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ICT and disabilities. Construction of a diagnostic instrument in Spain.

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Abstract

This work presents the process of validation of a questionnaire that aims to determine the level of training and knowledge of teachers in the Spanish primary education, with respect to the application of the Information Technology and Communication (ICT) for people with disabilities. The structure of the instrument includes 6 dimensions: general, visual, hearing, motor, cognitive, and accessibility. The procedure considered the content validation, validation of construct through factor analysis and determination of reliability through Cronbach Alpha. The "expert judgement" technique, was used for the validation of content by applying a process of selection of experts at our educational research, the so-called expert coefficient or "K coefficient". The developed process made it possible to give scientific validity to the intended instrument.

Key words: *ICT, disability, questionnaire, expert-coefficient, teacher-training competency.*

Introduction

The interaction between ICT and students with disability, or in other words, the ways in which ICT can contribute to the development of environments for learning that takes into account the diversity of students, represents a priority research in an educational framework. Educators should promote other forms of teaching and learning, and the commitment to educational innovation and oriented equity is always a matter of concern within educational community.

Approach to the problem

So offering a fair and equitable education in which those who have more difficulties to learn may find the necessary means and support to achieve it, is a priority objective in the education systems of inclusive orientation. Commitment to inclusive education needs the impetus of an educational system to open their schools to all students and to ensure, each one of them, an education capable of attending to the differences.

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Such a reality would not be possible without taking into account the educational support provided by the ICT to the inclusive process since they constitute the support that will allow constructing tasks that will meet the interests of persons.

One of the problems facing teachers for the incorporation of ICT into educational practice is in many cases the lack of both technological and instrumental, as methodological and strategic training. Regarding training, this is even less, such as been shown by different investigations, regarding the use of ICT for people with disabilities.

Along with this, the research wanted to determine the level of training and knowledge that teachers of primary education had with respect to the application of ICT for people with disabilities, and if such training had been determined by variables such as gender, location of the school, type of Centre, etc. Also would be important to know if the training and knowledge were different depending on the type of disability. Like this, it became necessary to build a valid and reliable diagnostic instrument.

Justification of the study

Currently studies that highlight the importance of the integration of technology for the improvement of the learning of "all" the students are abundant (Ghaleb, 2014; Khetarpal, 2015; Alper and Goggin, 2017), but are rarer those who made special emphasis on students with special educational needs disability (Wallace and Georgina, 2014; Istenic and Bagon, 2014). The potential that ICT has to contribute to a better quality of life in students with functional diversity is being proofed by different studies that have been made in recent years: Patton and Roschelle (2008) respecting students with mental disabilities; Bouck, Doughty, Flanagan, Szwed and Bassette (2010) regarding writing improvements; Shih et al. (2011), hearing problems. Although rare, there have been carrying out studies which highlight the lack of teacher training to teach successful ICT, in the framework of special education (Liu, 2011; Yusof, Gnanamalar, Low, and Aziz, 2014; Altinay and Altinay, 2015; Vladimirovna and Sergeevna, 2015).

In the Spanish context, studies regarding teachers training for the management of ICT, show that they have high attitudes towards them, but feel insecure for their incorporation into the process of teaching and learning, and not so much from a technological point of view, but rather from a didactic and methodological perspective (Prendes & Gutierrez, 2013). This explains the low

variability of technological materials that teachers used with students in their professional activity (Ferrandis, Grau & Fortes, 2010).

