



Future teachers facing the use of technology for inclusion: A view from the digital competence

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Abstract

Technologies provide a differential value to the training process, allowing for the generation of new environments, methodologies and resources that make it possible to attend to students in a more appropriate way. This potential is especially relevant in matters of inclusion, where technology is sometimes an indispensable element for learning. In this paper we explore the main advantages of the use of technology for the attention to diversity, taking into consideration the level of digital competence of future teachers and their perceptions regarding its use for the implementation of inclusive strategies. The results suggest that participants have an intermediate level of digital competence, with differences according to gender, age and degree. It is also remarkable that they perceive inclusion as one of the main challenges of the education system and that technology can contribute to making teaching practice more inclusive, allowing it to be adapted to specific needs and highlighting the importance of teacher training in both digital competence and inclusion as an educational principle.

Keywords Digital competence · Technologies · Inclusion · Attention to diversity · Teacher training

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1 Introduction

The integration of technology in the field of education has made it possible to provide training processes of a more personalised nature, allowing students with specific needs of educational support (SNES) to be catered for using different tools. However, beyond the availability (or lack thereof) of methodological alternatives, it is essential for the different agents involved in the design, implementation, and evaluation of teaching and learning processes to have the necessary technological skills to take advantage of their full potential.

In this sense, in recent years, there has been an institutional effort to promote different guidelines aimed at the digital training of teachers, based on the understanding that they are key both in the attention to diversity and in the use of digital resources. Hence, supranational bodies have designed different lines of work to serve as a starting point for policy-making in each country. Although the introduction of technology in education goes back several decades, the identification of digital competence as a key lifelong skill (European Commission, 2006; Council of Europe, 2018) was a turning point to consider technology at the societal and educational level. On the one hand, the EU guideline placed this competence at the same level as other basic skills such as communicative competence, mathematical competence, or social and civic attitudes, highlighting the need for any citizen to be able to develop digital skills throughout their lives so that they can function effectively in the new social model linked to the digital society (Marín et al., 2021a). On the other hand, and in connection with the same social reality, the recognition of digital competence transfers the responsibility to the school environment to favour the students' acquisition and development of technological skills at different educational stages and contexts (Gabarda et al., 2021).

The integration of technology in the Spanish education system takes place from different perspectives: on the one hand, the legislation explicitly transposes the EU guidelines, identifying digital competence as a transversal competence throughout the education system; on the other – and beyond incorporating proposals in the different areas of knowledge to comply with this criterion of transversality – it can structure specific curricular content in particular subjects (especially in secondary education). Finally, and as a consequence of all of the above, the need to reinforce both basic and in-service teacher training plans is recognised as necessary to provide teachers with the necessary skills to fulfil their role in a way that is more in line with social demands.

In this way, and focusing on the basic training of compulsory education teachers, the regulations governing training plans leading to teaching positions are not very explicit in defining the technological skills that any teacher must have, nor with the explicit integration of content that might contribute to their digital competence (Peirats et al., 2018). More specifically, the requirements established for the verification of official university degrees that enable students to practise the profession of Primary Education Teacher and the Master's Degree in Secondary Education (Order ECI/3857/2007 and Order ECI/3858/2007 respectively) do establish that the students of these degrees should know and apply information

and communication technologies in the classroom, but offer no specific descriptor to support this.

The same reflection can be extrapolated to the training of future teachers in inclusion and attention to diversity. In this case, the provisions detailed above offer few references to inclusion as a pedagogical principle (Gabarda et al., 2022), other than the mention of Hearing and Language or Therapeutic Pedagogy in the Degree in Primary School Education or the specialisation in Educational Guidance of the Master's Degree in Secondary Education. This means that the development of such fundamental teaching skills in our current context of diversity is otherwise limited for the rest of future educators.

Despite the bleak outlook offered by the analysis of basic teacher training both in digital competence and for the effective application of the principle of inclusion, the scientific literature has allowed us to confirm, on the one hand, that the scientific community is indeed interested in this phenomenon (López et al., 2020) and, on the other hand, that some experiences and studies do value the role that technology can play in the attention to diversity. Generally speaking, it is noteworthy that they explicitly mention the need to promote continuous training in this area (Cabero-Almenara et al., 2022) because of the low level of knowledge of the teachers about how to use the Information and Communication Technologies to promote the inclusion (Fernández-Batanero et al., 2022).

Thus, making technology available to learners with disabilities is the first step in providing alternatives for learning (Yelland & Neal, 2013). In addition, technology enables the development of an inclusive learning environment characterised by the redefinition of instructional methods in both online and face-to-face models (Galiani, 2019). Studies such as the one by Saladino et al. (2020) indicate that teachers use digital technologies daily, which helps them improve the instruction, motivation, and inclusion process for all their students. They also help students with special educational needs (SEN) to acquire new knowledge, improve their social interaction, and obtain new communicative experiences, improving the motivation, adaptation, and inclusion of students with SEN.

