	0.396	0.301	0.380	0.355	0.399	0.331	0.321
Woman	Mean	2.36	2.93	2.05	2.22	2.22	2.39	2.41	2.19
	Standard error	0.242	0.299	0.289	0.333	0.287	0.311	0.259	0.321

Table 6 Total and dimension averages according to age

Age		Total	D1	D2	D3	D4	D5	D6	D7
Under 30	Mean	3.32	4.04	3.34	3.36	3.30	3.29	3.00	3.00
	Standard error	0.12	0.10	0.14	0.11	0.11	0.12	0.14	0.13
Between 31 and 40 years old	Mean	4.00	3.90	3.00	5.00	5.00	5.00	5.00	4.00
	Standard error	0.10	0.09	0.12	0.08	0.11	0.10	0.09	0.12
Between 41 and 55 years old	Mean	2.21	2.48	1.69	1.96	2.18	2.00	2.19	2.44
	Standard error	0.08	0.10	0.07	0.09	0.11	0.10	0.09	0.10
Over 55 years old	Mean	2.59	2.29	1.61	1.70	2.62	2.61	2.53	2.36
	Standard error	0.09	0.08	0.07	0.10	0.09	0.10	0.08	0.11

Finally, as to whether the age of university teachers has an influence on the level of digital competence (Table 6), it can be seen that when grouped by age, some aspects stand out, although as mentioned above, this variable is not relevant for predicting the level of competence. In this case, among teachers aged 31 to 40, they are the most digitally literate ($\bar{X} = 4$), followed by teachers under 30 ($\bar{X} = 3.32$).

5.2 Interviews

With regard to the first research question related to the level of teacher training in ICT and disability, it is concluded that the interviewees (professionals from the ICT Production Resource Centres and the Services for People with Disabilities at the respective universities) perceive a greater need for more specific university teacher training on aspects related to attention to diversity and technology.

The interviewees recognise that they consider that a high percentage of university lecturers are poorly prepared to work using ICT as support tools for students with disabilities.

On the other hand, after organising and analysing all the categories, it was found that the improvement of higher education with ICT was the axis around which all the other categories were articulated. As can be seen in the diagram (Fig. 2), in order to seek university improvement in the use of ICT, it is necessary to: raise awareness and train teachers, develop and promote training experiences, take into account the educational context and address the barriers that prevent their development.

The reasons, which 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 teachers; the rapid updating of technological tools; lack of interest of the teachers; lack of training in the field of attention to diversity and, lastly, obsolete means and resources. These aspects are shown in comments such as:

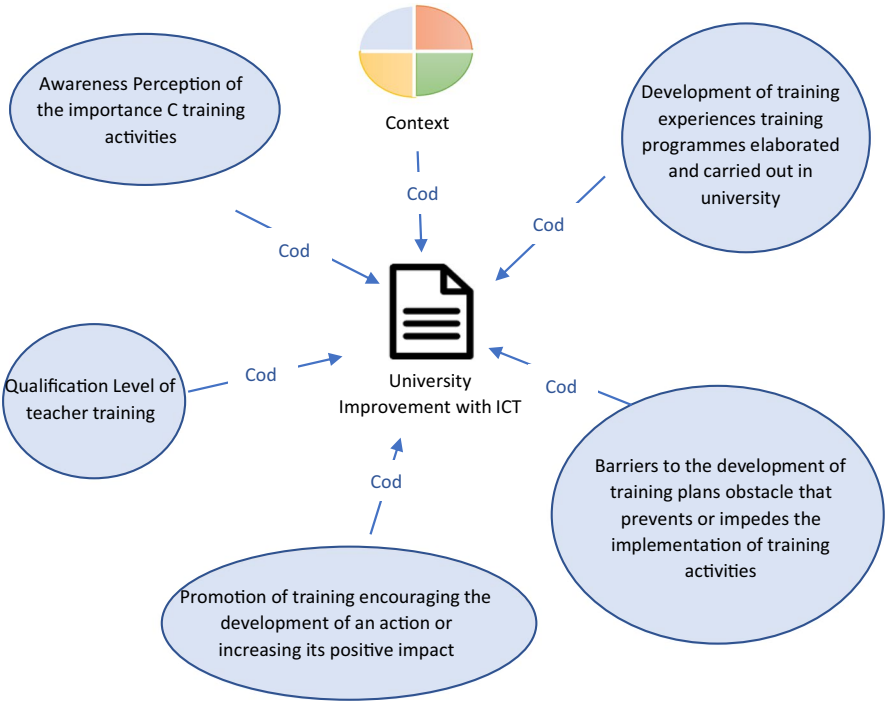


Fig. 2 Diagram on university improvement in the use of ICTs

"I think that they lack specific technological training in educational inclusion, not only because of the lack of it in initial training, but also because it is not offered in training plans" (E.5).
"It is logical that older teachers have problems adapting to technology. For example, many of them had a really bad time during the COVID-19 health crisis" (E.2).