In the case of this training for the use of ICT applied to people with special educational needs, the first thing to point out is the few number of research's, as we can see in articles that address the issue of the training of teachers and the skills need to be used with people with special educational needs (Rosario & Vazquez, 2012; Terigi, 2013; Rangel & Penalosa, 2013; Ortiz, Almazán, Penaherrera & Cachon, 2014). On the other hand, looking to this small number of investigations, they pointed out the lack of training and knowledge that teachers have with respect to different types of technologies that can be used with these people, the possibilities offered, and the functions that can be used (Roig, Ferrandez, Rodríguez-Cano & Crespo, 2012; Tello & Cascales, 2015). This gap on the use of ICT has negative repercussions, avoiding at the same time that these people benefit from the possibilities offered by these technologies as tools for inclusion in the classrooms. Is necessary to take into account such knowledge, since lately there are quite advanced studies regarding ICT showing that there exist significant instruments letting the inclusion of persons with different types of special needs: cognitive, sensory or motor, and that can help overcome the limitations arising from the same (Homer, Weaver & Calvo, 2017). In particular may promote the autonomy of students, being able to adapt to the needs and demands of each student in a personalized way; offering immediate feedback; facilitate synchronous and asynchronous communication of these students with other classmates and teachers; save time for the acquisition of skills and abilities; facilitate the diagnosis of the student; support a model of communication and multi-sensory training; promote an individualized training, since students can progress at their own pace, which is of extreme importance for these subjects; promote the development of the autonomy and independence of persons; avoid marginalization and the digital detachment; facilitate the social inclusion of the student with specific difficulties; provide moments of leisure; save time for the acquisition of skills and abilities; students can execute and repeat the exercises with minimal effort in order to acquire skills, attitudes and abilities; they encourage these people to approach the cultural and scientific world; and also being excellent simulators (Toledo, 2013).

A good teacher training requires a study to learn about the reality of which we start, and this necessarily requires the creation of valid and reliable instruments that allow diagnosis. In the Spanish context have been developed some, referred to the knowledge and digital competence that teachers and students had with respect to ICT (Bullón et. al., 2008), the Diagnostics of digital

competence of teachers and learners (Marin & Reche, 2011;) Ortiz, Almanzan, Penaherrera & Cachon, 2014; Morales, Trujillo & Raso, 2015 & Rangel, 2015), but none relating to ICT and disability.

These instruments have not been developed for the diagnosis of the knowledge that teachers may have for the incorporation and use of ICT, to be used with people with different types of disabilities. For this reason, this study, which was funded by the Spanish Ministry of Economy and Competitiveness was developed.

Method

We have established five stages for the design and construction of the instrument. This instrument will help to diagnosis the knowledge that teachers of primary education had regarding the potential and the application of the ICT for persons with disabilities:

- review of the literature;
- the first production version of the instrument;
- application of the instrument to the technique of "expert judgement" for analysis;
- draft of final version instrument;
- Test pilot to get the reliability index.

Review of the literature focused basically on various types of documents that have the following characteristics:

- Theoretical studies on ICT and disabilities;
- Research on the use of ICT for people with disabilities;
- Websites of institutions dedicated to persons with disabilities;
- Reviewing documents located in http://www.scoop.it/, and research on the domain of digital competencies.

Some of the documents have been presented previously to the theoretical foundation of the work. After the review of the literature, the next step was the development of the first version of the questionnaire by the members of the research team Diagnóstico y formación del profesorado para la incorporación de las TIC en alumnado con diversidad funcional (DIFOTICYD) (EDU2016 75232-P), direct translation, Diagnosis and Training of Teachers for the Incorporation of ICT with students with Disabilities, belonging to the universities of Sevilla, Jaén, Granada, Cordoba, Alicante, Leon and Extremadura. The first version of the instrument was formed by 66 items,

which had the following distribution by dimensions: 11 for General, 16 for Visual, 8 for Hearing, 13 for Motor, 8 to Cognitive and 10 for Accessibility. It was constructed a scale Likert type, usual for this type of research format. For the analysis of the validity of the content of the instrument it was applied the "expert judgement" technique, whose relevance depends clearly on the process followed by the selection of the same, which apply different criteria generally related to the expert with the theme linking to analyze (Brill, Bishop and Walker, 2006;) Garcia-Abreu and Fernández-García, 2008). Our study followed a double process for selection, first people who met some or several of the following criteria were selected:

- Have professional experience in special education, in the use of ICT for people with disabilities;
- Are teaching ICT applied to education or special education;
- Are from different universities, or working in an institution related to special education.

