Validity and reliability of an instrument to evaluate the digital competence of teachers in relation to online tutorials in the stages of Early Childhood Education and Primary Education

Validez y fiabilidad de un instrumento para evaluar la competencia digital del profesorado en relación a la acción tutorial online en las etapas de Educación Infantil y Educación Primaria

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Abstract

This article demonstrates the validity and reliability of an instrument to evaluate the level of digital competence of Early Childhood Education and Primary Education teachers to carry out online tutorials using ICT resources as part of the educational process during the COVID-19 pandemic. The instrument consists of 35 items classified into five dimensions (A – functions of the tutor with the students; B – functions of the tutor with the teaching staff; C – functions of the tutor with the family; D – training in ICT and transfer; E – use of ICT resources). The instrument was applied to a sample of 1,098 active teachers from 14 autonomous communities located in Spain. Reliability was measured using Cronbach's Alpha, the Spearman-Brown Coefficient, Guttman Two Halves, Omega McDonald, and for composite reliability. To check the validity of the instrument, we analysed the validity of understanding, and exploration of dimensionality using Factorial-Exploratory Analysis (EFA), and the instrument was adjusted for the different models through Confirmatory Factor Analysis (CFA). In addition, factorial invariance was evaluated based on the variables sex (male/female), type of centre (public/charter school), and type of teaching staff (Early Childhood Education/Primary Education), as well as external validity. The results of the reliability analyses were highly satisfactory and, in relation to the construct validity, the results found a good fit of the model, both in the internal validity and in the factorial invariance. The final version of the instrument consists of 25 items.

Keywords: digital competence, tutorial action, teachers, psychometrics, reliability, validity, factorial invariance, research methods

DOI: http://dx.doi.org/10.6018/red.474981

Resumen

El artículo presenta la validez y fiabilidad de un instrumento para evaluar el nivel de competencia digital del profesorado de Educación Infantil y de Educación Primaria para llevar a cabo la acción tutorial a través de recursos TIC como parte del proceso educativo en tiempos de COVID-19. El instrumento cuenta con 35 ítems clasificados en cinco dimensiones (A- funciones del tutor con el alumnado, B- funciones del tutor con el profesorado, C- funciones del tutor con la familia, D- Formación en TIC y transferencia, E- Uso de recursos TIC). El instrumento fue aplicado a una muestra de 1098 profesores en activo procedentes de 14 comunidades autónomas de España. La fiabilidad fue medida a través de Alfa de Cronbach, Coeficiente de Spearman-Brown, Dos mitades de Guttman, Omega McDonald y fiabilidad Compuesta. Para comprobar la validez del instrumento, fue analizado la validez de comprensión, exploración de la dimensionalidad mediante Análisis-Factorial-Exploratorio (AFE), y se fue ajustando el instrumento a través de diferentes modelos a través del análisis factorial confirmatorio (AFC). Además, fue analizada la invarianza factorial por la variable sexo (masculino-femenino), tipo de centro (público-concertado) y tipo de profesorado (educación infantil-educación primaria), así como la validez externa. Los análisis de fiabilidad fueron altamente satisfactorios y en relación a la validez de constructo, los resultados encontraron un buen ajuste del modelo tanto en la validez interna como en la invarianza factorial, con una versión final del instrumento de 25 ítems.

Palabras clave: competencia digital, acción tutorial, profesorado, psicometría, fiabilidad, validez, invarianza factorial, métodos de investigación

1. Preface

Technological advances are especially important in particularly adverse situations, such as those that are currently being experienced due to the COVID-19 pandemic (Rahiem, 2020). This problematic situation has transformed teaching and learning practices, requiring a more innovative and digitally competent teacher, as has never been required before (Moreno et al., 2020; Othman, 2020).

Face-to-face education has shifted, in recent months, to online education (Paudel, 2020), which has led to an exponential increase in communication needs between members of the educational community to digitally coordinate teachers, with each other, with students and their families (Vuorikari et al., 2020; Wolfe et al., 2020). However, the main problem, as De Soroa (2020) points out, is that these educational functions have been in the background since the current pandemic began, provided that the tutorial action plans were also in 'confinement'. However, at this time, it is of vital importance that an effective family–school collaboration be implemented, which represents an excellent opportunity to build more democratic and participatory schools (Ceballos, 2017; Miretzky, 2004).