The interviewees recognise that the perceived low level of teacher training in ICT and disability may also be due to the lack of demand in this area. More training and skills are needed to use digital tools, as teachers have a positive attitude towards them.

Among the factors associated with the promotion and development of training experiences on the use of ICT for students with disabilities (Q4), most of the interviewees agree that educational programmes are limited or very general. In other words, the few training actions that are carried out focus on the use of ICT in a generalised way, without taking into account their application to support students with disabilities in particular and educational inclusion in general. Despite this, there is a growing awareness. As a result, training experiences are gradually emerging.

"We from our unit promote and carry out training courses, however, we also organise some workshops on diversity awareness" (E.3).

Finally, among the barriers or obstacles that hinder the training of these teachers (Q5) are some intangible barriers, such as attitudinal and pedagogical barriers. The "lack of awareness of issues such as student diversity" on the part of some teachers turns attitudes into obstacles.

> "The main barrier is teacher awareness. Teachers are often aware of the problem they have in relation to dealing with student diversity, but they are also selfish in requiring training initiatives" (E.2).

6 Discussion

Based on the results, we can say that university teachershave a low level of training in technology to integrate these digital tools in the classroom with students with disabilities. This low level of training is evident both in the general dimensions and in each of the dimensions evaluated, i.e. those related to students with visual, hearing, motor, cognitive, accessibility and service disabilities. These findings coincide with those of other studies carried out in the Spanish context on university teachers training in ICT, at a general level (Agreda Montoro et al., 2019; Romero Alonso et al., 2019) and even more so, when these technological tools serve to support students with disabilities (Fernández Batanero et al., 2022a, c). However, it is necessary to point out that greater digital training is not necessarily linked to a more frequent use of these tools during teaching with students with disabilities, but that other issues need to be improved. The results presented here force us to consider the technology training schemes offered by higher education institutions.

In general, men tend to score higher than women on all dimensions assessed by the instrument. However, both men and women score below 3 on all dimensions. It is important to note that gender should not be a determining factor in teachers' digital competence. This finding does not coincide with other studies that have addressed gender from a digital competence perspective and have found opposite results, demonstrating the importance of gender in the level of digital competence (Marcelo et al., 2015; Martínez-Cantos & Castaño, 2017; Mercader & Duran-Bellonch, 2021). We also argue that rather than focusing on the gender difference, as it is not significant, future research could focus on ensuring that all teachers have the necessary technology skills and should be addressed in an equitable manner to ensure that all students have access to the best possible education.

It is also important to bear in mind that the use of ICT in inclusive education is an issue that goes beyond mere training and requires an attitude and willingness towards its use and application in the classroom.

In relation to the age variable, it is true that it is not a determining factor in determining the level of digital competence, but there may be a greater ease and fluency in the use of technologies among the younger generation of teachers. This is partly because teachers over 50 may have less experience with digital technologies and less confidence in their ability to use them, and younger teachers have received more recent technology training and have grown up in an environment where technologies are more prevalent (INTEF, 2018). However, it is important to bear in mind that the appropriate and

beneficial use of ICT in inclusive education goes beyond mere fluency and ease of use, but requires an attitude and disposition towards their application and use in a pedagogically appropriate way. Therefore, it is essential to promote training initiatives and the use of ICT in education, regardless of the age of the teachers to be able to implement the technologies with students with disabilities. (Rodríguez Espina et al., 2014; Fernández Batanero et al., 2022c).

With regard to the factors associated with the promotion and development of training experiences on the use of ICT by students with disabilities, it is clear that not only the lack of a specific training plans, but also the organisation of courses, seminars, workshops, etc. condition the promotion and development of experiences. These results are in line with other previous studies (Moliner et al., 2019; Román Graván & Fernández Cerero, 2022). Thus, the scarce supply of training in this line hinders the training of these teachers, as the increase in training courses could encourage teachers to use digital resources more frequently with these students (Tandika & Ndijuye, 2019). This coupled with "low awareness of issues such as learner diversity" or to the "lack of access to technology" make them intangible barriers. This aspect coincides with the study by Moliner et al. (2019) in the Valencian context.

Furthermore, the development of digital competences in diversity is essential to ensure inclusive and equitable education. These courses are often designed in a generic way and do not consider the educational needs of students with disabilities. However, diversity training courses in digital environments can be effective when they are based on a learner-centred approach, adapted to the specific needs of learners with disabilities and use appropriate technological tools (Hernández-Ruiz, 2020).