This led us to form an initial group composed of 52 expert assessors who were willing to participate in this process of construction of the instrument, an important aspect is that the process would have two turns. Then the coefficient expert, also known as "K coefficient", was obtained (Oñate, 2001, Garcia-abreu and Fernandez-Garcia, 2008; Blasco et al., 2010; Cabero and Llorente, 2013). This procedure of selection is being used in different articles Zayas (2011), Cabero and Barroso (2013), Llorente (2013) and Mengual-Andres, Roig-Vila and Blasco (2016) in which it was very significant.

The coefficient is obtained from the opinion of the expert on their level of knowledge about the research problem, as well as sources that allow analyzing the criterion established. The coefficient is obtained by applying the formula: $K = ½ (Kc + Ka)$ (Cabero and Barroso, 2013, 29). Where Kc is equal to the rate of knowledge or information that has the expert about the topic or problem, where is use a scale of 0 to 10 (whereas 0 - not having absolutely no knowledge and 10 - have full knowledge). Ka is the coefficient of argument or justification of the criteria of experts, obtained from estimations that perform the expert in different fields that we present in Table 1.

Table 1
Evaluations for obtaining the Ka value

	High	**Medium**	**Under**
Theoretical analyses carried out by you	.3	.2	.1
Experience gained from your practical activity	.5	.4	.2
Work study on the topic of Spanish authors	.05	.05	.05

Work study on the topic of foreign authors	.05	.05	.05
Own knowledge about the problem abroad	.05	.05	.05
His intuition about the topic addressed	.05	.05	.05

The above formula allows to obtain a score between 0 and 1 and is adopted as a criterion for those people who do not obtain a score greater than 0.8 they are not considered in the research experts. From the initial 52 judges, only were selected 36; i.e. 16 were eliminated.

It was administered to 36 judges the initial questionnaire, in order that each one of them could indicate us their "pertinence", "relevance" and "clarity" regarding the itens; to obtain from this the index of "Reason for content validity" of Lawshe modified by Tristan (2008). Table 2 presents the results achieved for each item.

Table 2

Reason for validity of content for each item

		CVR			
Dimension	**Item**	**Pertinence**	**Relevance**	**Clarity**	**Average**
General	1	.906	.938	.906	.917
	2	.938	.906	.813	.885
	3	.938	1,000	.938	.958
	4	.844	.813	.906	.854
	5	1,000	.906	.906	.938
	6	.875	.938	.875	.896
	7	1,000	.906	.906	.938
	8	1,000	.969	.906	.958
	9	.875	.875	.844	.865
	10	.969	.969	.906	.948
	11	.906	.906	.813	.875
	12	.938	.875	.969	.927
	13	.938	.938	.906	.927
Visual	14	.906	.938	.906	.917
	15	.906	.938	.906	.917
	16	.938	.906	.875	.906
	17	.875	.813	.750	.813
	18	.938	.938	.969	.948
	19	.938	.875	.938	.917
	20	.875	.906	.906	.896
	21	.875	.781	.781	.813