Therefore, using everyday technological devices present in the classroom or at home, such as mobile phones (Ismaili & Ibrahimi, 2017) or digital books (Shamir et al., 2018), it is possible to transform texts into adapted audio or to turn contents into concept maps or images. These actions can support or reinforce learning for the entire group (Saladino et al., 2019), in line with the intention of the Universal Design for Learning (UDL) framework.

Going a step further, the implementation of e-learning ensures the effectiveness of the educational process by focusing on the development of individual potentials. It provides feedback and combines personal and collective learning paths by presenting learners with many learning spaces and educational opportunities (Andriushchenko et al., 2020). This model was inevitably applied during the months of Covid-19 lockdown; technology made it possible to continue providing attention to all students (Gómez et al., 2018).

Creative communication facilitates the exchange of knowledge, thoughts, and ideas to meet the participants' educational need for self-expression and creativity (Shurygin et al., 2021), and increases communication opportunities through

technology, which can impact the socialisation of students with intellectual disabilities. In the words of Tatiachyкова et al. (2020), the socialisation of these students requires further technological involvement.

Just as students and schools can overcome barriers and improve the presence, participation, and learning of all children thanks to ICTs, parents have highlighted the need to extend the cooperation between educational organisations, guidance or health service professionals, and the family to design and implement personalised educational approaches for each child with a disability (Olkhina et al., 2021).

Based on this approach, the aim of this paper is to analyse the level of digital competence of future teachers of Primary and Secondary Education at the University of Valencia, as well as to explore their opinion on the use of technologies for the attention to diversity.

2 Methodology

This work is carried out using a mixed approach (Anguera et al., 2020) that integrates quantitative and qualitative methods to ensure research vigilance and epistemological coherence (Núñez-Moscó, 2017). There is broad consensus on the complementary nature of integrative research for the study of phenomena from social sciences (Del Canto & Silva, 2013). The need to adopt this perspective is justified by the changing and polyphonic subject matter and its place in the crossroads between inclusion and technology.

2.1 Participants

To determine the sample, a pre-analysis of study potential was carried out using the *G*Power 3.1* software to conduct a repeated measures MANOVA test with intra- and inter-subject interaction analysis for three different age groups (older, intermediate, younger), two genders, and with three values (pre-test DC perception, tested DC, and post-test DC perception). The effect size was $f(V)=0.25$ and the power was $1-\beta=0.90$, which indicated a sample of 169 subjects. The final participants were 166 prospective teachers in basic teacher training. Up to 69.9% were studying a Degree in Primary School Education, while the rest (30.1%) were studying a Master's Degree in Secondary Education. Regarding the gender of the participants, the majority were women (79.5%).

2.2 Instrumentation

The questionnaire used is based on the proposal made in the DigComp project and includes 20 questions grouped into the five competence areas, plus two questions to assess the participants' perception of their own digital competence before and after completing the questionnaire. The responses were recorded in Lickert scale and Google Forms was used to fill in the questionnaire. In addition to these questions, an

extra open-ended question was asked to identify the prospective teachers' perception of the potential use of technology to improve inclusion. Informed consent was obtained to use the data for the analysis.

2.3 Procedure

This study consisted of five phase that ran from September to December 2021.

The first phase consisted in the selection and adaptation of the data collection instrument.

In the second phase, the instrument was distributed during class time, and the participants were told that completion was entirely voluntary.

All of the narratives produced were included in the analysis, because they conformed to the length and subject matter recommendations. The data was then processed. In this third phase, based on the analysis of the narratives as primary documents, the quotations were coded according to four categories related to teaching challenges. The inductive content analysis made it possible to identify the interrelation between elements.

In the fourth phase, the dependent variables (DV) (Table 1) and independent variables (IV) (Table 2) that would guide the statistical analysis of the data were established.

The fifth phase involved the analyses and the drafting of the text to disseminate the results.

