

# Pre-Service Teachers' Perceptions of the Role of ICT in Attending to Students with Functional Diversity

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## Abstract

Educational technology offers multiple opportunities for students with functional diversity. For an enriching implementation, it is necessary to develop both aforementioned constructs in initial teacher training. Bearing this in mind, the objective of this study is to analyse pre-service teachers' perceptions of the role of ICT in attending to diversity. A quantitative and longitudinal design was constructed with pre-test and post-test measures, as well as descriptive, inferential, and predictive approaches. The sample included 284 pre-service teachers, and an adaptation of Subscale 1 from the "Demands and potentials of ICT and apps for assisting people with autism" questionnaire (DPTIC-AUT-Q) (Rodríguez-Fuentes et al., 2021) was used. The results indicated the pre-service teachers' positive perceptions regarding the use of ICT with students with functional diversity, revealing significant differences according to gender in the post-test. The digital competence variable is relevant for predicting the perceptions of both genders, in addition to the time and interest variables for men, and the confidence and adequate training variables for women. As a result, the positive impact that the implementation of a module on ICT and attention to diversity had on the pre-service teachers is discussed, with such an intervention being key for an improvement in working with these types of students.

**Keywords:** Information and Communication Technologies, Functional diversity, Teacher training, Digital competence

## Introduction

In an increasingly digitized society that affects all spheres (cultural, political, economic, or educational), Information and Communication Technology (ICT) has become an effective tool for mediating and promoting learning (Cabero-Almenara et al., 2021). Pre-service teachers must have a good level of digital competence to integrate ICT into educational processes (Hatlevik et al., 2018). To achieve this, it is necessary to offer quality training plans on educational technology both in initial and continuous training, that include research, theoretical, instrumental, methodological, and strategic knowledge for its implementation (Cabero-Almenara et al., 2016; Guillén-Gámez et al., 2020).

Among the different possibilities that ICT offers, it has allowed for the development of multiple educational opportunities for students with functional diversity (Budnyk, & Kotyk, 2020; Wedyan et al., 2021). The appropriate use of educational technology for attending to students with functional diversity has become a training requirement for pre-service teachers, with there being a latent concern in university contexts for the improvement and strengthening of such training (Kurt et al., 2016). At an international level, the United Nations calls for equitable and inclusive quality education in the fourth

objective of its Sustainable Development Goals (SDG) (United Nations, 2015). Consequently, inclusive education has become a requirement for all educational centres (Moliner et al., 2020). To promote learning for all people regardless of their abilities, needs, or challenges, it was necessary to create accessible and inclusive educational environments. In the educational field, this task was given the name Universal Design for Learning (UDL). This framework was developed as a proactive measure to attend to diversity (Rodríguez-Fuentes et al., 2021), where the incorporation of ICT for the personalisation of learning processes is key (Cothren, & Rao, 2018). In this way, technological advances were one of the main factors that promoted the application of UDL (Basham et al., 2020).

The focus, therefore, was to ensure inclusive educational proposals for all students using resources and methods that yield positive academic results (Ainscow, 2020; [Cored et al., 2022](#)), without forgetting that the process is under continuous reconstruction and improvement (Echeita, 2017). To this end, it became crucial to have a good level of digital competence to use ICT effectively in response to students' needs, thereby promoting inclusion (Cabero-Almenara et al., 2022). In this way, technology was established as a pillar that allowed for the development of teaching and learning processes that are adapted to students' capabilities and interests ([Fernández Batanero et al., 2022](#)).

In light of the above, the objectives of this study are as follows:

- O1. Analyse pre-service primary school teachers' perceptions of the role of technology in attending to diversity through a pre-test and post-test study design.
- O2. Determine if significant differences exist in the perceptions of the pre-service teachers according to gender in both moments (pre-test vs. post-test).
- O3. Identify significant predictors for each gender once the post-test is completed.

## **Theoretical Framework**

The use of ICT for students with disabilities has become an increasingly common topic in the field of research ([Hajjar et al., 2021](#); Mercado et al., 2021; Sweidan et al., 2019).

Focusing on the perceptions or training of education professionals in relation to applying ICT with students with functional diversity, there are studies that have yielded medium to low scores. This was the case in Fernández Batanero et al.'s (2017) study, where within a sample of 425 primary teachers, the men, despite their low perceptions, obtained better scores than the women, with the greater amount of time that men dedicate to learning about ICT being a potential influencing factor (García-Marcos et al., 2020). Ortiz-Jiménez et al. (2020), who investigated the perceptions of 2396 education professionals, had similar results. These results reflected the teachers' low perceptions of their ability to use ICT with students with functional diversity, with no significant differences in the scores according to gender. Along the same lines, Cabero-Almenara et al. (2022) conducted a study with 1194 teachers, which also produced medium to low-level results, with gender (women scored better than men) and motivation (greater interest in working with students with functional diversity through ICT) being key factors in the expansion of teaching knowledge.

