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ICT training for educators of Granada for working with people with autism

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ABSTRACT

Background: Innovative methodologies based on Information and Communication Technology (ICT) are a tested and motivating option for working with people with autism. Their use, however, should not be indiscriminatory and arbitrary, but didactic and appropriate.
Objective: We aimed to discover the training in ICT they had, its frequency of use, and the types of digital resources that they used.
Methods: We administered the questionnaire, "Demands and Potentials of ICT and Apps for Assisting People with Autism" to 310 educators in the city of Granada (Spain). The participants belonged to schools and associations that worked with people with autism. Adopting a quantitative-type study, we carried out descriptive analyses (frequencies, mean, mode, and standard deviation). Having confirmed that the data did not follow a normal distribution (Kolmogorov-Smirnov test for samples of >50 participants), we carried out non-parametric inferential and intrafactorial correlation analyses. We also calculated the effect size.
Results: The educators revealed that they had ICT training for working with people with autism, but not enough. This suggests that there is still a need to improve the digital competence of these professionals. Strong, direct and significant correlations were found between ICT training and the frequency with which they were used. There were also statistically significant differences according to sex, gender, age, type of institution, and type of educator. The educators who worked as Therapeutic Pedagogy teachers and those who worked in Special Education schools were shown to be more competent than the rest in educational technology applied to people with autism.
Conclusions: The results, which were not wholly positive since ICT training should be better and have achieved higher scores, revealed that there is a foundation in ICT education but it needs to be heightened and improved with greater knowledge and more practical experience.

1. Introduction

Advances in Information and Communication Technology (ICT) in the sphere of educating and attending to people with functional diversity have increased considerably over time. Today, one can access a multitude of digital educational resources almost

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instantaneously with a simple internet search. ICTs are defined as innovations in microelectronics, computing (hardware and software) and telecommunications that enable the processing of information [1], through computers and programs that manage and transform this information.

In this last decade, ICT has comprised tools such as laptops, digital tablets, mobile phones, virtual platforms, video conferencing platforms, applications and the like that are used at any educational level and modality [2,3]. In fact, in the field of education, ICTs have attained great transformations and innovative effects, to such an extent that their utilization is considered a skill that new generations must acquire [4].

Current studies on the implementation of technological resources that people with functional diversity receive in classrooms and therapies are numerous and interdisciplinary. They show the potential of ICTs [5–9] and the benefits derived from their use. Examples of these are those carried out in the fields of Specific Learning Difficulties (SpLD) [10], physical disability [11–14], intellectual disability [15,16], cerebral palsy [17–20], Down's Syndrome [21–23], and neurodevelopmental disorders [24,25]. This is so much so that in the specific field of attending to people with visual impairment in Spain and many other countries, it has acquired its own name: *Tiphlotechnology* ("Tiflotecnología" in Spanish).

As well as the studies that demonstrate the functionality that ICT offers people with functional diversity, there are many that focus on the lack of digital training that different educators have, and the lack of awareness about the possibilities represented by these tools [26,27]. In fact, authors such as Toledo and Llorente [28] highlight the need to adopt measures in the initial training of educators in order to instruct them in the incorporation and appropriate use of ICT for people with functional diversity.

1.1. ICT training for the care of people with autism

Something similar occurs in this regard with specialists in autism spectrum disorder (ASD) or with the educators who work with people with this disorder, both in schools and in the therapies that are provided in informal education. ASD, as the new revised version of the DSM-5-TR [29] states, is a disorder that means people suffer persistent difficulties and deficits in social communication and social interaction across multiple contexts, tied to restricted patterns regarding behaviours, interests and activities. Specifically, autism, which is included within ASD, involves neurodevelopmental impairments that affect brain function, producing different levels of impact [29,30].

The training that an educator needs in this area is very specialized, as is that concerning the use of ICT. However, there is a lack of training in educational technologies [31–33], even though these can: provide support and assistance to people with autism during cognitive therapies [34]; be a motivating tool for teaching [32]; facilitate access to the school curriculum [35]; enhance active participation [32,36]; and enable and foment inclusion [36], communication [37], social skills [38], and emotional development [39].

Despite the range of benefits that utilizing ICT provides for attending to people with autism, its use is not as widespread as one would wish. Although many varied interventions based on ICT exist that produce encouraging results in the areas in which people with autism present the most difficulties, this is not a frequent practice in schools or psychopedagogical therapies. Examples of this are the interventions by Fage et al. [40], Flores et al. [41], Jiménez et al. [42], Lozano et al. [43], and Weisblatt et al. [44], focused on developing Theory of Mind; Weng and Bouck [45], Li et al. [46], Yerys et al. [47], Flynn et al. [48], Wright et al. [49], and Wagle et al. [50], addressing the development of the executive functions; or Sweidan et al. [51], Teixeira and Cunha [52], and Aguilar-Velázquez et al. [53], focused on the acquisition and command of basic instrumental skills.

Authors such as Escobedo and Tentori [34], in their study with seven Mexican teachers and fourteen students with autism, state that ICT and, specifically, Augmented Reality tools, are a real support for assistance during cognitive therapies. Moreover, they add that they improve the educators' professional performance and decrease the workload.

In addition to this, Lledó et al. [31] in their research focused on identifying and evaluating inclusive response measures in specific ASD classrooms in 20 educational centres in Alicante (Spain), indicate that ICTs have potential for working with people with this disorder, but that there is a lack of training for educators and a lack of knowledge about their applicability.

Sabayleh and Alramamneh [33], in their research with 270 teachers in Amman (Jordan), focused on the obstacles to implementing educational techniques in special education centres, and they state that the main obstacles to including ICT in educational centres emerge from difficulties in three areas: 1) lack of equipment and technological resources in the educational institution itself; 2) lack of professional training to design digital educational programs, and scant teaching co-ordination; and 3) the students' difficulty with autism in using ICT, as these have not been well adapted to their needs.