Table 1 Dependent variables

Variable type	Variable coding	Definition	Scale
DV	Starting_PDC	Pre-test perception of digital competence.	1–6
	Actual_DC	Average of all digital competence items.	1–6*
	Final_PDC	Post-test perception of digital competence.	1–6
	DC1_Information	Average of questionnaire items measuring digital competence related to digital information location, evaluation, and organisation.	1–3
	DC2_Communication	Average of questionnaire items measuring competence related to digital communication and interaction using new technologies.	1–3
	DC3_Content_Creation	Average of questionnaire items measuring competence related to the use of ICT knowledge to process information and develop digital content.	1–3
	DC4_Safety	Average of questionnaire items measuring digital competence related to the safe handling of digital information.	1–3
	DC5_Problem_Solving	Average of questionnaire items measuring digital competence related to technical problems, innovation, creative use of technology and identification of digital competence gaps.	1–3

* Transformed through: $\text{Real_DC} = 1 + ((\text{DC} - 1) * 2.5)$

Table 2 Independent variables

Variable type	Variable	Groups	Values
IV	Gender	Male Female	
	Educational level	Degree Master's degree	
	Age*	Younger Intermediate Older	Older: percentile 1 to 32, aged 23–42. Intermediate: percentile 33–62, aged 20–22. Younger: percentile 63 and above, aged below 20.
	Level of digital competence*	High Medium Low	Low DC: test values between 1 and 2.07. Intermediate DC: values greater than 2.07 and up to 2.9. High DC: values greater than 2.9.

* Taking as reference the 33rd and 66th percentile values and confirming that there was no age overlap between the 3 samples

2.4 Data analysis

The content analysis of the participants' narratives (Fernández-Rouco, 2020) provided insight into their perception of fundamental aspects of life in the spatial and temporal context where subjectivities are created (Bolívar, 2002). In this case, this includes current challenges in the inclusion of students with SNES and the role of technology in this process. The categorisation of information was done by emergent coding, with an inductive-deductive analysis (Gibbs, 2012). The code system was constructed in this way and the information was triangulated. *WordArt* and *Atlas.ti* were used to represent the data and organise the information.

The statistical analysis was performed using *SPSS 26.0* (IBM, Chicago, USA). The reliability of the questionnaire was measured using Cronbach's alpha, which yielded highly reliable values of 0.89 (Cohen et al., 2008). Mean and standard deviation or median and interquartile range were calculated as descriptors, based on the sample distributions. Previously, K-S normality and Levene's tests were performed to homogenise the variances. To compare the degree of digital competence according to gender and grade, Mann–Whitney U tests were performed. To compare digital competence between the different age groups and between the different groups in the cluster analysis, a Kruskal–Wallis test was performed with subsequent Mann–Whitney U tests to adjust the significance value according to Bonferroni. A hierarchical cluster analysis was performed, using Ward's squared Euclidean distance grouping system, introducing as variables the Starting_PDC, Actual_DC, and Final_PDC, and labelling the cases using the variable Level of digital competence. To compare the different measures of perception and DC, a Friedman test was performed, with subsequent pairwise comparisons using the Wilcoxon test, adjusting for significance according to Bonferroni ($p < .05$).

3 Results and discussion

3.1 Analysis of prospective teachers' narratives

Using critical discourse analysis, we explore the perceptions of future teachers in basic teacher training about the role of technology in education in general and, more specifically, to promote inclusion for every student.

Based on the analysis of the students' narratives, different challenges related to society, the school, digital competence, and the training of educators are identified. These four categories are used to present the results.

Figure 1 shows the result of the content analysis based on the key categories and the relationships between the codes.

As can be observed, there is a link between the challenges identified. Inclusion has a central role in school, in society, and in teacher training, so it cannot be separated from the development of digital competence.

3.2 Digital society as a framework for action

Today's society is characterised by rapid change, in a true situation of technological revolution (Castells, 2003), or by the self-evident and omnipresent delocalisation of teaching-learning processes (Velázquez & López, 2021), which allows us to speak of a liquid society (Bauman, 2001) and of an era of uncertainty (Bauman, 2007) in which hyperconnection emerges as a characteristic of today's society, but also as a continuous and ever-present demand (Cáceres et al., 2017).