Due to its link with the present study, Fernández Batanero et al.'s (2018) study, which focused on preparing pre-service teachers for ICT use in the interest of educational

inclusion, stood out. With a sample of 777 participants, the scores indicated low skill levels for using ICT with students with disabilities. The same was found in a study carried out by Toledo and Llorente (2016), where 154 pre-service primary teachers displayed low perceptions regarding their knowledge on applying ICT with students with disabilities.

On the other hand, studies that report teachers' positive perceptions of ICT use in order to achieve inclusive education were also found. Among in-service teachers, studies by Al-Attiyah et al. (2020) with 183 primary teachers and by Arouri et al. (2020) with 83 childhood teachers, both in Qatar, reflected a high use of ICT and positive perceptions of its impact on the educational processes of these students. In line with this, Sanahuja et al. (2020) obtained positive evaluations by teachers and did not find gender to be a factor that produces significant differences in their perceptions. Vega-Gea et al. (2021), on the other hand, analysed the perceptions of 99 teachers regarding the use of ICT in inclusive education, obtaining positive evaluations of its implementation without any significant differences according to gender. Moreover, the teachers exhibited better perceptions if they had more specialized training on the topic. Focusing on pre-service teachers, Pegalajar (2017) examined the perceptions of 231 childhood and primary teachers in training and found positive assessments regarding the use of ICT with students with different educational needs.

## Method

*Design.* This study followed an ex post facto and pre-experimental quantitative and longitudinal design with pre-test and post-test measures. **The data were collected through a questionnaire addressing the perceptions of the role of technology in assisting people who present some sort of functional diversity in two separate moments (pre-test and post-test). After compiling the participants' data in both moments, descriptive and inferential analyses of the sample as a whole were conducted, with the gender variable also being taken into account.**

*Sample.* Non-probability sampling was used (for convenience) among the students in the "Information and Communication Technology Applied to Education" class within the undergraduate Primary Education program in the Faculty of Education at the University of Málaga during the 2021/2022 school year. A sample of 284 students was obtained, where 54.58% ( $n = 155$ ) were female and 45.42% ( $n = 129$ ) were male, **with an average age of  $18.87 \pm 1.176$ .**

*Instrument.* In order to understand the perceptions of pre-service teachers regarding the use of technology to assist students with functional diversity, an adaptation of Subscale 1 from the "Demands and potentials of ICT and apps for assisting people with autism" (DPTIC-AUT-Q) questionnaire developed by Rodríguez-Fuentes et al. (2021) was used. This subscale analyses "Opinion, Training and Uses of ICT by Professionals for Assisting People with Functional Diversity", **and it is based on previous studies regarding attention to diversity and the role of technology in the context of formal education (Cabero-Almenara et al., 2016; Fernández-Batanero et al., 2017; Ortiz-Colón et al., 2014; Pegalajar, 2015).**

The subscale is composed of three dimensions (Opinion, Requirements and Possibilities, and Training in ICT for Functional Diversity) with a total of 22 items. **The "Opinion" dimension (DIM A) was made up of items regarding professionals' opinions about ICT**

use for working with people with functional diversity. The “Requirements and Possibilities” dimension (DIM B) focused on the demands and potential of ICT for its use in attending to people with functional diversity. The “Training in ICT for Functional Diversity” dimension (DIM C) consisted of items centred on ICT training for professionals who work with people with functional diversity. A 5-point Likert scale was used to measure the items, with response options varying according to level of agreement (1 = Strongly Disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly Agree).

The psychometric properties of the adapted questionnaire were verified. To do so, the construct validity was verified first through exploratory factor analysis (EFA) and, subsequently, through confirmatory factor analysis (CFA). Once the model was validated, the reliability of the instrument was authenticated using SPSS V.24 and AMOS V.24 software.

With respect to the internal and latent structure analysis of the instrument, the maximum likelihood method with Oblimin rotation was used for the EFA to understand the relationship between the dimensions. The Kaiser-Meyer measure of sampling adequacy (KMO = 0.811) as well as Bartlett’s test of sphericity ( $\chi^2 = 1166.169$ ;  $gl = 120$ ;  $sig. = 0.001$ ) demonstrated the dimensionality of the instrument. The model revealed the presence of three factors that explained 48.53% of the true variance in the scoring of the instrument. Specifically, dimension C explained 25.71% of the true score, dimension B 13.48% of the variance, and dimension A 9.34%. The items with influence values under .30 were eliminated from the final instrument for this study. As a result, the refined version of the instrument after EFA comprised 16 items.