Oro (2010) defines tutorial action as an orientation process inherent to educational action, in which the tutor must design activities for their group of students in order to develop a multitude of strategies (Alexandrovich et al., 2020), such as conflict resolution, acquisition of emotional skills, and personal autonomy, among others. To achieve this, the tutor must coordinate both with the other teachers at the centre, as well as with families, so that the latter are involved in the process of teaching their children (Lamata, 2010).

A multitude of research supports a linear relationship between online education and academic success (Elhadary et al., 2020; Broadbent, 2017; Roschelle et al., 2016; Yeboah & Smith, 2016). Thus, if online education can improve the teaching-learning process, it should be possible that tutorials, carried out using ICT resources, would result in higher personal, social, and academic development of the students (Hill et al., 2018; Neely et al., 2017; Tanis & Barker, 2017), as well as in greater intrinsic and extrinsic motivation (Higgins et al., 2012; Huang, 2017).

Along these lines, it should be noted that the inclusion of ICT in the educational field represents one of the key advances during the pandemic, since these technologies allow the implementation of educational activities, such as facilitation and an increase in online tutoring (Guy & Lownes-Jackson, 2012), which improves communication and interaction with the educational community. In this regard, Gordon (2003) explains that current teachers have more opportunities to serve students in the online and ICT era. In this context, we must highlight online tutoring experiences that increase teaching contributions to the attention of students (Vasquez & Slocum, 2012); knowledge that emphasises highlighting the potential of online tutoring for students in rural educational centres (Koerwer, 2007); and actions that increase effectiveness through online tutoring compared to face-to-face tutoring (Chappell et al., 2011; Shenderovich et al., 2016). However, to develop different measures and guidelines for such action and online guidance, it is necessary that the tutor has an adequate level of digital competence so that they can continue supporting their student group online, ensuring the effectiveness of the teaching-learning process (Pardo & Peñalvo, 2008). This appropriate level can be associated with the levels provided by the DigCompEdu framework: Rookie, Explorer, Integrator, Expert, Leader and Pioneer (Cabero-Almenara & Palacios-Rodríguez, 2020).

Against this background, it should be considered that use of ICT resources is a determining element of digital teaching competence (Hidson, 2021; Guillén-Gámez et al., 2020; Orellana et al., 2021), in addition to teachers' attitude towards the integration of technology (Romero et al., 2020). The key is not the extent to which ICT resources are used but how they are applied to support the teaching-learning process, where the more training the teacher has in digital skills, the more effective their use will be (Guillén-Gámez et al., 2020; O'Malley et al., 2013) so, consequently, the personalised attention of the tutorial action and guidance through ICT will be better (Vallejo et al., 2020).

Viberg and Grönlund (2017) established that the use of technology in the teaching-learning process is essential, especially in online education and tutoring. This has promoted a growing interest regarding the study of the variables that influence teachers having a higher or lower level of digital competence, such as gender (Laabidi, 2017; Martin et al., 2019), type of centre (Ramírez-Montoya et al., 2017), or type of teaching staff (Guillén-Gámez et al., 2020).

Regarding the differences found with reference to sex, Erdogan and Sahin (2010) carried out an investigation on technological pedagogical content knowledge (the TPACK model), in which 137 teachers took part. The results showed a greater use of ICT by male teachers compared to female. Similar results were reported by Jang and Tsai (2013), Cabero and Barroso (2016), Akpabio and Ogiriki (2017), and Portillo et al. (2020). In the same context, Portillo et al. (2020) investigated the digital competence of 4,586 teachers during the COVID-19 pandemic. The results showed significant differences in the gender variable, favouring male teachers. However, other studies have reported contradictory results, such as those obtained by Ait Hammou and Elfatihi (2019), Barahona et al. (2019), and Usart et al. (2021), where no significant differences were found based on the sex dimension.

In relation to the type of education centre, Zia et al. (2017) examined the knowledge gap in ICT resources between private and public education centres, confirming that private centres have greater means to access ICT, resulting in higher digital skills. Similar results were found in studies by García-Martín and Cantón-Mayo (2019), and Akpabio and Ogiriki (2017). In the same context, Portillo et al. (2020) found that the level of digital competence of teachers in charter schools was higher in contrast to public schools. In addition, the authors stressed that there was a linear increase in the level of competence as teachers changed stages (from Early Childhood Education to Higher Education).