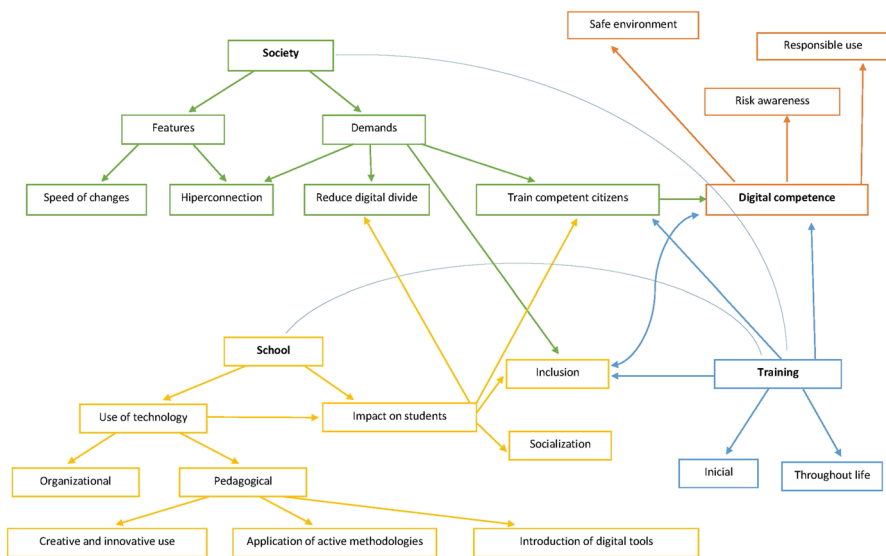


Fig. 1 Analysis categories and coding

In contrast, participants point out the existence of a digital divide.

I think we should not forget that, at least in the current context, not everyone has access to technology, so it can currently be exclusionary (MSE5).

In this regard, recent studies show that digital technologies can be a source of exclusion or discrimination in an environment where digitalisation affects different contexts of everyday life, such as education (Cabero & Ruiz-Palmero, 2017). Despite efforts to reduce or eliminate the digital divide, which is in many cases at the root of inequality, participants in this study still perceive that further measures must be implemented to achieve inclusion for all. However, the participants do recognise that digital educational technologies, devices, and resources can be a key element in helping all learners to be included, participate, and learn, as the following quote shows:

When used the right way, technology can help ensure that all learners have equal opportunities throughout the teaching-learning process. In this way, students with SEN, or those who have some language difficulties, can feel accepted and fulfilled (DPSE15).

In this context, the development of key competences is one of the fundamental objectives of the 21st century school. Given the characteristics of today's society and the potential of technology, it seems clear that schools – and the community as a whole – should encourage the development of digital citizenship skills in students at different educational stages.

3.3 Teachers' and citizens' digital competence

Participants point to the importance of developing digital citizenship competence as one of the key challenges, in line with the findings of Marín et al. (2021b). There is actually a large number of studies focused on Higher Education students, whose final results have improved some of the dimensions of digital competence (Castro et al., 2021).

The participants in this study express the need to acquire learning related to all the areas in digital citizenship competence stated in the DigComp 2.1 framework (INTEF, 2017). An example of this is how the task of creating educational resources, which involves higher-level technical and pedagogical skills, is recognised as part of the teachers' tasks.

In addition, we can create platforms with diverse activities adapted to the needs of each student (so each one can learn at their own pace), use technological games to learn, etc. This way, we will be encouraging autonomy, interaction, motivation, the approach to the digital world, etc. (DPSE55).

As stated by UNESCO (2008), the role of the teacher is key to ensuring that students can develop the skills necessary for life in the 21st century society. Thus,

technology must also be introduced into teacher training, which is another of the major challenges identified by the participants.

3.4 Teacher training as a key to inclusion

Consistent with previous studies, such as those by González-Gil et al. (2019), one of the fundamental challenges and the key to the success of inclusion and the use of digital technologies in schools lies in teacher training, as stated in the following quote:

Teacher training in these areas must also be taken into account, because if teachers are out of date, they will not be able to correctly use the elements that they are trying to implement, which could be of help to everyone (MSE8).

The reason is that training is the seed of change and innovation in teaching-learning processes in schools (Cargua et al., 2019), which must necessarily be inclusive if they aim for quality. One of the participants mentions the need to introduce changes in schools to better respond to the needs of a society that is immersed in constant technological revolution.

Without a doubt, learning how to use the technological possibilities available to us to evolve in terms of educational methodology, because, from my point of view, education is an area that has evolved very little compared to the speed at which everything is changing nowadays (DPSE60).

In basic training (in the Degree in Primary School Education), inclusion and technology contents are clearly perceived as insufficient, and they are actually non-existent in the Master's Degree in Secondary Education. In this line of discourse, recent findings reflect the reality of Educational Sciences curricula. More specifically, the study by Peirats et al. (2018) confirms that the number of credits devoted to the development of digital competence in teaching is limited, or only students in the ICT specialisation offered in some Spanish universities work on these contents, although in some cases, they are developed transversally throughout the teaching degrees. Gabarda et al. (2022) analyses a similar subject with regard to the attention to diversity in the curricula of universities in the Valencian Community (Spain). This idea of insufficiency is reflected in this statement by one of the students:

I believe that the challenges for a future teacher include facing a world surrounded by technology where the teacher will have to adapt to the evolution of ICTs. We will not only have to master ICTs as a means of digital support, but also learn how to integrate technology into our explanations, how to adapt the resources according to the type of students we have in the classroom, etc. It is quite a challenge (DPSE12).