In relation to this, the study by Saladino et al. [34], in which six teachers from Italian public schools participated, focused on assessing educators' digital skills and their implementation in classrooms. They highlight the importance of knowing which technological resources are necessary to work with which subject, and how digital knowledge significantly influences the teaching-learning process, given that the choice of one type of ICT or another is crucial. They conclude that technologies are fundamental for coping with life, are a pedagogical support in everyday life, and allow all pupils to be involved, but that it is essential for teachers to be trained in educational technology.

The few existing studies on autism and training in ICT show how the most experienced educators give more support to the use of tablets than their colleagues with less experience [35], which is in contrast to Saladino et al. [36], who found that the educators with more experience did not use ICT. Additionally, in Saladino et al. [36] the main technologies that were applied were the tablet, the laptop and the interactive digital screen.

As we have pointed out, studies on autism and ICT form an important part of the current research [54–56], but they do not address the training that different educators have on the digital tools available specifically for people with autism (apps, web platforms, etc.) [57]. We therefore set out the following aims.

1. To learn the frequency of use and types of ICT used by educators from Granada (Spain) for teaching people with autism.
2. To examine the training educators from Granada (Spain) have in ICT for attending to people with autism.
3. To determine teacher performance according to sex, gender, age, educational stage worked with, type of institution, and type of educator.

After reviewing previous studies focused on the subject and the proposed objectives, the following hypotheses are proposed, with the aim of accepting or rejecting them.

H1. ICT for attending to people with autism are used frequently. H2: ICT training of educators in Granada is not excellent.

H3. The frequency of ICT use is motivated by the educators' training and their knowledge about them.

H4. Women and men are equally trained in ICT.

H5. Younger educators are more trained in ICT for people with autism than older educators.

H6. All educators working with people with autism received the same ICT training, no matter the stage they work in.

H7. Educators in special education centres serving people with autism are more trained in ICT than those serving in less specialized institutions.

2. Method

This is a quantitative study with a non-experimental, comparative and cross-sectional descriptive design.

2.1. Participants

The sample comprised 310 educators from Granada (Spain) from formal and informal education, of whom 59 were men (19%) and 251 women (81%), with 61 identifying as male (19.7%), and 249 as female (80.3%). Bearing in mind the significant number of female participants, the sex and/or gender did not result in bias in this investigation, as studies in Social Science and Legal Science have a predominance of women [58].

The participants were aged between 20 and 64 years old ($M = 39.13$; $SD = 10.82$). Most worked as general teachers (29%), teachers of therapeutic pedagogy (26.5%), or specialist teachers (17.7%), in the stages of early-childhood (52.9%), primary (72.9%) and secondary (28.1%) education, with teaching experience with people with children younger than 10 years old ($n = 273$) in state schools (70.3%), charter schools (14.2%), special education schools (8.1%), and associations (8.1%). Table 1 shows other sociodemographic

Table 1
Other sociodemographic data and data on the ICT of the participants.

Variables		Educators *N* (%)
Type of educator	General teacher	90 (29)
	Therapeutic pedagogue	82 (26.5)
	Specialist teacher	55 (17.7)
	Speech and Hearing Teacher	25 (8.1)
	Therapeutic Pedagogy and Integration class teacher [PTAI]	12 (3.9)
	Special Needs class teacher [PTAE]	6 (1.9)
	Special Education assistant	22 (7.1)
	Therapeutic companion	5 (1.6)
	Psychologist	10 (3.2)
	Pedagogue	4 (1.3)
	Psychopedagogue	5 (1.6)
	Speech therapist	19 (6.1)
	Occupational therapist	5 (1.6)
	Social worker	1 (0.3)
	Social Integration Technical Specialist [PTIS]	1 (0.3)
Work location	Urban	219 (70.6)
	Rural	101 (32.6)
Internet access	Yes	308 (99.4)
	No	2 (0.6)
Types of ICT available at place of work	None	4 (1.3)
	Tablet	172 (55.5)
	Smartphone	95 (30.6)
	Computer	293 (94.5)
	Projector	209 (67.4)
	TV	79 (25.5)
	Digital Interactive Whiteboard	21 (6.8)

Note. Given as multiple response items. *PTAI* = (in Spanish) Maestro de Pedagogía Terapéutica de Apoyo a la Integración; *PTAE* = (in Spanish) Maestro de Pedagogía Terapéutica de Apoyo Específico; *PTIS* = (in Spanish) Personal Técnico de Apoyo a la Integración.

data and data on ICT of the sample.

2.2. Instrument

The self-report measure used for data collection, called "Demandas y potencialidades de las ICT y las apps para la atención a de personas con autismo (DPTIC-AUT-Q)" ["Demands and potentials of ICT and apps for assisting people with autism"], was validated by Rodríguez et al. [59]. It had a section on sociodemographic data and four subscales connected to ICT: Subscale 1: Opinion, training and uses of ICT by professionals for teaching people with functional diversity; Subscale 2: Training and uses of ICT by professionals for teaching people with autism; Subscale 3: Uses and benefits of apps in assisting people with autism; Subscale 4: Uses and possibilities of specialized apps for people with autism. In order to meet the aims of this study, we have only used the second subscale, "Training and uses of ICT by professionals for teaching people with autism", which comprised questions with Likert-scale responses (1 = Completely disagree; 5 = Completely agree). The instrument was designed to be used in its entirety, or by subscales or dimensions. For this study, we used the first dimension of the subscale, Dimension 1: Training in ICT for autism (items 23–31), and two questions on the frequency of use of ICT (1 = Little, 4 = A lot) and the type of ICT used.

The questionnaire has adequate psychometric properties. It obtained excellent Intraclass Correlation Coefficients in Subscale 2 = 0.994; significant Kendall's *W* inter-rater concordance ($p < .001$) = 0.125 clarity; 0.160 coherence; 0.186 relevance; and 0.132 objectivity; and an exceptional internal consistency: αSubscale_2 = 0.967. The results of the CFA for Subscale 2 were equally favourable and acceptable [60,61]: the chi-square value was statistically significant ($\chi^2 = 4158.964$, $p = .0000$). All other values indicated an adequate instrument fit: RMSEA (0.048), SRMR (0.080) and WRMR (1.39), demonstrating the goodness of the model. Cronbach's coefficient was high ($\alpha = 0.92$), as was Composite Reliability ($CR = 0.90$).