The theoretical and latent proposal provided by the EFA was verified through structural equation modelling (CFA). The maximum likelihood method was used again, adopting the thresholds recommended by Hu and Bentler (1999): minimum discrepancy (CMIN), chi-square fit statistics/degree of freedom (CMIN/DF), the Comparative of fit Index (CFI), the Parsimony Comparative of fit Index (PCFI), Normed Fit Index (NFI), the parsimony normalized fit index (PNFI), the Incremental Index of Fit (IFI), the Tucker–Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). The model proposed by EFA was composed of a total of 16 items and 3 correlated latent dimensions, which demonstrated the factorial structure formulated in the EFA. In Table 1, the coefficients provided by the final satisfactory model in addition to the recommendations made by Hu and Bentler (1999) can be seen. Moreover, the structural equation modelling diagram, which shows the correlations found between the items and the dimensions, can be found in Appendix 1.

**Table 1.** Coefficients of the CFA model and recommended values

Indexes	Model coefficients	Hu & Bentler (1999) recommendations
CMIN	176.906	< 500
CMIN/DF	1.752	<3
CFI	.929	> 0.9
PCFI	.782	> 0.7
NFI	.852	> 0.7
PNFI	.717	> 0.7
IFI	.930	> 0.9

TLI	.916	> 0.9
RMSEA	.052	< 0.070

The analysis of the internal consistency of the final version of the instrument, calculated by using Cronbach's alpha coefficient, reached an acceptable level of reliability ( $\alpha = 0.793$ ).

Regarding the predictor variables, the Digital Competence Questionnaire for Pre-service Teachers (DCQPST) (Cabero et al., 2020) was included. This instrument is composed of 5 dimensions and 20 items that address aspects such as technological literacy, the search for and processing of information, or digital citizenship. Scoring is based on an 11-point Likert scale (0 to 10 inclusive). The questionnaire possesses an excellent level of reliability ( $\alpha = 0.931$ ) and fulfils the CFA's criteria of psychometric validity (CMIN = 176.88; GFI = 0.944; PGFI = 0.758; NFI = 0.993; PNFI = 0.836). The criterial validity for the study sample was achieved among the instruments, as reflected by the moderate positive relationship obtained in Spearman's correlation ( $r = .757$ ).

*Procedure and data analysis.* The study was carried out in the context of the "Information and Communication Technology Applied to Education" class. **Within the course syllabus, there is a module on technology and attention to diversity. In this module, called "Regulatory framework for the use of ICT in education. Attention to diversity", the professor addresses the role of ICT in working with diversity, explaining the technology implementation processes for students with different educational needs and covering the most common technologies and software, delving into resources for each possible disability (visual, auditory, motor, or cognitive). In this way, the students can understand the possibilities that ICT offers students with functional diversity, the requirements and necessities that arise when implementing ICT with these students, and the training that is needed to properly address and work with functional diversity.**

Considering the objective of understanding the students' perceptions of the role of technology in attending to diversity, it was decided to analyse their assessment of the issue at two distinct moments: (1) before starting the module on technology and attention to diversity, due to its specific nature and its relation to the study at hand, and (2) after finishing this module of contents in order to assess the evolution of their perceptions resulting from the knowledge acquired over the course of the module. For data collection, a digital questionnaire (GoogleForms) was distributed electronically.

Regarding the statistical techniques used, the following points are considered:

- The descriptive statistics from the pre-test and post-test were examined. To test for the existence of significant differences between both moments (pre-test vs. post-test), Levene's test and Student's t test were applied to paired samples that passed the Kolmogorov-Smirnov test ( $p > 0.05$ ). For the effect size, Rosenthal's  $r$  was calculated, which established values of 0.2, 0.5, and 0.8 as small, medium, and large effects respectively (Rosenthal et al., 1994).
- For contrast analysis of the gender variable, Levene's test and Student's t test for independent samples were applied when the normality criterion was fulfilled ( $p > .05$ ). In order to calculate the sizes of the significant differences, Rosenthal et al.'s (1994)  $r$  was again used.
- To discover if predictors based on gender significantly influence perceptions of the role of technology in attending to diversity, multiple linear regression (MLR)

using the total scores from the post-test (summation of all the dimensions) was carried out. Moreover, the non-violation of the assumptions that allow for this type of technique to be used was also studied.

## Results

This section is divided into three subsections: the first analyses and contrasts the students' perceptions in the pre-test and post-test; in the second, a statistical contrast comparing the beginning and end of the study (pre-test vs. post-test) was executed for each gender; and in the third, significant predictors that affect the students' perceptions of the role of technology in attending to diversity were identified for each gender once the study was finished (post-test).