On the other hand, students mention that lifelong training programmes are essential to keep up with advances:

From my point of view, because technologies are very up-to-date nowadays and their use is very important at the academic level, I see the need for future teachers to carry out constant training on new ICTs in order to provide students with new knowledge and broaden their digital competence so that they use them independently in the future (DPSE21).

However, the content of the subjects or the training pathway is entirely up to the individual teacher. That said, despite the wide offer and the availability of multiple opportunities and materials for lifelong learning, several studies conclude that both the educational offer related to attention to diversity and the demand for such courses are limited (Goenechea, 2008). The perception observed in the study about Madrid is not shared in other autonomous regions such as the Valencian Community, where a firm commitment is being made to in-service teacher training to promote both inclusion and technology in schools. Participants specify the topics and objectives they consider relevant for their future career, as in the following example:

As future teachers, it is essential to have lifelong training (what sort of platforms to use, how to use them, etc.), to incorporate more digital elements and resources into our methodology, to promote student confidence and motivation towards this type of platforms, to create a safe environment regarding the use of technology, to modify and adapt assessment, etc. (DPSE19).

In short, training must be directed towards transformative action (Cela-Ranilla et al., 2017) by using technologies from a pedagogical perspective that goes beyond the technical-instrumental approach (Llorente, 2008) to develop citizens, who must be placed at the centre of the teaching-learning process, as already proposed from the perspective of the social construction of knowledge (Mercer, 1995).

3.5 The digitisation of schools

As proposed by Area et al. (2020), the integration of technologies in schools is manifested in both the organisational and the pedagogical spheres. In this sense, future teachers do recognise the value of technology in the 21st century school and of identifying their potential based on the changes they enable, introducing active methodologies and determine which digital tools can be used in schools to improve the inclusion of all students. In fact, some of the participants have a broad view of the needs of the classroom and thus perceive technology both as a tool and as a framework.

I personally see technology as the key to inclusion, because it allows us to develop solutions that make life easier for people with disabilities, slower learners, and anyone with any sort of difficulty. Technology can help adapt educational practice, and it can also help social inclusion by targeting the most disadvantaged sectors of society with specific programmes to help them enter the digital world (MSE37).

The introduction of digital technologies in schools has a strong impact on students, and according to the participants, they allow for the development of skills

such as digital, social, and civic competences, which are key to inclusion. The results include improved achievement in fundamental aspects of life, like autonomy and quality of life.

The results of the quantitative analysis are shown below, in the relationship between digital competence and the participants' gender, education, or age, as well as in the cluster analysis.

3.6 Digital competence and gender

As can be seen in Table 3, the gender variable had no significant influence on any type of digital competence, nor on the pre-test or post-test perception of competence. The average value for both genders remains below 2 for all types of digital competence, as does the average in actual digital competence (ranged 1 to 3), with men obtaining slightly higher average values than women (not significant). Perceived competence values were also higher for men than for women, but, again, the difference was not significant.

3.7 Digital competence and educational level

The type of degree (basic degree or Master's degree) had no significant influence on any type of digital competence either, nor on the pre- and post-test perception of competence. However, the average digital competence was observed to be higher among degree students than among master's degree students, although the latter perceived themselves as more competent (Table 4).

3.8 Digital competence and age

As shown in Table 5, age had a significant influence on DC1_Information and DC3_Content_Creation. Thus, the intermediate age group proved to have higher digital

Table 3 Comparison of different types of digital competence (DC) and perception of digital competence (PDC) according to gender

Variables	Male			Female			<i>p</i>
	M	Mn	IQR	M	Mn	IQR	
DC1_Information	1.85	1.67	1	1.88	1.67	0.67	0.83
DC2_Communication	1.61	1.5	0.5	1.66	1.58	0.67	0.6
DC3_Content_Creation	1.57	1.5	0.5	1.49	1.25	0.5	0.18
DC4_Safety	1.71	1.75	0.5	1.64	1.5	0.75	0.3
DC5_Problem_Solving	1.6	1.5	0.75	1.56	1.5	0.5	0.67
Starting_PDC	3.81	4	2	3.83	4	2	0.97
Final_PDC	3.39	3	1	3.28	3	1	0.59
Actual_DC	2.64	2.55	1.19	2.59	2.37	1.16	0.73

Table 4 Comparison of different types of digital competence (DC) and perception of digital competence (PDC) according to educational level