Ultimately, analysing the level of digital training of university teaching staff to serve students with disabilities is important for several reasons (Fernández Batanero et al., 2022b):

Accessibility: Technology and digital tools can improve accessibility for students with disabilities. However, teachers need to be adequately trained to use these tools and make classroom content accessible to all.
Adaptation: A teacher with good digital training will be able to adapt his or her lessons and teaching materials to the specific needs of individual students with disabilities. For example, students with visual impairment may need materials in Braille or audio format, while students with hearing impairment may need subtitles or sign language interpreters.
Inclusion: Digital teacher training can contribute to the inclusion of students with disabilities in university life. If faculty are trained to meet the needs of students with disabilities, they will feel more integrated into the university community and have a better chance of academic success.

7 Conclusions

Through our study, we have been able to determine the knowledge and skills of university lecturers in the use of information and communication technology (ICT) to support students with disabilities. One of the main conclusions is that university

teachers in the Community of Madrid have a low level of training in the use of ICT to integrate students with disabilities. Although this conclusion cannot be generalised to other autonomous communities or cities in Spain, it is true that the level of training of university teachers in the use of ICT is limited at national level, as demonstrated in a recent study (Fernández Batanero et al., 2022a).

A second conclusion of the study is the scarcity of existing training provision in digital skills with an inclusive orientation.

In summary, it is important to highlight that the teachers are ensuring the continuity and academic success of students with disabilities at university. Therefore, it is necessary that this group is willing to keep up to date and to adopt an open attitude towards training and the implementation of innovative and inclusive strategies in their teaching practice.

7.1 Limitations

Some of the main limitations of our research are the use of self-perception instruments, which means that the information collected reflects what teachers think they know about the use of ICT to support students with disabilities; and the low participation rate in the study (low number of participating teachers) which could affect the generalisability of the results. It would be necessary to replicate the research in other autonomous communities and check if the data remain like generalise the results. Similarly, we are aware of the low participation of key informants, hence the need to increase their number in future research.

7.2 Future research

Today's higher education institutions are increasingly calling for up-to-date and innovative education that includes the use of digital tools in the teaching–learning process for all students, including those with special educational needs due to disabilities. In this sense, the implications go in two directions. On the one hand, the need to design, develop and implement training plans and teacher counselling in relation to technologies and people with disabilities. Only in this way will we be able to comply with European policies that demand universities that are more committed to inclusion. On the other hand, and because of the above, only with the necessary technological training will teachers be able to make effective use of the technological resources available to the entire educational community. In this sense, future work to enable researchers to make further progress in this area is aimed at:

- Investigate the specific barriers faced by university teachers in implementing assistive technologies for the inclusion of students with disabilities, and how these barriers can be overcome.
- Evaluate the effectiveness of specific training programmes in the use of ICT for inclusion of students with disabilities in improving the competence and capacity of university teachers.

- Investigate how assistive technologies for the inclusion of students with disabilities can be integrated into the teaching and assessment of university courses.
- Evaluate the accessibility and inclusion of digital educational resources and online learning platforms used in higher education to ensure that they are accessible to students with disabilities.
- Investigate how collaboration and coordination between professionals from ICT Production Resource Centres and Disability Services and university lecturers can be improved to ensure inclusive education for all students.
- To explore the relationship between the inclusion of students with disabilities in higher education and their academic and professional success.

Annex 1

QUESTIONNAIRE	1	2	3	4	5	6
I have a general knowledge of the possibilities offered by ICT for people with disabilities						
I know the difficulties caused by different types of disabilities in using ICT						
Can select specific ICT according to different people's physical, sensory and cognitive characteristics						
I am aware of different resources and documents specifically dedicated to analysing the possibilities of ICT for people with different types of disabilities						
I am aware of educational experiences in applying ICTs for people with different types of disabilities						
I know of mobile applications which can be used with people with special educational needs						
I know Augmented/Virtual Reality applications that can be used with people with special educational needs						
I know what 3D printing technology can do to help people with special educational needs						
I am aware of the main limitations that may condition the use of ICT by learners with disabilities						
I consider myself competent to locate educational materials for people with special educational needs online						
In general, I feel prepared to help learners with certain disabilities in the use of technical aids and the use of ICT						
I can design activities with generalised educational software for students with special educational needs						
I am able to explain the possibilities offered by a Braille typewriter						
I know the possibilities offered by Kurzweil reading machines for visually impaired students						
I am aware of the possibilities offered by telescopes for visually impaired pupils						
I recognise different computer programmes specifically designed for visually impaired people						