### *Students' perceptions before and after the technology and attention to diversity module*

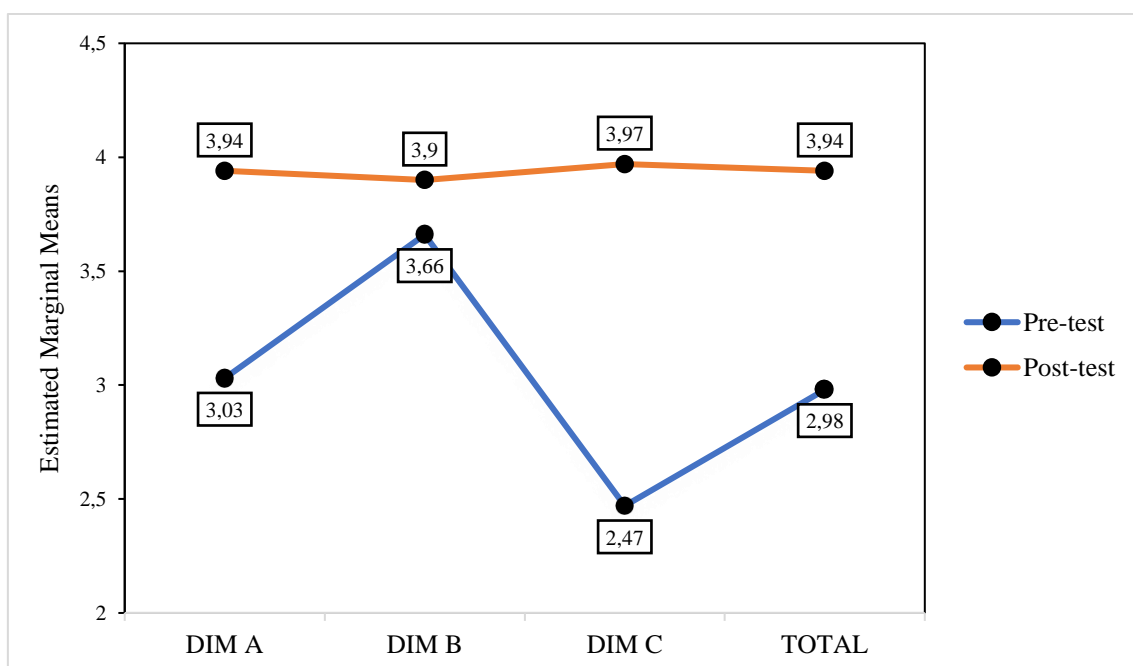
Students' perceptions regarding the role of technology in attending to diversity were examined prior to the start of the module on technology and attention to diversity (pre-test) and after its conclusion (post-test). In Table 2, the definitive structured items in their dimensions of reference are included, as well as the average scores obtained in the pre-test and post-test.

**Table 2.** Descriptive statistics for the dimensions and items regarding the students' perceptions before and after implementing the technology and attention to diversity module

Dimension	Pre-test	Post-test
	M	M
A. Opinion: ICT for People with Functional Diversity...	3.03	3.94
- OP3. Provide greater flexibility in the teaching-learning process	3.13	3.94
- OP5. Are easy to use in attending to diversity	3.18	3.93
- OP6. Enable inclusion	3.05	3.99
- OP7. Offer multiple opportunities in attending to diversity	3.00	3.97
- OP10. Make access to information possible	3.13	3.92
- OP11. Make it possible to achieve aims in a more flexible way	3.18	3.92
B. Requirements and Possibilities: Demands and Necessities of ICT for Assisting People with Functional Diversity...	3.66	3.90
- RP12. They require greater commitment and effort in my work	3.60	3.82
- RP13. They require specific training	3.69	3.95
- RP14. They need more material means and investment by management	3.76	3.99
- RP15. They help give more attention to diversity	3.59	3.85
C. Training in ICT for Functional Diversity: ICT Training of Professionals for Assisting People with Functional Diversity...	2.47	3.97
- FD16. I know the main limitations that can condition its use	2.42	3.92
- FD17. I know different internet sites where I can find specific resources	2.53	3.94
- FD18. I know how to design activities with non-specialist educational software	2.41	3.93
- FD19. I feel prepared to help them in the use of technical aids and use of ICT	2.42	4.12
- FD20. It makes it easier for me to design and adapt activities	2.47	4.01
- FD21. It helps me to carry out assessment	2.56	3.90

As can be observed, the scores are higher in all the items after concluding the module on attention to diversity with ICT. In the pre-test, it is important to recognize that the highest levels of agreement are found in connection with the items that make up the “Requirements and Possibilities” dimension, due to the fact that it includes aspects such as items 13 (M = 3.69) and 14 (M = 3.76), which highlight the need for materials and specific training in order to help students with difficulties. For this reason, the lowest levels of agreement are linked to the “Training in ICT for Functional Diversity” dimension in items such as 18 (M = 2.41), which is related to the students’ perceptions of their ability to design activities with non-specialised software. As for the post-test, the growth of the items’ scores is very substantial in terms of range in dimensions C and A; however, it is lower in dimension B. It should also be noted that the scores are quite similar for all the items, item 12 (M = 3.82), which refers to the level of commitment and effort required when working with students with functional diversity, being scored the lowest, while item 19 (M = 4.12), which reflects the positive perception of feeling prepared to assist students with such diversity using ICT, received the highest score.