Variables	Degree			Master's Degree			
	M	Mn	IQR	M	Mn	IQR	P
DC1_Information	1.87	1.67	0.67	1.87	1.67	0.75	0.81
DC2_Communication	1.68	1.67	0.67	1.6	1.5	0.67	0.21
DC3_Content_Creation	1.51	1.5	0.5	1.49	1.25	0.5	0.97
DC4_Safety	1.66	1.5	0.75	1.63	1.5	0.25	0.72
DC5_Problem_Solving	1.59	1.5	0.75	1.51	1.5	0.81	0.24
Starting_PDC	3.84	4	2	3.78	4	1.25	0.68
Final_PDC	3.36	3	1	3.16	3	2	0.43
Actual_DC	2.64	2.43	1.07	2.51	2.43	1.07	0.34

competence in these 2 dimensions ($U = 1106$; $Z = -2.59$; $p = .01$ and $U = 1099$; $Z = -2.3$; $p = .009$) than the younger group. On the other hand, the intermediate group tended to have higher DC3_Content_Creation than the older group ($U = 911$; $Z = -1.95$; $p = .05$) and higher DC5_Problem_Solving ($U = 1196.5$; $Z = -2.03$; $p = .04$) and Actual_DC ($U = 1172.5$; $Z = -2.14$; $p = .03$) than the younger group.

3.9 Cluster analysis

The hierarchical clustering (Fig. 2) indicates 4 different groups in the sample separated approximately 5 units on the y-axis.

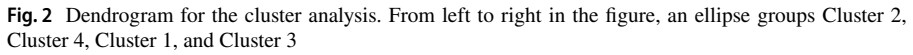
The group variable in the cluster had a significant influence on the DC group ($X^2_6 = 70.3$; $p < .001$; $V = 0.46$). There were no significant differences in Gender, Age Group and Educational Level (Table 6).

The cluster had a significant effect on Starting_PDC ($H3 = 118$; $p < .001$), Final_PDC ($H3 = 114.4$; $p < .001$), and Actual_DC ($H3 = 75.4$; $p < .001$)

Table 5 Comparison of different types of digital competence (DC) and perception of digital competence (PDC) according to age group

Variables	Older		Intermediate		Younger		H	P
	M	Mn(IQR)	M	Mn(IQR)	M	Mn(IQR)		
DC1_Information	1.89	1.67(0.5)	2.01	2(0.67)	1.77	1.67(0.67) #	6.4	0.04
DC2_Communication	1.58	1.5(0.58)	1.71	1.67(0.67)	1.69	1.67(0.67)	3.9	0.139
DC3_Content_Creation	1.49	1.25(0.25)	1.65	1.75(0.75) †	1.42	1.25(0.5) #	7.3	0.026
DC4_Safety	1.69	1.5(75)	1.7	1.75(0.5)	1.61	1.5 (0.25)	1.6	0.438
DC5_Problem_Solving	1.52	1.5(0.5)	1.7	1.5(0.69) †	1.5	1.5(0.5)	4.9	0.088
Starting_PDC	3.8	4(1)	4	4(2)	3.68	4(2)	2.4	0.296
Final_PDC	3.27	3(2)	3.42	3(1)	3.23	3(2)	1.2	0.546
Actual_DC	2.54	2.43(2)	2.84	2.79(1.25) †	2.50	2.31(1.07)	5.6	0.061

Statistically different from the intermediate age group ($P < .017$) and † tendency statistically different from the younger age group ($P < .05$)



The symbols *# † ‡ are used to denote significant differences between the pairwise comparisons with Bonferroni significance adjustment ($p < .0125$): * is used for differences with Cluster 1, # for differences with Cluster 2, † for differences with Cluster 3, and ‡ for differences with Cluster 4.

The effect of the measure (Table 8) had a significant effect on initial and final PDC, and their relation to the DC measure for Cluster 1 ($X^2_2=30.5$; $p<.001$), Cluster 2 ($X^2_2=101.6$; $p<.001$), Cluster 3 ($X^2_2=15$; $p=.001$), and Cluster 4 ($X^2_2=16.6$; $p<.001$). Thus, we observe (Tables 7 and 8) that in Clusters 1 and 2 there is a significant decrease between starting and final PDC, with the latter being significantly higher than Actual_DC. In Cluster 3, PDC decreased