2.3. Procedure

First, the approval of the University of Granada Ethics Committee on Human Research (Spain) was obtained for the questionnaire, receiving a favourable report [2002/CEIH/2021]. The questionnaire was then administered during the period December 2020 to December 2021. It was administered to teachers and educators of schools and associations in the city of Granada. The aim of the participating associations was to attend to people with functional diversity and, specifically, autism. They offered therapy and individualized attention for the development of daily life skills for people with this condition, as well as for the promotion of other areas of development (communication, language, executive functions, basic instrumental skills or theory of mind), apart from leisure activities and enjoyment of free time. The participating schools attended to people with autism, either in ordinary classrooms (depending on the personal and material support they needed) or in specific classrooms. Educators from special education centres also participated. The link to access the questionnaire, designed on the *LimeSurvey* platform, was provided in face-to-face sessions and via email. At all times, participants were informed of the voluntary nature of the questionnaire, its anonymity and data exclusivity, as well as the aims of the study.

2.4. Data analysis

The data were analysed with the SPSS v.28.0 statistics packet. We calculated descriptive statistics (mean, mode and standard deviation) and frequencies. Non-parametric inferential analysis and intrafactorial correlations analysis were carried out. For the analysis of correlations, we calculated Spearman's correlation coefficient [62,63], and to examine the comparisons between "sex" and "gender", we carried out the Mann- Whitney U non-parametric test, since the data did not show a normal distribution (Kolmogorov-Smirnov <0.05). We also estimated the effect size using Cohen's *d* calculation [64]. For the variables "age", "stage of work ", "type of institution" and "type of educator", we applied the Kruskal-Wallis test and the consequent Games-Howell post hoc test, as well as the effect size using Hedges'*g* [65].

Table 2
Frequency of use and type of ICT used for working with people with autism (n = 310).

	Variables	*N* (%)
Frequency of use	Never	7 (2.3)
	Little	36 (11.6)
	Sometimes	111 (35.8)
	Quite a lot	131 (42.3)
	A lot	25 (8.1)
Type of ICT	Computer	234 (75.5)
	Tablet	150 (48.4)
	Smartphone	118 (38.1)
	Projector	104 (33.5)
	TV	36 (11.6)
	Digital interactive whiteboard	13 (4.2)

Note. The "type of ICT" was given as a multiple response item.

3. Results

The frequency of use of ICTs with people with autism showed that the educators used them between "quite a lot" (42.3%) and "sometimes" (35.8%), while the type of ICT they used most often was the computer (75.5%), followed by the tablet (48.4%) (Table 2).

In Table 3, according to the mean and mode values, it can be seen that the opinion of the participants on their ICT training for people with autism settled on option 4 ("agree") out of 5. Only item 23 ("I know how to use specific software to make materials") was found at option 3 ("neither agree nor disagree").

The educators showed that they were aware of the possibilities offered by ICT to people with autism and the difficulties that can be found in their usage, as well as the accessibility options of operating systems and different browsers. They also stated that they felt competent to help people with autism to use technological aids, and to find specific materials on the web. However, they revealed that they agreed less with knowing how to use specific software to make materials, being capable of carrying out adaptations to the curriculum based on ICTs, and describing the limitations that multimedia materials might have.

The analysis of correlations (Table 4) showed that the relationship between teachers' training in ICT and their frequency of use was direct, considerable and positive ($r = .535$), and significant ($p < .001$). There was likewise a positive and significant ($p < .001$) but mean ($r = 0.182$) correlation between age and training.

We also found that the correlation between the age of the participants and professional experience with people with autism was negative and mean ($r = -0.345$), and significant ($p < .001$).

The inferential analyses did not produce any differences according to participants' "years of experience" or "place of work", but there were differences according to "sex" in item 31, "I feel prepared to help them with the use of technological aids and their utilization" ($d = 0.32$), in favour of the men with a small effect size (Table 5). The same occurred with the male "gender" in item 31 ($d = 0.32$).

The variable "age" proved discriminative in all the items assessed (Table 6). The youngest group of teachers (20–30 years old) answered that they were more competent and had more training in ICT than the oldest group (51–64 years old), according to the Games-Howell post hoc contrasts, with a small effect size for all items, according to Hedges' g values ($\varepsilon^2 = 0.04$ to 0.06). The youngest educators also showed greater agreement on the following: knowing how to use specific software for making materials (item 23); being capable of carrying out curricular adaptations using ICT (item 24); applying teaching strategies to promote the inclusion of people with autism (item 25); describing the limitations of multimedia materials (item 26); having knowledge about the accessibility possibilities of operating systems and browsers (item 27); the difficulties of ICT in their use by people with autism (item 28); considering themselves competent at finding specific materials on the web (item 29); knowing the possibilities that different types of ICT offer people with autism (item 30); and feeling prepared to help them in the use of technological aids (item 31).

Note. I = Item; n = number of elements that comprise the sample; M = Mean; SD = Standard Deviation; AR = Average range; K = Statistic associated with the Kruskal Wallis test; p = Probability associated with K; Statistically significant: $^*p < .05$ $^{**}p < .01$ $^{***}p < .001$.

The "stage worked with" also produced statistically significant differences (Table 7) with a small effect size for all items according to Hedges' g values ($\varepsilon^2 = 0.03$). The educators who worked in early childhood education revealed they were more competent at finding specific materials on the web than those from primary education (item 29) and also more prepared to help people with autism in the use of technological aids than the participants who worked with adults (item 31).