In regard to the scientific literature relating to teaching digital competence, no studies have been found that analyse said competence to carry out the tasks of teaching tutorial actions (Pettersson, 2018). Therefore, the objective of this study is to analyse the psychometric properties of an instrument that evaluates the digital competence of Early Childhood Education and Primary Education teachers in relation to the level of use of ICT resources to carry out tutorial actions in these educational stages. The reliability is evaluated through different techniques, and the validity of the knowledge and the internal (exploratory and confirmatory) and external construct and invariance by gender, which confirms the validity of the developed instrument.

2. Method

2.1 Design and participants

First, an ex post facto design was used for data collection; second, a psychometric design (reliability and validity) with descriptive and inferential data analysis, was applied in order to be able to generalise and use the instrument with the population.

Using intentional non-probabilistic sampling, a sample of 1,098 active teachers of the Early Childhood Education and Primary Education stages was collected, from the entire Spanish territory. Table 1 shows the distribution of teachers by type of centre, sex, and educational stage. It should be specified that charter schools are institutions founded by a private company and that receive subsidies from the state. Regarding gender, male teachers had a mean age of 43.45 years (± 9.90) and a mean teaching experience of 16.68 years (± 10.61), while female teachers had a mean age of 42.86 years (± 9.67) and a mean teaching experience of 16.36 years (± 9.90).

Table 1. *Demographic data of the present study*

	Sex (%)		Title			Stage	
Autonomous communities	Male	Female	Public	Private	Charter	Infant	Primary
Andalusia	12.7%	18.2%	11.8%	20.0%	24.9%	14.6%	14.1%
Estremadura	3.8%	4.9%	4.8%	0.0%	1.0%	5.4%	3.7%
Basque Country	2.3%	5.8%	2.0%	0.0%	9.0%	2.5%	3.5%
Canary Islands	6.5%	4.5%	6.8%	0.0%	2.0%	3.3%	6.6%
Castilla la Mancha	10.8%	9.7%	12.4%	0.0%	2.0%	9.6%	10.7%
Castile and Leon	9.0%	6.5%	8.3%	0.0%	8.5%	8.3%	8.3%
Aragon	8.7%	8.8%	7.6%	20.0%	13.4%	10.0%	8.4%
Galicia	10.9%	8.1%	9.8%	0.0%	11.9%	12.1%	9.6%
The Rioja	2.3%	1.9%	1.9%	0.0%	3.5%	1.3%	2.4%
Navarre	4.1%	3.2%	4.0%	0.0%	3.0%	2.9%	4.1%
Madrid	14.9%	13.0%	15.7%	60.0%	7.5%	15.4%	14.1%
Balearic Islands	4.9%	4.9%	4.8%	0.0%	5.5%	4.6%	5.0%
Murcia	5.9%	5.8%	5.9%	0.0%	6.0%	3.8%	6.5%
Valencian Community	3.3%	4.5%	4.0%	0.0%	2.0%	6.3%	2.9%
Total	28.1%	71.9%	81.2	0.05	18.3	21.9	78.1

2.2 Instrument

To measure the digital competence of teachers to implement online tutorial actions using ICT resources, we used the instrument developed by Rufete et al. (2020). However, in the original instrument the psychometric properties (reliability and validity) had not been verified. The authors had created the dimensions and their corresponding items without actually carrying out a validation of the aforementioned instrument. The test format is a Likert scale with five response options ranging from 1 (no use) to 5 (frequent use). The instrument consisted of 35 items across five dimensions. The dimensions can be theoretically defined as follows:

- Tutor’s functions with students: The role of the tutor in relation to the students can be seen as follow-up and orientation in order to understand the content, the interpretation of the procedural descriptions, the moment and the appropriate manner to carry out tasks, exercises, or self-evaluations; and, in general terms, for the specific and customised clarification of any doubt (Padula, 2002).
- Tutor’s functions with the teaching staff: This refers to the teacher’s capacity to carry out collaborative coordination work with their course and teaching stage colleagues, using ICT resources (Judyk & Margalot, 2018).
- Tutor’s functions with students’ families: According to Ortega (2007), the online tutor must provide information, comment on the communication, promote interactivity, and provide support and motivation.
- Training in ICT and transfer: The virtual tutor must have adequate training in technical and administrative dimensions, allowing them to acquire the skills to use the technological tools that make up virtual learning environments in order to exercise their tutoring functions (Espinoza & Ricaldi, 2018).
- Use of ICT resources: This refers to the use of ICT resources to implement the tutorial function, this necessitates the relevant hardware and software tools, as well as an Internet connection in schools and teacher training in ICT, to improve educational quality (Rodríguez & Llorent, 2015).