	22	.875	.844	.906	.875
	23	.875	.844	.813	.844
	24	.938	.906	.844	.896
	25	.906	.906	.844	.885
	26	.875	.844	.844	.854
	27	.906	.875	.844	.875
	28	.844	.875	.938	.885
	29	.781	.688	.844	.771
	30	.906	.938	.938	.927
Hearing	31	.938	.938	.938	.938
	32	.906	.906	.938	.917
	33	.875	.938	.844	.885
	34	.938	.906	.875	.906
	35	.906	.906	.906	.906
	36	.938	.906	.969	.938
	37	.906	.844	.906	.885
	38	.875	.906	.938	.906
	39	.906	.813	.844	.854
	40	.906	.844	.781	.844
	41	.813	.781	.781	.792
Motor	42	.906	.875	.906	.896
	43	.969	.875	.781	.875
	44	.906	.875	.938	.906
	45	.844	.813	.875	.844
	46	.906	.844	.813	.854
	47	.906	.813	.813	.844
	48	.906	.906	.844	.885
	49	.844	.813	.844	.833
	50	.813	.781	.813	.802
	51	.875	.875	.875	.875
Cognitive	52	.906	.875	.781	.854
	53	.938	.844	.781	.854
	54	.906	.781	.844	.844
	55	.875	.813	.844	.844
	56	.906	.875	.813	.865
	57	.844	.813	.813	.823
	58	.844	.813	.750	.802
	59	.844	.750	.813	.802
	60	.813	.688	.750	.750
Accessibility	61	**.625**	**.563**	**.750**	**.646**
	62	.719	.656	.750	.708
	63	.781	.719	.813	.771

64	.938	.750	.844	.844
65	**.688**	**.656**	**.531**	**.625**
66	.813	.719	.813	.781
CVR	**.886**	**.852**	**.854**	**.864**

The result of each dimension is presented in Table 3.

Table 3

Reason for validity of content for each dimension

Dimension	Pertinence	Relevance	Clarity	Average
General	.932	.920	.884	.912
Visual	.906	.883	.875	.888
Hearing	.887	.887	.902	.892
Motor	.899	.853	.861	.871
Cognitive	.883	.832	.824	.846
Accessibility	.791	.713	.763	.755

Different criteria were adopted for the construction of a new version of the questionnaire:

- Following the proposal of Tristan (2008), deleting those items that do not have a CVI (Content Validity Index) average of 0.65 or higher;
- Following the recommendation of the experts, unifying questions so the questionnaire could be not so much extensive;
- Reduce the questionnaire regarding the factors visual and motor, because the number of items was not proportional with the others;
- And make some changes regarding the formulation or the terminological precision in some items.

This led us to build a new instrument, in this case consisting of 53 items that were organized by size according to the following distribution: 10 (General), 12 (Visuals), 9 (Hearing), 7 (Motor), 7 (Cognitive), and 8 (Accessibility).

This version was then passed to experts in a second round, so they valued from 0 to 10, its pertinence, relevance and clarity; and at the same time, they appreciate it on a global basis. Values are presented in Table 4 with the means and standard deviations.

Table 4

Averages and standard deviations overall assessment

Dimension	Mean	Standard deviation
Pertinence	9.63	.63
Relevance	9.44	.93
Clarity	9.67	.48
Overall assessment	9.97	.19

As we can see this version obtained a fairly high score by experts. What led us to carry out a pilot study to obtain the index of reliability, which was obtained by the alpha of Cronbach coefficient as suggested by O'Dwyer and Bernauer (2014).

The instrument, Likert-type and 6 response options (VP = very positive/very relevant; P = positive/relevant; R+ = Regular positive/regularly relevant; R- = Regular Negative/moderately inappropriate; N = negative/Inopportune; VN = very negative/very inconvenient) was administered to 291 teachers of different Spanish autonomous community and who mainly taught at public schools in primary education. The instrument applied via the internet, was built with Google Docs, and it can be seen at the following web address:

https://docs.google.com/forms/d/e/1FAIpQLSfux6m1cU6Nf-69eiiMS28LjcSom38yqe2OmS-Jy4mXAgJVnA/viewform

In Table 5 we present the mean and standard deviation of the 6 dimensions that were part of the instrument.

Table 5

Averages and standard deviations of different dimensions

Dimension	Mean	Standard deviation
General	3.54	1.32
Visually	2.73	1.59
Hearing	2.91	1.66
Motor	2.97	1.70
Cognitive	3.20	1.67
Accessibility	2.63	1.57

Table 6 presents the means and standard deviations reached in each of the items.