Regarding the "type of institution" (Table 8), the participants who worked in Special Education schools showed that they agreed more than the participants from state schools about being aware of the possibilities of ICT for people with autism (item 28), about being more competent at finding specific materials on the web (item 29), and about their being prepared to help them with the use of technological aids (item 31). The size of the differences, according to Hedges' g-values, was small ($\varepsilon^2 = 0.04$ to 0.05).

Along the same lines as the previous analysis, statistically significant differences were found according to the "type of educator" in all the items assessed, except number 27 (Table 9). The Games-Howell post hoc contrasts revealed that the educators whose profile was that of Therapeutic Pedagogy teachers were more in agreement than general, Speech and Hearing, and specialist teachers that they knew how to use specific software for making materials (item 23) and that they were capable of carrying out curricular adaptations

Table 3
Training in ICT for working with people with autism.

ITEM	M	SD	M_o	%				
				1	2	3	4	5
23. I know how to use specific software to make materials	3.13	1.14	3	8.7	21.0	31.0	27.4	11.9
24. I am capable of carrying out curricular adaptations using ICT	3.52	1.1	4	5.5	11.3	29.0	34.2	20.0
25. They enable me to apply teaching strategies to promote inclusion	3.71	0.99	4	3.2	7.4	26.1	41.3	21.9
26. I can describe the main limitations that multimedia materials can have	3.52	0.92	4	2.9	8.7	34.5	41.3	12.6
27. I know the possibilities of operating systems and browsers for adapting accessibility, speed …	3.59	1.03	4	3.5	12.3	23.5	42.9	17.7
28. I am aware of the difficulties that can arise in their use	3.55	1.00	4	4.2	10.3	26.5	44.2	14.8
29. I consider myself to be competent at finding specific materials on the web	3.76	1.00	4	2.6	9.0	22.6	41.6	24.2
30. I know the possibilities ICT offers them	3.85	0.92	4	1.9	5.8	21.9	46.1	24.2
31. I feel prepared to help them with the use of technological aids and their utilization	3.62	0.99	4	3.2	9.7	26.5	42.9	17.7

Note. M = Mean; SD= Standard Deviation; M_o = Mode; *1* = Completely disagree; *2* = Disagree; *3* = Neither agree nor disagree; *4* = Agree; *5* = Completely agree.

Table 4
Spearman's correlation between training in ICT, age of the educator, experience and frequency of use.

	Training	Age	Experience	Frequency
1. ICT Training	1			
2. Age of educators	−.182**	1		
3. Professional experience in autism	−.004	−.345**	1	
4. Frequency of ICT use	.535**	-.025	.020	1

Table 5
Significant differences in ICT training according to sex and gender.

ITEM	Men ($n = 59$)			Women ($n = 251$)			Mann-Whitney	
	M	*SD*	Average Range	*M*	*SD*	Average Range	*U*	*p*
31	3.88	0.87	177.41	3.56	1.09	150.35	6112.00	028*
ITEM	**Male ($n = 61$)**			**Female ($n = 249$)**			**Mann-Whitney**	
	M	***SD***	**Average Range**	***M***	***SD***	**Average Range**	***U***	***p***
31	3.87	0.87	176.02	3.56	1.01	150.47	6342.50	.035*

Note. n = number of elements that make up the sample; M = Mean; SD= Standard Deviation; U = Results of Mann-Whitney U test; p = Probability associated with U; *Statistically significant*: $*p < .05$.

Table 6
Significant differences in ICT training according to age Age Groups (years old).

	Age Groups (years old)												Kruskal-Wallis	
I	20-30 (n = 82)			31-40 (n = 94)			41-50 (n = 82)			51-64 (n = 52)				
	M	*SD*	*AR*	*M*	*SD*	*AR*	*M*	*SD*	*AR*	*M*	*SD*	*AR*		
23	3.43	1.24	178.71	3.04	1.07	148.66	3.16	1.09	158.03	2.77	1.08	127.28	12.01	.007**
24	3.71	1.06	170.20	3.35	1.14	143.50	3.73	1.03	171.71	3.19	1.09	128.46	12.21	.007**
25	3.94	0.99	175.90	3.69	0.87	150.45	3.77	1.02	161.17	3.31	1.06	123.53	12.75	.005**
26	3.79	0.87	181.41	3.46	0.89	149.04	3.52	0.91	154.41	3.19	0.99	128.03	13.82	.003**
27	3.88	0.96	179.51	3.47	1.07	146.06	3.66	0.97	160.58	3.25	1.05	126.58	13.95	.003**
28	3.83	0.93	179.96	3.33	1.02	135.94	3.70	0.98	168.27	3.29	0.99	132.16	17.71	.001***
29	3.99	1.05	178.26	3.69	0.93	147.63	3.78	1.02	158.18	3.48	0.98	129.61	11.57	.009**
30	4.05	0.98	177.28	3.84	0.85	152.86	3.91	0.95	162.83	3.44	0.83	114.38	18.72	.001***
31	3.89	0.97	178.55	3.55	0.96	148.99	3.62	0.98	155.70	3.33	0.99	130.60	11.09	.011*

using ICT (item 24). The Therapeutic Pedagogy teachers showed that they were more competent than general and specialist teachers in knowing how to apply teaching strategies to promote the inclusion of people with autism (item 25), in finding specific materials on the web (item 29), and in their preparedness to help them with the use of technological aids (item 31). In addition, these teachers revealed a higher degree of agreement in being aware of the limitations of multimedia materials (item 26), in detecting the difficulties that people with autism might find in their use (item 28), and in knowing the possibilities that ICTs offer them (item 30), in comparison with the specialist teachers. The size of the differences, according to Hedges' g-values, was small ($\varepsilon^2 = 0.04$ to 0.12).

4. Discussion and conclusions

The inclusion of ICT for working with people with autism is a difficult task, both due to the lack of training of the professionals involved [31–33], as we stated earlier, and/or due to the lack of equipment, digital resources, and coordination between specialists [33]. Regardless of the reasons or circumstances that underlie this issue, the potential of ICT for improving the comprehensive development of people with autism in formal and informal education is well known.