2.3 Data collection and analysis procedure

Data collection was carried out during the second semester of 2020. The sample selection was intentional, based, firstly, on the collection of emails from 11,960 educational centres across Spain. Second, these centres were contacted using the same method, asking the director/secretary to share the survey (via a Google form) with the teaching staff of their centre. At all times, the confidentiality and privacy of the contributions of the participating educational centres was respected. The response rate was 1,098 completed surveys. According to the recommendations of Hair et al. (2010), to analyse the psychometric properties of an instrument, it is necessary to collect a sample size between five and ten times greater than the number of items that the questionnaire contains. In this study, the initial number of items was 35, which resulted in a ratio of 31.37, a figure well beyond this recommendation. The data analysis included several procedures, which will be detailed below.

First, the comprehension validity was analysed at a quantitative level, following the recommendations of Meroño et al. (2018) (Table 2). First, the assumption of normality of the variables was verified through the Kolmorogov-Smirnof statistic; however, this statistic is too sensitive to small deviations from normality when working with large samples or Likert-type variables. As a result, it is not appropriate to use it as the sole method of evaluating normality. To this end, Pérez and Medrano (2010) considered suitable those items with asymmetry and kurtosis coefficients in the range of ± 1.5. In addition, items with a standard deviation greater than 1 were also considered adequate (Meroño et al., 2018).

Second, the sample was divided into two randomly drawn subsamples in order to analyse the internal structure of the instrument, following the recommendations of Hinkin et al. (1997) and Henson and Roberts (2006). The sample of subjects employed for the Exploratory Factor Analysis (EFA) was composed of 553 randomly selected subjects, while the rest were allocated to the Confirmatory Factor Analysis (CFA).

Next, the EFA was performed using the IBM-SPSS 24 software. For this purpose, the Oblimin rotation system and the Principal Axis Factorisation method were used, trying to explain most of the common variance, being also quite robust to violations of the normality assumption (Fabrigar et al., 1999; De Winter & Dodou, 2012). The type of correlation applied was the Polychoric Correlation Matrix (PCC), since all items were measured on a Likert-type ordinal scale (Freiberg et al., 2013). This matrix was examined using the Bartlett sphericity test and the KMO index (Kaiser-Meyer-Olkin) to determine the adequacy of the analysis.

From the EFA, the reliability of each of the instrument factors was calculated, as well as the global reliability of the instrument. Thus, four types of coefficient were used: Cronbach's alpha, Spearman-Brown, Guttman, Omega McDonald, and composite reliability (CR).

Then, Structural Equation Models (SEM) were applied using the AMOS.24 software under the maximum likelihood criterion in order to check the fit of the theoretical model established in the EFA (Thompson, 2004). For the interpretation of the CFA indices, it was essential to base this on the recommendations made by different experts (Bentler, 1989; Byrne, 2010; Hu & Bentler, 1999; Marsh & Hocevar, 1985): minimum discrepancy/degrees of freedom (CMIN/DF), where values lower than 5 indicate a reasonable adjustment; Root Mean Square Error of Approximation (RMSEA), where values less than 0.07 indicate a good fit; and the Goodness-of-fit Index (GFI), Comparative Fit Index (CFI), and Normed Fit Index (NFI), with adequate values considered to be those above or close to 0.9.

Next, to determine if the factorial structure of the model was invariant regarding the variables of sex (male/female), type of centre (public/private), educational stage (infant/primary), a multigroup analysis was performed to determine if the instrument was equally valid for the different categories of these variables. Finally, the external validity of the instrument was verified in order to establish its predictive value in the different study variables (sex, type of centre, and type of teaching staff). The level of statistical significance was $p < .05$.