Regarding the dimensions and the questionnaire as a whole, the results reveal an increase in the scores from the pre-test to the post-test, thereby raising the averages by between 0.24 and 1.50 points in these dimensions and in the overall questionnaire (Figure 1). In this way, it can clearly be seen how the students’ perceptions regarding the role of technology in attending to diversity improved after the implementation of the educational module. It should be noted that dimension B was ranked highest in the pre-test with an overall level of agreement (M = 3.66), whereas it was rated lowest in the post-test, simply maintaining the agreement level, however with a higher score (M = 3.90). On the other hand, dimension C received the lowest ratings in the pre-test, with an overall level of disagreement (M = 2.47), then reaching the highest score of agreement in the post-test (M = 3.97). As for dimension A, it was initially met with indifference or neutrality in the pre-test (M = 3.03) but rose to achieve a level of agreement in the post-test (M = 3.94). Looking at the questionnaire as a whole, the initial overall score indicated indifference or neutrality (M = 2.98), subsequently increasing to agreement (M = 3.94).



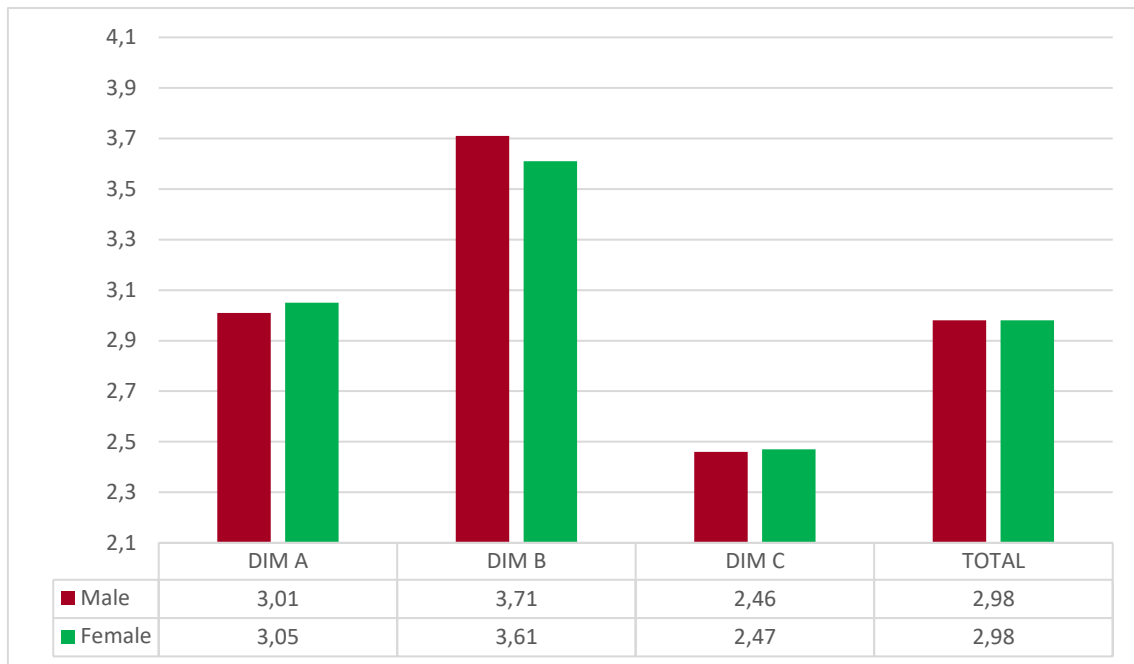
**Figure 1.** Students' perceptions before and after implementing the technology and attention to diversity module.

The data confirm the existence of significant differences between the pre-test and post-test scores in all the dimensions and in the questionnaire as a whole. In regard to the dimensions, a significant increase can be observed in the group of students' scores that reflect their perceptions before and after studying the technology and attention to diversity module. This can be seen in DIM A ( $t = -21.531$ ,  $p < .05$ ) with a medium effect size ( $r = .684$ ), in DIM B ( $t = -11.213$ ,  $p < .05$ ) with a small effect size ( $r = .356$ ), and in DIM C ( $t = -35.399$ ,  $p < .05$ ) with a large effect size ( $r = .815$ ). The same occurred with the questionnaire as a whole ( $t = -40.589$ ,  $p < .05$ ), which also had a large effect size ( $r = .816$ ).