The results derived from this study have made it possible to analyse the perception about ICT training that educators from Granada have for attending to and helping people with autism.

It should be highlighted that, in the classrooms of both schools and associations that attend to people with this disorder, the use of ICT was positioned between the options of "sometimes" and "quite a lot". This indicates that, in practice, a range of digital options is used, above all computers and tablets. These results are encouraging, showing that, given the surge in educational technology and its use in training and education, the community of people with autism is not being left behind. Perhaps the problem does not lie in the widespread use of ICT or in their availability, but in the training of autism specialists in their use. In this sense, H1 is accepted: it affirmed that ICT for people with autism were applied frequently.

In general terms, the autism professionals who participated in this study showed that they had training in ICT for working with people with this disorder. The scores were positioned above the mean value, but none surpassed 4 or 5 points (Agree/Completely

Table 7
Significant differences in ICT training according to the stage worked with.

Stage Worked With																	
I	Early Childhood ($n = 48$)			Primary ($n = 111$)			Early Childhood & Primary ($n = 111$)			Secondary ($n = 30$)			Adult Education ($n = 7$)			Kruskal-Wallis	
	M	***SD***	**AR**	***M***	***SD***	**AR**	***M***	***SD***	**AR**	***M***	***SD***	**AR**	***M***	***SD***	**AR**	***K***	***p***
29	3.35	1.19	126.57	3.87	0.98	165.13	3.86	0.93	163.34	3.57	0.94	135.98	3.86	0.67	157.14	9.51	.004**
31	3.31	1.13	133.53	3.79	0.90	168.91	3.55	1.01	148.96	3.60	0.93	152.27	4.29	0.76	213.93	10.03	.004**

Note. n = number of elements that comprise the sample; I = Item; M = Mean; SD = Standard deviation; AR = Average range; K = Statistic associated with the Kruskal Wallis test; p = Probability associated with K; Statistically significant: $^{*}p < .05$ $^{**}p < .01$.

Table 8
Significant differences in ICT training according to type of institution.

Type of institution																
I	State ($n = 215$)			Charter ($n = 39$)			Private ($n = 5$)			Special Ed. School ($n = 27$)			Association ($n = 24$)			Kruskal-Wallis	
	M	***SD***	**AR**	***M***	***SD***	**AR**	***M***	***SD***	**AR**	***M***	***SD***	**AR**	***M***	***SD***	**AR**	***K***	***p***
28	3.46	1.00	147.42	3.74	1.09	175.85	2.60	1.14	81.10	3.96	0.81	189.22	3.79	0.78	172.38	13.33	.005**
29	3.69	1.02	149.87	4.05	0.94	182.91	2.40	0.89	48.30	4.07	0.78	184.44	3.79	0.93	165.83	15.02	.010**
31	3.55	0.99	149.44	3.64	1.11	158.04	2.80	1.10	87.80	4.11	0.70	196.94	3.83	0.82	173.13	11.79	.019*

Note. n = number of elements that comprise the sample; I = Item; M = Mean; SD = Standard deviation; AR = Average range; K = Statistic associated with the Kruskal Wallis test; p = Probability associated with K; Statistically significant: $^{*}p < .05$ $^{**}p < .01$.

Table 9
Significant differences in ICT training according to the type of educator.

Type of educator														
I	General teacher (n = 84)			Therap. Pedagogy (n = 94)			Speech & Hearing (n = 25)			Specialist (n = 45)			Kruskal-Wallis	
	M	***SD***	**AR**	***M***	***SD***	**AR**	***M***	***SD***	**AR**	***M***	***SD***	**AR**	***K***	***p***
23	2.90	1.06	108.48	3.65	1.09	150.95	2.76	1.09	102.68	2.42	1.03	83.11	35.98	.000***
24	3.31	1.11	103.54	4.08	0.98	149.59	3.20	1.19	97.38	3.22	1.09	97.69	29.69	.000***
25	3.55	1.07	110.96	4.04	0.89	141.02	3.68	1.03	116.88	3.18	1.09	88.24	20.72	.000***
26	3.48	0.96	118.04	3.75	0.86	134.04	3.28	1.02	102.66	3.13	0.99	95.33	12.08	.007**
28	3.45	0.94	112.65	3.79	0.96	134.78	3.40	1.13	116.08	3.11	1.21	96.61	10.97	.012*
29	3.69	1.04	112.93	4.11	0.93	141.34	3.64	1.19	112.24	3.24	1.05	86.58	21.78	.000***
30	3.79	0.88	114.64	4.11	0.86	138.30	3.64	1.08	107.02	3.38	1.07	91.68	16.65	.001***
31	3.48	0.96	110.04	3.96	0.92	142.13	3.36	1.22	105.76	3.20	1.08	94.17	19.55	.000***

Note. n = number of elements that comprise the sample; I = Item; M = Mean; SD = Standard deviation; AR = Average range; K = Statistic associated with the Kruskal Wallis test; p = Probability associated with K; Statistically significant: *p < .05 **p < .01 ***p < .001.

agree), which shows that further digital training is still needed by the educators. They revealed that they were aware of the possibilities that ICT offers people with autism and the difficulties that these students might encounter in their use, along with the accessibility options of operating systems and different browsers. They also showed that they were competent at helping them with the use of technological aids and to find specific materials on the web. However, they were less in agreement that they knew how to use specific software to make materials, that they were capable of making curricular adaptations based on ICT, and that they could describe the limitations that multimedia materials might have. These results are in line with those found by Lledó et al. [31] on the lack of knowledge about the applications that ICTs have for working with people with autism, and with the need for educators to know what digital resources are most suitable for each person and each disability [36]. Not being completely capable of carrying out curricular adaptations using ICT can be a challenge these days, as these tools notably enhance the development and integration of key competences for daily life [36]. Thus, H2, which established that educators in Granada did not have excellent training in ICT for people with autism, is accepted. The whole analysis carried out is based on the data obtained from the answers of 310 respondents to eleven questions, of which the first nine are part of a larger questionnaire and serve to self-assess generic competencies on tools that would be part of an ICT category for autism. The correlations showed a strong relationship between the frequency of use of ICTs and training, which makes perfect sense. The more training in digital resources, the more frequently teachers can put their knowledge into practice, as opposed to those who are ignorant of the options that educational technology offers to the community of people with functional diversity and, specifically, those with autism. These results partially agree with those of Saladino et al. [36], in which they state that the better the knowledge of ICT and the more training they have on them, the better they can be selected. Given that the choice of one ICT or another has a direct impact on the teaching-learning process, H3 is accepted, since it has been shown that the more training, the more frequently ICT is used. The correlations analysis did not find any relationship between professional experience and age along with the frequency of use of ICT. This is in contrast to the study by Omar et al. [35], who found a link between the use of ICT and teaching experience. It is possible that, with greater opportunities to choose their posts, older professionals choose positions that do not involve working with people with autism.