3. Results

3.1 Comprehension validity

Table 2 shows the items of the instrument classified into their corresponding dimensions. The descriptive results of the items showed adequate comprehension validity since the values found were between the predefined limits, so no item was eliminated in this preliminary analysis.

Table 2. *Descriptive statistics and asymmetry and kurtosis indices*

		TD	A	K
A. Tutor's functions with students				
1.	I use ICT to collect information about students' knowledge (interests, motivations, evaluations, etc.)	1.28	-0.123	-1.029
2.	I know the group-class through the realisation of online sociometric techniques (computer programs to detect skills, relationships, capacities, etc.)	1.08	1.167	0.543
3.	I provide information to students through digital media (blogs, web pages, educational platform of the centre, etc.)	1.24	-0.543	-0.746
4.	I use the internet as a source of information to carry out a good tutorial action with the students	1.17	-0.585	-0.456
5.	I propose strategies to students to communicate online safely	1.35	0.011	-1.200
6.	I teach students to solve problems of accessibility and digital inclusion	1.35	0.136	-1.179
7.	I prepare my students for the use of social networks (Instagram, WhatsApp, TikTok, etc.) and solve conflicts in them.	1.27	0.695	-0.673
8.	I propose to the students digital strategies to identify erroneous information or Fake news	1.23	0.708	-0.598
9.	I propose tasks to students with technologies that involve collaboration between them	1.36	0.194	-1.179
B. Tutor's functions with the teaching staff				
10.	I coordinate myself with the rest of the teaching team of the group-class through different digital means such as videoconferences, emails, chats, WhatsApp groups, etc.	1.00	-1.030	0.337

11.	I carry out classroom programming collaboratively through modifiable online documents (Google, Drive, Dropbox, etc.)	1.31	-0.550	-0.828
12.	Telematic tools are available to develop common lines of action with the other tutors within the centre's tutorial action plan	1.25	-0.373	-0.853
13.	I use digital resources to establish common guidelines for tutorial action with the rest of the tutors at the centre	1.26	-0.198	-0.955
14.	The teaching team has defined strategies to solve the difficulties of accessibility and inclusion of the students	1.20	-0.320	-0.709
15.	I propose collaborative online environments to work with the teaching team on aspects of my tutoring	1.30	-0.034	-1.075
C. Tutor's functions with students' families				
16.	I use some type of application to communicate to the family the behaviour of their children, their attendance, their tasks, etc.	1.21	-0.950	-0.089
17.	I use applications (ClassDojo, Remind, Edmodo or others provided by the centre…) to be able to interact privately with their families	1.49	-0.490	-1.187
18.	I use digital devices to summon families to private or group meetings, send newsletters, reminders	1.20	-1.002	0.017
19.	I develop digital educational projects in which the educational community (families, teachers and students) participates in relation to the educational centre	1.32	0.263	-1.056
20.	I make presentations in digital format for group meetings with families	1.42	-0.353	-1.188
21.	I guide families about the possible use of technologies at home based on the educational needs of their child	1.22	-0.169	-0.919
22.	I provide families with strategies to solve problems of accessibility and digital inclusion and communicate through technology for educational purposes for their children	1.25	-0.207	-0.949
23.	I advise families on the responsible use of ICT at home by their children	1.29	-0.149	-1.049
D. ITC training and transfer				
24.	During my initial learning process I have received training on the educational use of technologies	1.41	0.198	-1.251
25.	I have received permanent training on technologies as a means for their use in the tutorial action	1.29	0.033	-1.061
26.	I update the development of the tutorial action with the latest technological developments	1.23	-0.164	-0.866
27.	I actively develop my digital competence related to tutoring	1.20	-0.249	-0.862
28.	I address accessibility and technological inclusion as part of the mentoring	1.20	-0.108	-0.876
29.	I carefully program the use of ICT to guarantee its added value	1.20	-0.259	-0.822
30.	I protect digital content related to tutoring in a safe and responsible way	1.21	-0.492	-0.667
31.	I transfer my theoretical knowledge about technologies to the tutoring sessions	1.27	-0.159	-1.009
E. Use of ICT resources				
32.	I use centre resources (Mirador, Virtual Classroom, Classdojo, Telegram ...) to carry out the tutorial action through the technologies	1.33	-0.587	-0.834
33.	I use ICT with ease to coordinate with the teaching team during the current period of online teaching	1.09	-0.825	-0.087
34.	I use ICT easily to interact with students during the current period of online teaching	1.19	-0.699	-0.441
35.	I use ICT easily to coordinate with families, during the current period of online teaching	1.13	-0.790	-0.199