*Statistical contrast of the students' perceptions with respect to gender and the moment of the methodology's application*

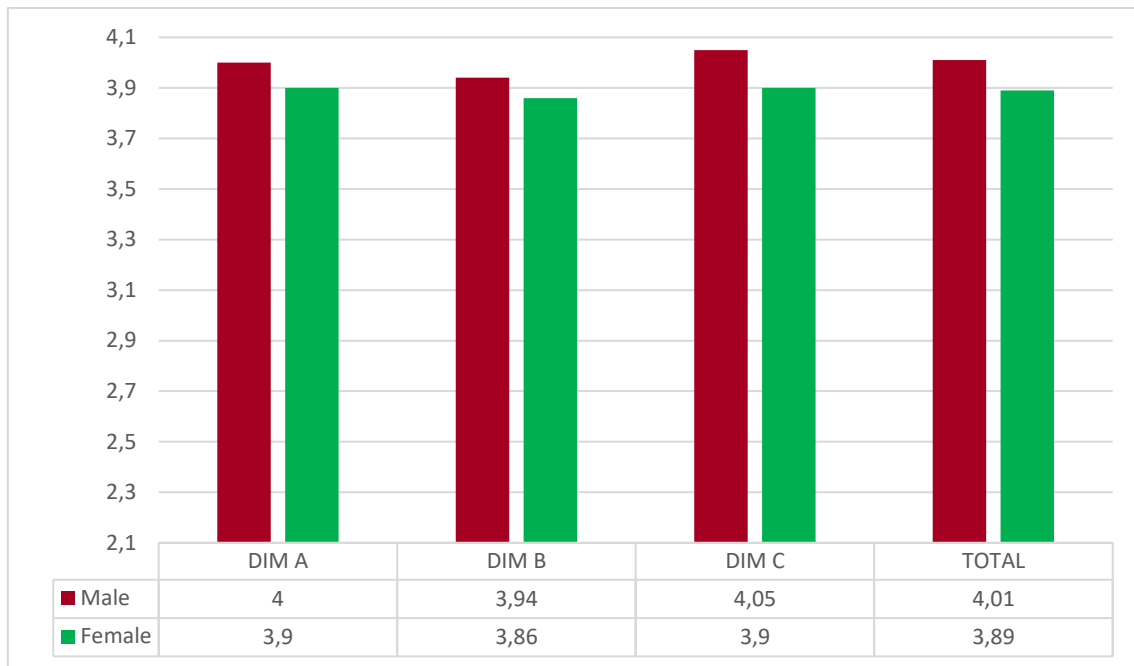
In Figure 2 and 3, the results for each of the instrument's dimensions as well as the total scores, which are classified according to gender and the moment of the test's application (pre and post), can be observed by means of a measure of central tendency (mean).

Regarding the pre-test (Figure 2), it was noted that the students' assessment of DIM A was neutral, with that of the female students being slightly higher ( $M = 3.05$ ) in comparison with that of the male students ( $M = 3.01$ ), although there were no significant differences between the two genders ( $t = -.602$ ;  $p = .547$ ). The students' perceptions in DIM B revealed an acceptable level of agreement, the male students' average score ( $M = 3.71$ ) being higher than that of the female students ( $M = 3.61$ ), constituting a significant difference between their scores ( $t = 2.504$ ;  $p = .013$ ) with a very small effect size ( $r = .153$ ). Dimension C reflected the students' disagreement, being rated better by the female students ( $M = 2.47$ ) than by the male students ( $M = 2.46$ ), despite not establishing a significant difference between the two genders ( $t = -.175$ ;  $p = .861$ ). Lastly, the students' overall perceptions involving the entirety of the instrument reached the same score for both genders ( $M = 2.98$ ), aligning with indifference or neutrality without any significant differences between the scores of each group ( $t = .067$ ;  $p = .946$ ).



**Figure 2.** Pre-test descriptive statistics according to the gender variable.

As for the post-test (Figure 3), DIM A generated all-around agreement with a slightly more positive viewpoint in the male students ( $M = 4.00$ ) in comparison with the female students ( $M = 3.90$ ), yielding a significant difference between the two scores ( $t = 2.426$ ;  $p = .016$ ) with a very small effect size ( $r = .130$ ). In regard to the students' perceptions involving DIM B, an acceptable level of agreement was maintained for both genders, with higher scores resulting from the male students ( $M = 3.94$ ) than from the female students ( $M = 3.86$ ), constituting a significant difference ( $t = 2.221$ ;  $p = .027$ ) with, again, a very small effect size ( $r = 0.132$ ). With respect to DIM C, the scores of the male students proved to be slightly higher ( $M = 4.05$ ) when compared with those of the female students ( $M = 3.90$ ), also establishing a significant difference between their scores ( $t = 3.250$ ;  $p = .001$ ) with another small effect size ( $r = 0.187$ ). Lastly, in the total scores of the questionnaire, the overall viewpoint of the male students was higher ( $M = 4.01$ ) than that of the female students ( $M = 3.89$ ), both of which align with an assessment of agreement, thereby producing a significant difference in their perceptions ( $t = 3.517$ ;  $p = .001$ ) with a small effect size ( $r = 0.211$ ).