In terms of sex and gender, the men and the participants who identified as male showed themselves to be more prepared than the rest to help people with autism with the use of technological aids. H4, which stated that men and women were equally prepared, was thus rejected. These results cannot be compared to previous studies due to the absence of investigations examining this topical issue.

The youngest participants (20–30 years old), compared with the oldest (51–64 years old), were different in all the items analysed. This could reflect that the younger generations are digital natives, or, at least, much of their lives they have used technologies in different spheres of their everyday existence (home, school, university, social relationships …), and it therefore makes sense that they would have had more of a digital education than older generations. These results confirm H5, because the younger professionals have more training in ICT than older professionals.

The teachers who worked in early childhood education were shown to be more competent at finding specific materials on the web for people with autism, compared to those from primary education. Likewise, they felt more prepared to help them with the use of technical aids and their utilization than those who worked with adults. H6 is rejected because, as shown by the results, not all the professionals are equally trained, since the educational stage in which they work has an influence on their training. As we have already stated, these results cannot be compared with previous studies.

It is worth noting that the educators from special education schools, compared to those from state schools, considered themselves more competent at finding specific materials on the web, more aware of the difficulties that people with autism might encounter in the use of ICT, and more prepared to help them with the use of technological aids. This was also the case with teachers in Therapeutic Pedagogy when compared with the rest of the educators, producing higher means in all the items involving ICT training for people with autism. As these professionals and schools are more specialized in working with diversity, they have had more specific training on attending to people with autism than the other institutions with professionals who have had a more varied and generalized training. This confirms H7, since professionals from Special Education centres reported a higher level of training in ICT for people with autism than those from less specialized institutions. Again, there are no prior studies with which to compare our findings.

By way of conclusion, it is essential to stress the relevance of ICTs as a motivational work tool, as well as a learning and

development complement that entails including digital media in assisting, teaching and caring for people with autism. We should also highlight the importance for professionals to know how to use specific software (e.g., autism apps for Tablet/Smartphone) for the design of individualized materials, given the importance of teaching personalization as a key element in the education process.

From the results we obtained, which are not wholly positive, since ICT training ought to be better and have attained higher scores, we can state that there is a foundation of ICT education that needs to be improved and heightened with further knowledge and hands-on practice. In the Saladino et al. [36] study, participants acknowledge that they have received specific training in the use of ICT in classrooms with students with autism, and that such training is crucial and much needed.

Studies have shown both the benefits and the interest of people with autism regarding the different digital options, and now that we are well into the twenty-first century and have witnessed so many advances, it is vital for educators to provide more innovative and stimulative teaching, particularly when considering the range of studies based on scientific evidence that endorse the encouraging results derived from the use of ICT. For future research, the applicability and usefulness that educators consider ICT to have should be analysed. It would also be worthwhile to analyse what knowledge is held about the existing assistive technologies by professionals in functional diversity and, specifically, in autism. Following on from the results obtained here, it would be appropriate to investigate the frequency of use of each type of ICT and whether this has a positive influence on the quality of attention given to people with autism. Furthermore, given that training in competences has particular relevance in the current training framework, it would be interesting to investigate the digital competence that professionals have for the use of ICT in the institutions belonging to formal and informal education, examining not only the perception that they themselves have about their training in ICT, but also their level of competence.

In agreement with Toledo and Llorente [28], there is a need to adopt measures in the initial training of educators for the implementation of ICT with people with functional diversity. Only by learning the training needs that educators in Granada have can intervention plans be proposed in higher education that address these deficiencies. This will undoubtedly improve the teaching and attention given in classrooms and the quality of therapies given by professionals working with any kind of needs and, specifically, autism.

In terms of limitations, this study used a sample exclusively from the city of Granada, thus affecting any generalization of the results. Linked to this, we therefore propose, by way of future research, that the number of participants from other cities and countries should be increased in order to establish relationships and differences between them. Taking the quantitative direction of this research further, it would be worthwhile to carry out a quasi-experimental study in which the educators undergo a practical training course in ICT for people with autism, and assess their benefits and feelings, in comparison with other educators who do not undertake the course. Alongside this idea is that of complementing the quantitative study with qualitative research, based on conducting in-depth interviews and ethnographic observation to discover in a more detailed way the advantages and disadvantages different educators in formal and informal education encounter when putting into practice the different digital resources specifically designed for people with autism. In addition to the previously mentioned sampling limitation, there is the limitation of any survey or self-report research [66,67], even with validated instruments. This could influence the veracity of the responses [68] or the possibility of generating new ideas or theories [69]. In fact, it is essential to increase the theoretical and research corpus, not only in order to optimise teacher training and practice, but also to improve the discussion of results, which will lead to more solid conclusions.

Author contribution statement

Antonio Rodríguez Fuentes; María Jesús Caurcel Cara: Performed the experiments; Analysed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Carmen del Pilar Gallardo Montes: Conceived and designed the experiments; Performed the experiments; Analysed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data included in article/supplementary material/referenced in article.

Declaration of interest's statement

The authors declare the following conflict of interests: Authors have an invitation from the editorial board (Dr. Hange Teng and Dr. Dr. Tomayess Issa), which allows for free publication of APC.