Note. M= mean; TD= Typical deviation; A= asymmetry; K=kurtosis

Table 3 presents the analysis of the instrument's total reliability based on Cronbach's Alpha if an item was deleted, as well as the homogeneity index of each of the items (corrected element/total correlation), with the purpose of determining the suppression of any of the items with values lower than 0.4 (on the recommendation of Shaffer et al., 2010). The correlation indices of the item-corrected total for all items were appropriate, as they were greater than 0.40; thus, no items were eliminated.

Table 3. *Analysis of the scale discrimination index*

	Mean scale if item has been deleted	Scale variance if item has been suppressed	Corrected total item correlation	Cronbach's alpha if the item has been deleted
Item1	110.1239	705.893	.567	.952
Item2	111.3834	718.895	.450	.953
Item3	109.6366	704.013	.620	.952
Item4	109.5965	711.543	.533	.952
Item5	110.3670	700.393	.614	.952
Item6	110.4709	702.282	.589	.952
Item7	111.0191	712.726	.471	.953
Item8	111.0519	710.326	.522	.952
Item9	110.4845	701.433	.594	.952
Item10	109.0865	719.498	.480	.953
Item11	109.6521	708.991	.507	.953
Item12	109.7978	704.750	.602	.952
Item13	109.9672	703.510	.616	.952
Item14	109.8734	705.921	.612	.952
Item15	110.2031	698.011	.675	.951
Item16	109.3078	710.891	.525	.952
Item17	109.7869	705.196	.491	.953
Item18	109.2577	710.941	.529	.952
Item19	110.5838	704.312	.573	.952
Item20	109.8570	702.943	.547	.952
Item21	110.0373	700.552	.682	.951
Item22	110.0993	700.296	.668	.951
Item23	110.1375	703.087	.606	.952
Item24	110.4490	713.963	.402	.953
Item25	110.2814	704.786	.583	.952
Item26	110.0710	698.646	.711	.951
Item27	109.8944	698.186	.734	.951
Item28	110.0647	697.251	.751	.951
Item29	109.9435	698.305	.735	.951
Item30	109.6803	702.619	.656	.951
Item31	110.0856	696.603	.715	.951
Item32	109.6412	705.835	.545	.952
Item33	109.2832	707.673	.645	.952
Item34	109.4636	703.469	.654	.952
Item35	109.3497	707.227	.628	.952

Table 4 shows the correlation matrix between the dimensions of the instrument, showing that the factors are correlated, which points to the unidimensionality of the instrument, made up of a base of five dimensions.

Table 4. *Factorial correlation matrix (λ = 1)*

Factor	D	A	B	E	C
D	1.000				
A	.518	1.000			
B	.536	.333	1.000		
E	.489	.203	.463	1.000	
C	.612	.461	.492	.469	1.000

3.2 Construct validity (exploratory)

The dimensionality of the instrument was analysed through the EFA, finding the following descriptive statistics: KMO = 0.949; $\chi 2$ = 12777.009; S.I.G. = 0.001. Table 5 shows the five factors with the factorial weights of the items, ordered according to the saturation they have within their respective dimension, with a rotation conversion of 9 iterations. The first factor corresponds to dimension "D – ICT training and transfer", including items 26, 27, 28, 25, 31, 29, 30, and 24. The second factor was dimension "A – tutor's functions with students", which included items 8, 6, 7, 9, 5, 3, and 2. The third factor was dimension "B – tutor's functions with teaching staff", comprising items 13, 12, 11, 15, 14, and 10. The fourth factor was dimension "E – use of ICT resources", including items 35, 34, 33, and 32. The last factor was dimension "C – tutors' functions with students' families", containing items 21, 22, 23, 18, 20, 19, 16, and 17. Items 1 and 4 were left out of the extraction as they had a saturation lower than 0.30, so were removed from further analysis. The minimum value of the saturation values of the items was the minimum value of 0.323 and a maximum value of 0.922. These five factors explained 61.03% of the total variance.