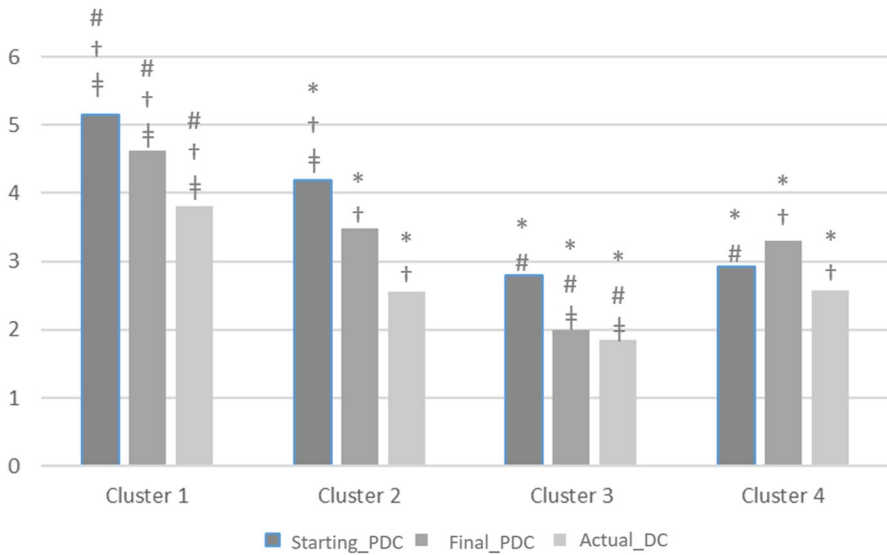
Table 6 Comparison of the different types of participants according to cluster

Variables	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
	N	%	N	%	N	%	N	%
DC Group								
Low	0	0*	21	29.2a	28	73.7b	7	26.9a
Medium	2	7.4a	27	37.5b	9	23.7.b	10	38.5b
High	25	92.6a	24	33.3b	1	2.6c	9	34.6b
Gender								
Male	7	25.9	13	18.1	7	18.4	4	15.4
Female	20	74.1	59	81.9	31	81.6	22	84.6
Age Group								
Older	7	25.9	22	31.4	13	34.2	7	26.9
Intermediate	11	40.7	22	31.4	6	15.8	9	34.6
Younger	9	33.3	26	37.1	19	50	10	38.5
Educational level								
Degree	20	74.1	50	69.4	24	63.2	20	76.9
Master's Degree	7	25.9	22	30.6	14	36.8	6	23.1

* This category is not used in column ratios because its ratio is equal to 0

Table 7 Comparison of different types of digital competence (DC) and perception of digital competence (PDC) according to educational level

Variables	Cluster 1			Cluster 2			Cluster 3			Cluster 4		
	M	Mn	IQR	M	Mn	IQR	M	Mn	IQR	M	Mn	IQR
Starting_PDC	5.15	5	0	4.19	4	0	2.79	3	1.25	2.92	3	0
Final_PDC	4.63	5	1	3.49	4	1	2c	2	0	3.31	3	1
Actual_DC	3.8	3.7	0.95	2.55	2.55	0.95	1.85	1.83	0.71	2.58	2.55	1.07

**Fig. 3** Effect of cluster group in PDC and DC

significantly from the initial moment to after the test, showing an adjustment (similar results) between Final_PDC and Actual_DC. Finally, Cluster 4 was the only one showing an increase in PDC from the initial state to the final one, intensifying the difference with respect to Actual_DC.

In summary, Cluster 1 had the highest digital competence of the 4 clusters. Its members also had the highest perception of digital competence of all. Three out

Table 8 Comparison of measurements of perceived digital competence (PDC) and digital competence (CD) for each cluster

Cluster N	Starting_PDC vs. Final_PDC	Final_PDC vs. Actual_DC
Cluster 1	Z= -3.28; p= .001	Z= -3.51; p< .001
Cluster 2	Z= -6.27; p< .001	Z= -6.4; p< .001
Cluster 3	Z= -3.53; p< .001	Z= -1.5; p< .001
Cluster 4	Z= -3.16; p= .002	Z= -3.5; p< .001