Table 6

Averages and standard deviations of each different items

Item	M	SD.
1 I have general knowledge about the possibilities that ICT offered to persons with disabilities. (G)	3.92	1.35

2 I'm aware of the difficulties that generate different types of disability for the use of ICT. (G)	3.76	1.46
3 I would know how to select, specific ICT based on physical, sensory and cognitive characteristics of different people. (G)	3.47	1.43
4 I know different resources and documents which are specifically dedicated to the analysis of the possibilities of ICT for people with different types of disabilities. (G)	3.33	1.47
5 I know the application of ICT educational experiences for people with different types of disabilities. (G)	3.49	1.45
6 I know mobile apps, which can be used with people with special educational needs.(G)	3.33	1.67
7 I know the main limitations that can influence the use of ICT by students with disabilities. (G)	3.57	1.45
8 I consider myself competent to find educational materials online for people with special educational needs. (G)	3.95	1.48
9 I'm, in general, ready to help students with certain disabilities in the use of the technical support and use of ICT. (G)	3.70	1.58
10 I know to design activities with educational software generalized for the pupils with special educational needs. (G)	2.93	1.64
11 I'm able to explain the possibilities offered by a machine to write in Braille system. (V)	2.89	1.78
12 I know the possibilities offered to students with visual disabilities by the *Kurzweil* reading machines. (V)	2.54	1.72
13 I know the possibilities offered by the *telelupas* for students with visual disabilities. (V)	3.00	1.68
14 I recognize different computer programs specifically designed for people with visual disabilities.	2.82	1.70
15 I know what are magnifying screens programs to facilitate access to students with visual impairments to the computer. (V)	2.71	1.70
16 I know different readers software's screen, such as the *JAWS, Tiflowin,...* (V)	2.61	1.76
17 I know how to make teaching materials by using a word processor, eliminating aspects that make it difficult to use for people with visual impairment. (V)	2.82	1.70
18 I'm able to enumerate different *tiflotecnologicos* materials which allow access to persons with visual disabilities regarding calculation. (V)	2.52	1.73
19 I know specific browsers for visually impaired people. (V)	2.43	1.63
20 I know different websites where educational resources for people with visual disabilities can be located. (V)	2.70	1.66
21 I'm able to apply teaching strategies and adapting the curriculum supported by ICT to facilitate inclusion of students with visual impairments. (V)	2.84	1.70
22 I know the possibilities that ICT provide to students with Visual limitations. (V)	2.93	1.71
23 I'm able to use sign language. (H)	2.53	1.80
24 I'm able to express messages according to the language of signs. (H)	2.55	1.83
25 I'm able to identify different computing resources for the empowerment of the voice and speech. (H)	2.86	1.79
26 I know different educational software that stimulates language and the acquisition and development of oral and written language skills. (H)	3.03	1.72
27 I'm able to identify different websites where educational resources for people with hearing impairment can be located. (H)	3.18	1.73
28 I'm able to apply instructional strategies supported by ICT to facilitate inclusion of students with hearing impairment. (H)	3.07	1.77
29 I'm able to apply instructional strategies supported by ICT to facilitate inclusion of students with hearing impairment. (H)	3.02	1.75
30 I know the possibilities that ICT provide students with hearing impairment. (H)	3.07	1.74
31 I know different speech re-education programs. (H)	2.83	1.85