Table 5. *Rotated factorial loads*

	Factor				
	D	A	B	E	C
Item26	.922				
Item27	.893				
Item28	.780				
Item25	.706				
Item31	.591				
Item29	.553				
Item30	.523				
Item24	.323				
Item4					
Item8		.852			
Item6		.835			
Item7		.835			
Item9		.683			
Item5		.653			
Item3		.383			
Item2		.336			
Item1					
Item13			.895		
Item12			.850		
Item11			.678		
Item15			.579		
Item14			.511		
Item10			.396		
Item35				.830	
Item34				.809	
Item33				.641	
Item32				.348	
Item21					.778
Item22					.758
Item23					.753

Item18					.479
Item20					.468
Item19					.416
Item16					.353
Item17					.334
% explained variance	38.875	7.736	4.943	4.507	3.865

3.3 Construct validity (confirmatory)

After the EFA, the CFA was performed to test the fit of the data with different models. The objective was to obtain the simplest and most parsimonious instrument possible (with fewer items) without compromising reliability or validity. Table 6 shows the fit indicators for each model. The RMSEA residual-based index was less than .07 for the third model, and the CFI, TLI, and NFI coefficients were greater than .9 in only the third model. This indicates that the adjustment is satisfactory. In addition, the multigroup normality was 58,782, higher than the recommendations of Byrne (2010), according to whom the Mardia coefficient must be greater than 2.

Table 6. *Indicators of goodness of fit of the model*

Models	χ^2	gl	C.M./df	CFI	TLI	NFI	RMSEA	90% CI
1º	1958.254	485	4.038	.878	.867	.844	.074	.071- .078
2	1805.650	407	4.436	.876	.867	.835	.079	.075- .083
3	958.849	270	3.551	.923	.914	.901	.068	.063- .073

The resulting structure for model three would be composed by five correlated latent variables, consisting of the following items: dimension A – functions of the tutor with students (3, 5, 6, 8 and 9), dimension B – functions of the tutor with the teaching staff (10 , 11, 12, 13, 14 and 15), dimension C – functions of the tutor with the family (19, 20, 21, 22 and 23), dimension D – ICT and transfer (25, 27, 28, 29 and 30), and dimension E – use of ICT resources (30, 31, 32 and 33). Therefore, in this last model, items 2, 16, 17, 18, 24, 26, and 31 have been eliminated, obtaining an instrument with 25 items. Figure 1 shows the standardised regression weights of the latent items and dimensions of said model.

The validity of the model was evaluated using convergent validity (with the hypothesis that the dimensions are related). This was measured using the test of average variance extracted (AVE) for the dimensions of the instrument, which must be equal to or exceed the recommended threshold value of .50 (Hair et al., 2010; Henseler et al., 2015). After performing the analysis, it was found that the AVE coefficients for the dimensions of the instrument had an acceptable level of convergent validity that ranged between .551 and .663, as follows: dimension A (.567), dimension B (.585), dimension C (.551), dimension D (.616), dimension E (.663).