Appendix I. Demands and Potentials of ICT and Apps for Assisting People with Autism (extracted from Rodríguez et al. [59: 22–30])

For each statement, mark the box corresponding to your degree of agreement, according to your personal and/or professional criteria, based on the following scale
1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

SUBSCALE 1. Opinion, Training and Uses of ICT by Professionals for Assisting People with Functional Diversity

Dimension 1: Opinion

Nº Initial Item	Nº EFA Item	Nº Final Item	*ICT for People with Functional Diversity …*	Scale 1	2	3	4	5
I.1.	V1.	1.	Improve the competences of the teacher					
I.6.	V4.	2.	Require advice on the search for, selection and evaluation of ICT resources for the teaching-learning process					
I.9	V7.	3.	Provide greater flexibility in the teaching-learning process					
I.10.	V8.	4.	Make it possible to meet educational needs					
I.11.	V9.	5.	Are easy to use in attending to diversity					
I.12	V10.	6.	Enable inclusion [Favorecen la inclusión]					
II.13	V11.	7.	Offer multiple opportunities in attending to diversity					
III.21	V19.	8.	Improve performance and efficacy					
III.22	V20.	9.	Increase motivation in learning					
III.25	V21.	10.	Make access to information possible					
III.26	V22.	11.	Make it possible to achieve aims in a more flexible way					

Dimension 2: Requirements and Possibilities

Nº Initial Item	Nº EFA Item	Nº Final Item	*Demands and Necessities of ICT for Assisting People with Functional Diversity …*	Scale *1*	*2*	*3*	*4*	*5*
I.2.	V2.	12.	They require greater commitment and effort in my work					
I.3.	V3.	13.	They require specific training					
I.7.	V5.	14.	They need more material means and investment by management					
I.8.	V6.	15.	They help give more attention to diversity					
II.14.	V12.	16.	I would know how to choose specific ICT according to their needs					

Dimension 3: Training in ICT for Functional Diversity

Nº Initial Item	Nº EFA Item	Nº Final Item	*ICT Training of Professionals for Assisting People with Functional Diversity …*	Scale *1*	*2*	*3*	*4*	*5*
II.15.	V13.	17.	I know the main limitations that can condition its use					
II.16.	V14.	18.	I know different internet sites where I can find specific resources					
II.17.	V15.	19.	I know how to design activities with non-specialist educational software					
II.18.	V16.	20.	I feel prepared to help them in the use of technical aids and use of ICT					
II.19.	V17.	21.	It makes it easier for me to design and adapt activities					
II.20.	V18.	22.	It helps me to carry out assessment					

SUBSCALE 2: Training in and Uses of ICT by Professionals to Assist People with Autism

Dimension 1: Training in ICT for Autism

Nº Initial Item	Nº EFA Item	Nº Final Item	*ICT Training of Professionals for Assisting People with Autism…*	Scale [Escala] 1	2	3	4	5
IV.1.	V1.	23.	I know how to use specific software to create materials					
IV.2.	V2.	24.	I am capable of making curricular adaptations using ICT					
IV.3.	V3.	25.	They enable me to apply teaching strategies to facilitate their inclusion					
IV.4.	V4.	26.	I can describe the main limitations that multimedia materials may contain					
IV.5.	V5.	27.	I know the possibilities of operative systems and browsers for modifying accessibility, speed, font size…					
IV.6	V6.	28.	I know what difficulties that may arise for them in its use					
IV.7	V7.	29.	I consider myself competent at locating specific materials on the web					
IV.8	V8.	30.	I know what possibilities ICT offer them					
IV.9	V9.	31.	I feel prepared to help them with the use of technological aids and their use					

Dimension 2: Benefits of ICT for Autism

Nº Initial Item	Nº EFA Item	Nº Final Item	*ICT for People with Autism …*	Scale [Escala] *1*	*2*	*3*	*4*	*5*
V.10.	V10.	32.	It increases motivation					
V.11.	V11.	33.	It supports learning					

(*continued on next page*)

(*continued*)