32 I know different types of keyboards for people with different types of limitations in mobility. (M)	2.88	1.80
33 I know the uses of circuit breakers, switches and pointers. (M)	2.97	1.87
34 I know computer programs that control the computer with the voice. (M)	2.92	1.80
35 I know the augmentative bases of alternative software systems to facilitate communication for persons with motor disabilities. (M)	2.81	1.81
36 I find websites containing educational resources for people with motor disabilities. (M)	3.14	1.76
37 I'm able to apply instructional strategies supported by ICT to facilitate inclusion of students with motor limitations. (M)	3.02	1.70
38 I know the possibilities that ICT provide students with motor disabilities. (M)	3.07	1.78
39 I can quote some educational programs used for the rehabilitation of cognitive skills. (C)	3.10	1.82
40 I'm able to quote different websites where we can find educational resources for people with cognitive disabilities. (C)	3.31	1.84
41 I know how to use specific software to make materials adapted to a concept keyboard. (C)	2.67	1.80
42 I'm able to apply instructional strategies supported by ICT to facilitate inclusion of students with cognitive disabilities. (C)	3.22	1.75
43 I'm capable of adapting the curriculum supported by ICT for individuals with cognitive disabilities. (C)	3.34	1.84
44 I'm able to describe the main limitations that may contain materials multimedia to be used with people with cognitive disabilities. (C)	3.17	1.76
45 I can find websites containing educational resources for people with cognitive disabilities. (C)	3.43	1.71
46 I know the possibilities that ICT provide for students with cognitive disabilities. (C)	3.34	1.76
47 I know the possibilities offered by operating systems and browsers to modify certain aspects of programs (i.e. speed, font size, type of pointer...) making the program more accessible for people with different types of disabilities. (A)	3.47	1.80
48 I know what the test of accessibility for websites is. (A)	2.90	1.82
49 I know the general guidelines of W3C/WAI which is used to make websites accessible. (A)	2.40	1.70
50 I'm able to create web pages with high parameters of accessibility. (A)	2.27	1.61
51 I'm able to adjust a computer to the educational needs of any disabled person. (A)	2.48	1.69
52 I know different institutions that are related to the study and investigation of the accessibility of websites. (A)	2.58	1.77
53 I am able to point out different accessibility test. (A)	2.34	1.68

After the statistical analyzes we obtain the Cronbach alpha, in general, and for each of the dimensions like is stated in the following Table 7.

Table 7

General scale and its different dimensions - Cronbach alpha

Dimension	Cronbach Alpha
Total scale	**.993**
General	.967
Visual	.986
Hearing	.983
Motor	.982

Cognitive	.979
Accessibility	.967

The values reached, in accordance with the proposal of Matthew (2004) and O'Dwyer and Bernauer (2014), can be considered very high and therefore they would indicate high levels of reliability of the produced instrument, both globally and in the various dimensions.

In order to analyze if the removal of an item would increase the reliability of the instrument, we make the total item correlation, reached the values that are shown in Table 8.

Table 8

Total item Correlation.

	Average scale If the element Is deleted	Scale variance If the element Is deleted	Total correlation with corrected elements	Cronbach's alpha If the element Is deleted
1	155.32	5887.265	.719	.993
2	155.48	5876.947	.709	.993
3	155.77	5851.703	.84	.993
4	155.91	5850.315	.822	.993
5	155.75	5864.153	.774	.993
6	155.91	5820.671	.839	.993
7	155.67	5846.272	.852	.993
8	155.29	5881.483	.679	.993
9	155.54	5846.821	.780	.993
10	156.31	5832.257	.807	.993
11	156.35	5805.804	.845	.993
12	156.70	5806.874	.871	.993
13	156.24	5821.395	.832	.993
14	156.42	5807.993	.876	.993
15	156.53	5797.692	.913	.993
16	156.63	5799.936	.874	.993
17	156.42	5801.909	.919	.993
18	156.72	5808.976	.856	.993
19	156.81	5819.338	.865	.993
20	156.54	5823.699	.832	.993
21	156.40	5803.453	.892	.993
22	156.31	5797.282	.914	.993
23	156.71	5803.754	.841	.993
24	156.69	5794.815	.857	.993
25	156.38	5795.023	.88	.993
26	156.21	5806.932	.869	.993