**Figure 3.** Post-test descriptive statistics according to the gender variable.

Finally, the results of the statistical contrast (Levene's test and Student's t test for paired samples) between the pre-test and post-test can be seen in Table 3 for each dimension of the instrument and for each gender. Significant differences between the pre-test and post-test can be observed for both genders, with large effect sizes for DIM C and the total score of the instrument, a medium effect size for DIM A, and a small one for DIM B.

**Table 3.** Student's t test for paired samples between the pre-test and post-test perceptions according to gender

Dimension	Male			Female		
	t	p.	r	t	p.	r
DIM. A	16.021	.000*	0.713	14.662	.000*	0.660
DIM. B	7.184	.000*	0.362	8.610	.000*	0.357
DIM. C	24.579	.000*	0.821	25.727	.000*	0.811
TOTAL	29.807	.000*	0.829	28.273	.000*	0.810

\* Significance level at 0.05

#### *Predictive analysis of the perceptions regarding the role of technology in attending to diversity according to gender*

Looking into objective 3, several variables that influence the students' perceptions of the role of technology in attending to diversity have been identified. To this effect, multiple linear regression (MLR) was applied. The regression model was centred on the total scores from the post-test regarding the students' perceptions (summation of all the dimensions) according to the gender variable. The different independent variables analysed for each gender in the MLR model are indicated in Table 4. Each predictor has been assigned an ID code, and the type of variable as well as the measurement scale and possible categories that each one possesses have been described.

**Table 4.** Description of the variables

Code	Variable	Type	Measurement scale	Categories
IV1	Time	Quantitative	Ordinal	Likert 5 points
IV2	Adequate training	Quantitative	Ordinal	Likert 5 points
IV3	Interest	Quantitative	Ordinal	Likert 5 points
IV4	Confidence	Quantitative	Ordinal	Likert 5 points
IV5	Resistance to change	Quantitative	Ordinal	Likert 10 points
IV6	Test DCQPST	Quantitative	Ordinal	Likert 10 points
IV7	Age	Quantitative	Reason	

Normality was achieved in the post-test's total for both genders through the Kolmogorov-Smirnov test (Male:  $KS = .177$ ;  $p. > .05$ ; Female:  $KS = .126$ ;  $p. > .05$ ). The Durbin-Watson statistic indicated the independence of the residuals for both genders (Male: D.W. = 1.612; Female: D.W. = 1.412), since the statistic was close to the value 2 (Chen, 2016). Multicollinearity was verified through the tolerance values (higher than .6) and the variance inflation factor (VIF) with values lower than 10, which indicates non-collinearity (Chan, 2004; Ghani & Ahmad, 2010). The values from the model for each gender are listed in Table 5.

**Table 5.** MLR predictive model

Gender	R	R <sup>2</sup>	R <sup>2</sup> Adjusted	Std. Error
Male	.801	.642	.618	.18987
Female	.699	.489	.461	.17958

\* Significance level at 0.05

In Table 6, the significant predictors, categorized by gender, can be found.

**Table 6.** Model coefficients

Gender	Code	Standardized Coefficients $\beta$	t	p.	Tolerance	VIF
Male	<i>Constant</i>	3.527	10.072	.000		
	IV1	.037	2.032	.044	.610	2.440
	IV3	.064	3.254	.001	.665	1.503
	IV6	.004	7.009	.000	.682	2.075
Female	<i>Constant</i>	3.280	13.795	.000		
	IV2	.081	5.746	.000	.782	1.279
	IV4	.051	3.561	.000	.682	1.718
	IV6	.002	3.428	.001	.605	1.979

\* Significance level at 0.05

Starting with the male group of students, the significant predictors were time ( $t = 2.032$ ;  $p. < .05$ ), interest ( $t = 3.254$ ;  $p. < .05$ ), and the DCQPST test ( $t = 7.009$ ;  $p. < .05$ ). The resulting equation is as follows:

$$\text{Male} = 3.527 + 0.037*\text{Time} + 0.64*\text{Interest} + 0.004*\text{Test DCQPST}$$

Lastly, regarding the female group of students, the significant predictors were adequate training ( $t = 5.746$ ;  $p. < .05$ ), confidence ( $t = 3.561$ ;  $p. < .05$ ), and the DCQPST test ( $t = 3.428$ ;  $p. < .05$ ). The corresponding equation is as follows:

$$\text{Female} = 3.280 + 0.081*\text{Adequate Training} + 0.51*\text{Confidence} + 0.002*\text{Test DCQPST}$$

## Discussion

In an increasingly digital context, ICT is a pillar for the development of inclusive and equitable educational processes for students with functional diversity. To this end, it is necessary for pre-service teachers to receive quality initial training where education that attends to diversity through technology is promoted. For this reason, the present study focused on pre-service teachers' perceptions before and after the implementation of an educational module on ICT and attention to diversity, as well as an analysis of predictors that may influence their perceptions.