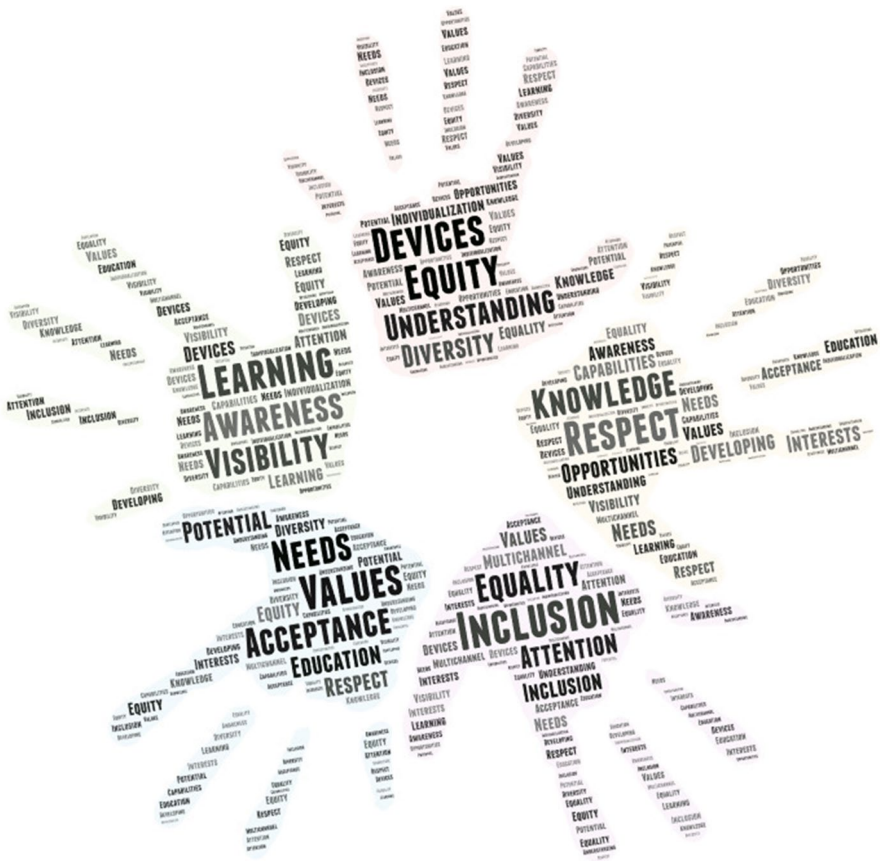


Fig. 4 Most frequent keywords

of four members in this group are women, mostly in the intermediate age group, and also three quarters of them were undergraduates.

On the other hand, Cluster 3 was characterised by a significantly lower actual digital competence, but was the most realistic in terms of perceived competence and its similarity to actual competence. This group was characterised by a majority of women (4 out of 5) and of the group of younger participants studying the degree (2 out of 3).

The third and fourth groups (Clusters 2 and 4) were characterised by having an actual digital competence value between the two groups described above. However, the main differences between cluster 2 and cluster 4 groups were that cluster 4 had more realistic perceptions than cluster 3, with significantly closer perceived competence and actual competence values; cluster 4 was the only cluster that improved its PDC from the baseline to after the test. Both groups also consist mostly of undergraduate male participants from the younger age group.

4 Discussion and conclusions

The ultimate aim of education is the comprehensive development of all individuals, because education is a right, and in a fair and equitable society such as the one we are trying to achieve in the 21st century, inclusion is an unquestionable requirement in a developed society. Inclusion involves not only allowing everyone to *be* there, but also to participate and learn, and the views of educators in training are key to a better understanding of the state of play and be able to facilitate opportunities from a universal perspective (Andriushchenko et al., 2020).

From a mixed approach, the current analysis gives a voice to the professionals of tomorrow so that they can identify needs, problems, and proposals for a positive, responsible, and critical use of technologies for the inclusion of every student.

This work identifies shared concepts, but also singularities in the perception of a complex reality in a society where the technologies play a key role (Marín et al., 2021a).

The results show that the participants consider different concepts that are key to inclusion (Fig. 4).

In any case, the challenges identified remain to be studied in the near future, based on the analysis of the participants' responses and consistently with previous work (Marín & Castro, 2021). In order to address them, four major issues need to be tackled in a profound and systematic way, with the involvement of the entire educational community.

Concerning the results on digital competence, there is a noticeable idealisation of one's own competence, also evidenced in previous studies such as Cabero et al. (2020). There are also differences depending on the areas of development of the different competences, and the need to promote lifelong training plans aimed at developing strategies for attention to diversity and inclusion mediated by ICTs is made explicit (Cabero-Almenara et al., 2022). In this way, it will be possible to promote greater knowledge of how to implement technology for inclusion and overcome the low skills that teachers currently have in this area (Fernández-Batanero et al., 2022).

As for the study limitations, the results of the qualitative analysis cannot be extrapolated to the rest of the population, but this is one of the characteristics of studies carried out using this methodological approach, and the proposed solution is to combine them with the results from the quantitative analysis. The second limitation lies in the gender mismatch in the sample, especially in the case of the Degree in Primary Education, which is explained by the tendency of women to choose studies linked to the stereotypically female social roles, such as childcare. This has been the case for a long time, at least in Spain (Marín et al., 2021c).

Finally, in terms of future lines of research, the analysis might focus on comparing these results with others obtained from educators in non-compulsory educational stages such as Early Childhood Education or Higher Education, as well as comparing teachers in basic training with the actual use that working teachers make of technology for the inclusion of all students. Another potentially interesting analysis might focus on competence areas, to reconsider the design of training actions for inclusion at school.

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Declarations

Conflict of interest None.

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