27	156.06	5799.195	.894	.993
28	156.17	5792.648	.899	.993
29	156.22	5791.761	.910	.993
30	156.17	5795.012	.906	.993
31	156.41	5778,911	.908	.993
32	156.36	5788.853	.898	.993
33	156.27	5780.142	.893	.993
34	156.32	5779.725	.928	.993
35	156.43	5789.932	.888	.993
36	156.10	5793.543	.898	.993
37	156.22	5802.485	.894	.993
38	156.17	5787.693	.909	.993
39	156,14	5793.433	.869	.993
40	155,93	5792.827	.861	.993
41	156.57	5799.946	.856	.993
42	156.02	5812.578	.830	.993
43	155.90	5797.724	.844	.993
44	156.07	5799.057	.877	.993
45	155.81	5822.641	.813	.993
46	155.90	5806.923	.849	.993
47	155.77	5807.466	.827	.993
48	156.34	5805.321	.825	.993
49	156.84	5827.094	.802	.993
50	156.97	5846.205	.768	.993
51	156.76	5809.793	.872	.993
52	156.66	5795.578	.887	.993
53	156.90	5821.097	.834	.993

The analysis of Table 8, shows that if we don't remove any item it would increase the reliability of the instrument, therefore, we took the decision not to remove any of them.

Our next step, and with the aim of analyzing the dimensionality of the instrument, was to conduct an exploratory factor analysis, using the extraction method of analysis of main components and a Varimax rotation with Kaiser Normalization (Merino Pardo, 2002). After its conclusion, we obtain the values set out in Table 9.

Table 9

Varimax rotation

	1	2	3	4	5
1		.752			

2		.808			
3		.660			
4		.688			
5		.703			
6		.624			
7		.717			
8		.803			
9		.776			
10		.499			
11	.714				
12	.731				
13	.725				
14	.716				
15	.694				
16	.777				
17	.690				
18	.756				
19	.724				
20	.728				
21	.620				
22	.665				
23			.645		
24			.655		
25			.689		
26			.654		
27			.607		
28			.557		
29			.508		
30			.582		
31			.628		
32			.554		
33			.579		
34			.494		
35			.581		
36			.572		
37			.467		
38			.514		
39				.619	
40				.671	
41					.616
42				.753	
43				.769	
44				.691	

45			.776	
46			.727	
47	.479			
48				.580
49				.799
50				.752
51				.668
52				.598
53				.709

Data analysis indicates that the different items tend to gather in the dimensions/factors that had been foreseen: General, Visual, Hearing, Cognitive, Accessibility and Motor. Only two items "41 - I know how to use specific software to make materials for a concept keyboard." and "47 - I know the possibilities offered by operating systems and browsers to modify certain aspects of programs (i.e. speed, font size, type of pointer,...) making the program more accessible for people with different types of disabilities." have been established outside the dimension provided by us and by the experts who helped the construction of the instrument.

The first of this is enclosed in the dimension of "Accessibility" as retrieved by the Varimax analysis, and the second, in the "Visual", in this case from a conceptual point of view.

Conclusions

There are several conclusions resulting from our work: 1) efficiency and validity of the procedure followed for the design and construction of diagnostic instrument; allowing an valid and reliable instrument; such efficiency is also related to the construction of diagnosis instruments in digital skills applied to various problems (Cabero, Fernandez-Batanero & Cordoba 2016;) Gutierrez-Castillo, Cabero & Estrada, 2017); 2) the study conducted provides a tool for the diagnosis of knowledge that pre-school and primary teachers possess in relation to the use of ICT with persons with disabilities, such instrument is new regarding the scientific literature, primarily by the lack of interest this issue has aroused (Cabero, Fernandez-Batanero, & Barroso, 2016) 3) the constructed instrument allows not only to inquire about knowledge of ICT in general regarding its use in an diversity environment but also related to specific disabilities (Visual, Hearing, Cognitive and Motor), and with respect to Accessibility, which makes it more attractive for their use; and 4) think

that the instrument can be used in the Latin American context, where this problem is beginning to awaken interest with some language adaptations.

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