SUBSCALE 1. Opinion, Training and Uses of ICT by Professionals for Assisting People with Functional Diversity									
Dimension 1: Opinion									
Nº Initial Item	**Nº EFA Item**	**Nº Final Item**	***ICT for People with Functional Diversity …***	**Scale**					
				1	**2**	**3**	**4**	**5**	
V.12.	V12.	34.	It improves learning						
V.13.	V13.	35.	It facilitates independent learning						
V.14.	V14.	36.	It increases active participation						
V.15.	V15.	37.	It strengthens memory						
V.16.	V16.	38.	It improves attention						
V.19.	V19.	39.	It provides capabilities for relating with others						
V.20.	V20.	40.	It helps recognize emotions in others						
V.21.	V21.	41.	It helps to understand symbolic play						
V.22.	V22.	42.	It increases skills linked to vocabulary acquisition						
V.23.	V23.	43.	It develops oral language in people with autism						
V.24.	V24.	44.	It helps to ask for something in an instrumental way						
V.25.	V25.	45.	It enhances skills linked to reading and writing						
VI.40.	V40.	46.	It promotes leisure and entertainment						
Dimension 3: Uses of ICT for Autism									
Nº Initial Item	**Nº EFA Item**	**Nº Final Item**	***Uses of ICT for People with Autism …***	**Scale**					
				1	***2***	***3***	***4***	***5***	
V.17.	V17.	47.	To facilitate the perception of time						
V.18.	V18.	48.	To enhance communicative and social skills						
VI.26.	V26.	49.	To develop communication						
VI.27.	V27.	50.	To develop oral language						
VI.28.	V28.	51.	To develop understanding of emotions						
VI.29.	V29.	52.	To develop the expression of emotions						
VI.30.	V30.	53.	To manage time						
VI.31.	V31.	54.	To stimulate cognitive development						
VI.32.	V32.	55.	To develop autonomy						
VI.33.	V33.	56.	To carry out tasks related to planning						
VI.34.	V34.	57.	To carry out tasks related to organization						
VI.35.	V35.	58.	To carry out tasks related to self-regulation						
VI.36.	V36.	59.	To carry out tasks related to memory						
VI.37.	V37.	60.	To facilitate learning how to read						
VI.38.	V38.	61.	To facilitate learning how to write						
VI.39.	V39.	62.	To facilitate learning arithmetic						
SUBSCALE 3: Uses and Benefits of Apps in Assisting People with Autism									
Dimension 1: Benefits of Apps for Autism									
Nº Initial Item	**Nº EFA Item**	**Nº final Item**	***Apps for People with AUTISM…***	**Scale**					
				1	2	3	4	5	
VII.6.	V6.	63.	Stimulate cogitive development						
VII.11.	V11.	64.	Make it easier to carry out memory-related tasks						
VII.12.	V12.	65.	Facilitate learning how to read						
VII.15.	V15.	66.	Promote leisure and entertainment						
VIII.16.	V16.	67.	Complement the use of other, traditional means of working (book, blackboard, etc.)						
VIII.18	V17.	68.	Make psychopedagogic intervention more effective						
VIII.19.	V18.	69.	Are a complement for reinforcing what has previously been worked on						
VIII.20.	V19.	70.	Are a way to consolidate concepts						
VIII.21.	V20.	71.	Are a motivating tool						
VIII.23.	V22.	72.	Facilitate socialization						
Dimension 2: Uses of Apps for Autism									
Nº Initial Item	**Nº EFA Item**	**Nº Final Item**	***Uses of Apps for People with Autism …***	**Scale**					
				1	***2***	***3***	***4***	***5***	
VII.1.	V1.	73.	To develop communication						
VII.2.	V2.	74.	To develop oral language						
VII.3.	V3.	75.	To develop understanding of emotions						
VII.4.	V4.	76.	To develop expression of emotions						
VII.5.	V5.	77.	To manage time						
VII.7.	V7.	78.	To develop autonomy						
VII.8.	V8.	79.	To carry out tasks related to planning						
VII.9.	V9.	80.	To carry out tasks related to organization						
VII.10.	V10.	81.	To carry out tasks related to self-regulation						
VII.13.	V13.	82.	To facilitate learning how to write						
VII.14.	V14.	83.	To facilitate learning arithmetic						
VIII.22.	V21.	84.	To hold attention for longer time						

(*continued on next page*)

(*continued*)

SUBSCALE 1. Opinion, Training and Uses of ICT by Professionals for Assisting People with Functional Diversity									
Dimension 1: Opinion									
Nº Initial Item	**Nº EFA Item**	**Nº Final Item**	***ICT for People with Functional Diversity …***	**Scale**					
				1	**2**	**3**	**4**	**5**	
SUBSCALE 4: Uses and Possibilities of Specific Apps for People with Autism									
Dimension 1: Functionality									
Nº Initial Item	**Nº EFA Item**	**Nº Final Item**	***Functionality of Specific Apps for People with Autism…***	**Scale**					
				1	2	3	4	5	
IX.8.	V8.	85.	They enable universal accessibility (changes in font size, colour, graphic elements, etc.)						
IX.10.	V10.	86.	They function correctly						
IX.15.	V15.	87.	They respect the pace of learning						
IX.16.	V16.	88.	They enable the user to add personalized images or pictograms						
IX.17.	V17.	89.	They specify the age they are designed for						
IX.18.	V18.	90.	They are available in several languages						
IX.19.	V19.	91.	They track the user's progress						
IX.20.	V20.	92.	They facilitate assessment and user progress tracking						
Dimension 2: Applicability									
Nº Initial Item	**Nº EFA Item**	**Nº Final Item**	***Applicability of Specific Apps for People with Autism …***	**Scale**					
				1	***2***	***3***	***4***	***5***	
IX.1.	V1.	93.	They can be found easily on Google Play or the App Store						
IX.2.	V2.	94.	They are available on smartphones						
IX.3.	V3.	95.	They are available on tablets						
IX.4.	V4.	96.	There are many of them						
IX.5.	V5.	97.	They are varied in terms of subject area (emotions, communication, time management, etc.)						
IX.6.	V6.	98.	They include tasks that respond to their needs						
IX.7.	V7.	99.	Their design is adapted to their characteristics						
IX.9.	V9.	100.	They offer different codes of communication (visual, auditory)						
IX.11.	V11.	101.	They are intuitive and easy to use						
IX.12.	V12.	102.	They present their content in a clear and intuitive way						
IX.13.	V13.	103.	They specify what content they include						
IX.14.	V14.	104.	They include suitable content						
IX.21.	V21.	105.	They offer a controllable environment and situation						
Dimension 3: Uses of Specific Apps for Autism									
Nº Initial Item	**Nº EFA Item**	**Nº Final Item**	***Uses of Specific Apps for People with Autism …***	**Scale**					
				1	***2***	***3***	***4***	***5***	
X.22.	V22.	106.	Work on the area of emotions in a suitable way						
X.23.	V23.	107.	Work on the area of oral language in a suitable way						
X.24.	V24.	108.	Work on the area of communication in a suitable way						
X.25.	V25.	109.	Work on the area of leisure and entertainment in a suitable way						
X.26.	V26.	110.	Work on autonomy in a suitable way						
X.27.	V27.	111.	Work on time management in a suitable way						
X.28.	V28.	112.	Work on cognitive stimulation in a suitable way						
X.29.	V29.	113.	Work on planning in a suitable way						
X.30.	V30.	114.	Work on organization in a suitable way						
X.31.	V31.	115.	Work on self-regulation in a suitable way						
X.32.	V32.	116.	Work on memory development in a suitable way						
X.33.	V33.	117.	Work on learning how to read in a suitable way						
X.34.	V34.	118.	Work on learning how to write in a suitable way						
X.35.	V35.	119.	Work on learning arithmetic in a suitable way						

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