QUESTIONNAIRE	1	2	3	4	5	6
I am familiar with different screen magnification programmes to facilitate access to the computer for visually impaired students						
I know different screen reader softwares, such as JAWS, Tiflowin, etc.…						
I can produce didactic materials in a word processor, eliminating the aspects that make it difficult for visually impaired people to use it						
I am able to list different tiflotechnological materials that enable visually impaired people to access numeracy						
I know of specific browsers for visually impaired people						
I am aware of different websites where educational resources for people with visual impairment can be found						
I am aware of the possibilities that ICT offers the visually impaired student						
I am aware of the possibilities that 3D printers offer to visually impaired students						
I am able to use sign language						
I am able to express messages according to sign language						
I am able to identify different computer resources for voice and speech enhancement						
I am familiar with different educational software programmes that stimulate language and the acquisition and development of oral and written language skills						
I am able to identify different websites where educational resources for people with hearing impairment can be located						
I am able to apply teaching strategies supported by ICT to facilitate the inclusion of students with hearing impairment						
I am able to make ICT-supported curricular adaptations for students with hearing impairment						
Generally speaking, I am aware of the possibilities that ICT offers to hearing impaired learners						
I am familiar with different speech re-education programmes						
I know different types of keyboards for people with different types of mobility limitations						
I know the uses of switches, toggles and pointers						
I know of software that controls the computer by voice						
I know the basics of alternative augmentative software systems to facilitate communication for people with motor disabilities						
I locate websites containing educational resources for people with motor disabilities						
I am able to apply ICT-supported teaching strategies to facilitate the inclusion of learners with motor impairments						
I am aware of the possibilities offered by ICT for students with motor disabilities						
I am aware of the possibilities that 3D printers are offering for the manufacture of prostheses						
I can cite some educational programmes used for the rehabilitation of cognitive skills						

QUESTIONNAIRE	1	2	3	4	5	6
I am able to cite different websites where educational resources for people with cognitive disabilities can be located						
I can use specific software to produce materials for a concept keyboard						
I am able to apply ICT-supported teaching strategies to facilitate the inclusion of learners with cognitive disabilities						
I am able to make ICT-supported curricular adaptations for subjects with cognitive disabilities						
I am able to describe the main limitations that multimedia materials may contain for use with people with cognitive disabilities						
I can locate websites that contain educational resources for people with cognitive disabilities						
I am aware of the possibilities offered by ICT for students with cognitive disabilities						
I know the potential offered by Apps or mobile applications dedicated to cognitive training or rehabilitation of people						
I am aware of the possibilities offered by operating systems and browsers to modify certain levels of programme operation (speed, font size, pointer type, etc.) and make the programme more accessible to people with different types of disabilities						
I know what accessibility testing is for websites						
I am familiar with the general WAI/W3C guidelines for making websites accessible						
I am able to create web pages with high accessibility parameters						
I am able to adapt computer equipment to the educational needs of any person with a disability						
I know different institutions that are involved in the study and research of website accessibility						
I am able to cite different accessibility tests						
I am aware of the services that my university offers for people with disabilities						
If I have a student with a hearing impairment I know where in my university I can direct them						
I am aware of the services offered in my faculty for people with special needs						
I know the services my university offers to people with motor impairments						
I know the services my University offers to people with visual impairment						

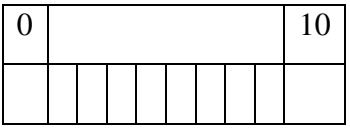
Annex 2

Dear teacher and researcher,

We ask you to answer honestly in order to select the experts for the questionnaire.

A) Please tick in the appropriate box the degree of knowledge you have about the following topics: ICT teacher training, ICT and inclusive education, disability,

accessibility, ICT and disability,….. Please rate yourself on a scale of 0 to 10 (where 0 is no knowledge and 10 is complete knowledge of the state of the art).



Note: The score Kc (knowledge coefficient - value from 0 to 10) is obtained.

B) Self-assess the degree of influence that each of the following sources has had on your knowledge and views on teacher training in ICT, ICT and inclusive education, disability, accessibility, ICT and disability, ……

	Low	Medium	High
Theoretical analysis carried out by you			
Your experience gained from your practical activity			
Study of work on the subject carried out by Spanish authors			
Study of work on the subject carried out by foreign authors			
Your knowledge of the state of the problem abroad			

Note: The Argumentation Coefficient (Ka) is obtained by assigning a series of scores to the different sources of argumentation that the expert has been able to wield. The table shows the scores for the evaluation of the sources of argumentation.

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Data availability The datasets generated during and/or analysed during the current study are not publicly available due to the anonymity of the participants but are available from the corresponding author on reasonable request.

Declarations

Statements on open data and ethics The data described in this paper contains no personal, or personally identifiable information.

Conflicts of interest There is no conflict of interest regarding this work.

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