Regarding the analysis of pre-service teachers' perceptions of the role of technology in attending to diversity, there are high positive perceptions overall after the implementation of the module on technology and attention to diversity. These positive evaluations were consistent with those of other studies (Pegalajar, 2017; Sanahuja et al., 2020; Vega-Gea et al., 2021). However, other studies (Cabero-Almenara et al., 2022; Fernández Batanero et al., 2017; Ortiz-Jiménez et al., 2020) contradict such findings, reflecting low teacher training in the application of ICT with students with functional diversity. It should specifically be noted that there was agreement among the participants of the present study on the positive impact of incorporating ICT in the educational processes of students with functional diversity, which aligns with other studies (Al-Attiyah et al., 2020; Arouri et al., 2020; Perera-Rodríguez, & Moriña Díez, 2019). Additionally, the pre-service teachers upheld the importance of adequate and specific training on incorporating ICT in education for students with functional diversity. This ultimately corresponds with studies that reflect low levels of teacher training on how to incorporate technology in order to help these students (Cabero-Almenara et al., 2016; Fernández Batanero et al., 2017; 2022; Ortiz Colón et al., 2019; Vega-Gea et al., 2021). Moreover, the participants also agreed that the problem with ICT and attending to students with functional diversity is linked to teachers' low levels of knowledge on how to use such materials with these students and the need for resources as well as investment for their implementation. This was the case in the present study, where the perceptions of pre-service teachers reflected low results for the previously mentioned aspects, which also occurred in other studies (Ahmed, 2018; Fernández Batanero et al., 2018; 2022).

Regarding differences according to gender, the men had better perceptions of ICT use for attending to students with functional diversity, with there being significant differences primarily in the post-test. These results coincided with those of different studies (Emmers et al., 2020; Fernández Batanero, & Colmenero, 2016; Fernández Batanero et al., 2017), whereas they contradicted other studies that did not find such differences according to gender (Beacham, & McIntosh, 2014; Cabero-Almenara et al., 2022; Llorent et al., 2020; Ortiz-Jiménez et al., 2020; Pegalajar, 2017; Sanahuja et al., 2020; Vega-Gea et al., 2021).

As for the identification of predictive factors for each gender, men are positively influenced by time dedicated to learning about ICT, thus constituting a relevant factor as in other studies (García-Marcos et al., 2020). Their interest in this topic was also a predictor, which is related not only to their greater use of ICT for teaching purposes, supported by Marcelo et al.'s (2015) study, but also to their motivation sparked by such use, as reflected in different studies (Guillén-Gámez, & Ramos, 2021; Guillén-Gámez et al., 2018).

A predictor for women, on the other hand, was the perception of having adequate training, which was reflected in the study carried out by Vega-Gea et al. (2021), since the pre-service teachers who had greater knowledge on attention to diversity saw better results.

Confidence in relation to ICT use with students with functional diversity also had a positive influence. This predictor is supported by Mercader and Durán-Bellonch's (2021) study, which reveals that women use ICT better than they think and that their confidence is key.

The fact that digital competence levels influence the perceptions of both genders, this factor may be more connected to their status as pre-service teachers (still in training), than to the gender variable itself. In this way, different studies (Cabero-Almenara et al., 2020; Llorent et al., 2020) indicate that younger teachers tend to have greater technological skills, which can be extrapolated to students in training.

## **Conclusion**

Achieving inclusive and equitable education requires the use of the necessary means as well as the improvement of teaching training in order to attend to all students. In this sense, the implementation of ICT in the educational processes of students with functional diversity entails a clear improvement in their educational possibilities and opportunities. Because to this, the present study focused on pre-service teachers' perceptions of the role of ICT in attending to diversity.

The findings of this study indicate that the implementation of a module on ICT and attention to diversity in the initial training of pre-service teachers improved their perceptions regarding the possibilities of technology, as well as the specific requirements for its use and the importance of specialized training. No significant differences according to gender were found, although the men's evaluations were slightly higher than those of the women. It should be noted that digital competence levels constituted a positive predictor of perceptions for both genders, with men also being influenced by time dedicated and interest shown, while for women it was confidence levels and perceptions of having adequate training in relation to implementing ICT with students with functional diversity.

As for the limitations of this study, we take the size of the sample and its non-randomness into account, since they hinder the generalization of the results. In future studies, the aim should be to increase the number of participants and carry out probability sampling. In addition, it would be interesting to consider other variables such as the participants' professional status (pre-service teacher or in-service teacher) or years of experience for in-service teachers. Lastly, the use of an instrument based on self-perception is another limitation, as it gathers information about what the pre-service teachers believe. As a future line of work, an instrument that proposes concrete actions to be solved by the participants would be developed, so that their true levels of competence in applying ICT with students with functional diversity could be evaluated objectively.

## **Data availability statements**

The datasets generated during and/or analysed during the current study are not publicly available due to they belong to our research group, but are available from the corresponding author on reasonable request

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## Appendix 1