DOI: http://dx.doi.org/10.6018/red.474981

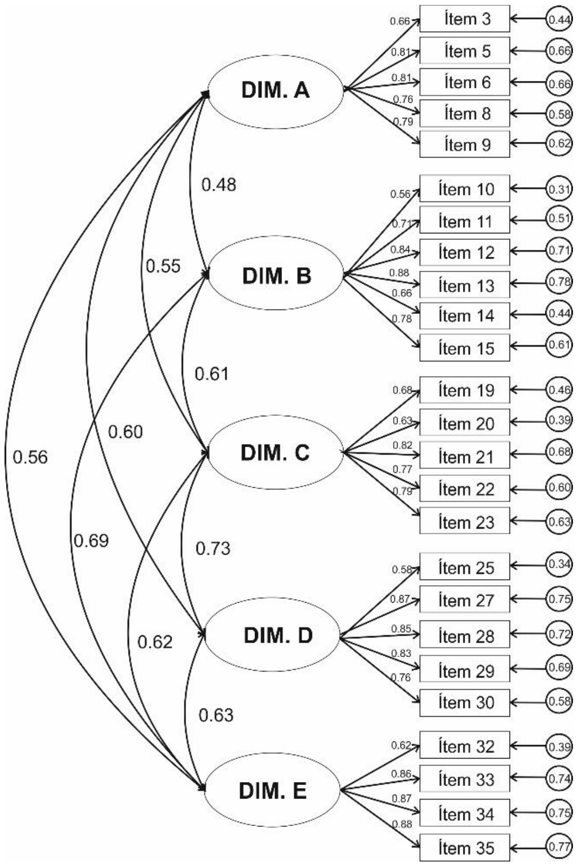

Figure 1. *Structural equation model*

3.4 Reliability analysis

The analysis of the internal consistency of the final version of the instrument and its corresponding dimensions was calculated through Cronbach's Alpha coefficients with values greater than 0.7, Spearman-Brown (even length) and Guttman with values greater than .6, and, finally, Omega McDonald with values higher than .8, as can be seen in Table 7. Once the analyses had been carried out, it was found that all the coefficients were highly satisfactory. In addition, the internal consistency of each factor was evaluated using composite reliability (CR).

Table 7. *Reliability coefficients*

Dimension	D	A	B	E	C	TOTAL
Cronbach's alpha	.880	.878	0.881	.871	.844	.948
Spearman-Brown coefficient	.891	.860	0.861	.840	.843	.893
Split-half of Guttman	.891	.826	0.858	.840	.816	.890
Omega McDonald	.960	.929	0.944	.902	.906	.995
CR	.903	.871	0.887	.885	.858	-

3.5 Analysis of invariance by gender

In multigroup invariance tests, the goodness of fit statistics is of special interest, especially the values of $\chi 2$, CFI and RMSEA, since they allow the researcher to determine to what extent the tested parameters operate in an equivalent way between the groups (Byrne, 2010). In this study, a multigroup invariance analysis was carried out with respect to the variables: sex (male/female), educational stage (infant/primary education), and type

DOI: http://dx.doi.org/10.6018/red.474981

of centre (public/charter). It was not possible to determine the invariance in the private centre category since the distribution of this sample was insufficient with respect to the other categories (only 5% of the total of centres).

Cudeck and Browne (1983) and MacCallum et al. (1992) argued that the χ2 difference test represents an excessively strict invariance test. In accordance with this perspective, Cheung and Rensvold (2002) stated that it is more reasonable to base invariance decisions on a difference in CFI rather than on χ2 values. The authors proposed that the evidence for non-invariance be based on a difference in CFI values exhibiting a probability <0.01. The model in the three variables analysed is completely and totally invariant between the groups assessed, as shown in Table 8.

Table 8. Multigroup analysis of factorial invariance by sex, educational stage and type of centre

Invariance by sex (male/female)									
Models	χ^2	*gl*	χ^2/gl	$\Delta\chi^2$	Δgl	CFI	IFI	TLI	RMSEA (IC90%)
Unconstrained	1418.528	567	2.502	-	-	.905	.905	.899	.052 (.049-.056)
Measurement weights	1430.947	579	2.471	12.419	12	.905	.905	.901	.052 (.048-.055)
Structural covariances	1434.275	585	2.452	3.328	18	.905	.905	.903	.051 (.048-.055)
Measurement residuals	1473.179	600	2.455	38.900	33	.903	.903	.903	.051 (.048-.055)
Invariance by educational stage (Childhood-Primary education)									
Unconstrained	1456.629	379	2.396	-	-	.901	.901	.903	.053 (.050-.057)
Measurement weights	1470.098	391	2.364	13.469	12	.901	.901	.901	.053 (.050-.056)
Structural covariances	1484.453	397	2.347	14.355	18	.900	.900	.903	.053 (.049-.056)
Measurement residuals	1561.456	412	2.475	77.003	33	.893	.893	.899	.054 (.041-.057)
Invariance by type of centre type (public/charter)									
Unconstrained	1427.163	567	2.517	-	-	.905	.905	.899	.053 (.049-.056)
Measurement weights	1435.354	579	2.479	8.191	12	.905	.905	.902	.052 (.048-.055)
Structural covariances	1439.849	585	2.461	4.495	18	.905	.906	.903	.052 (.048-.055)
Measurement residuals	1497.548	600	2.496	57.699	33	.901	.901	.901	.052 (.049-.055)

3.6 External validity

Finally, the level of global digital competence was analysed in relation to different variables. For the gender variable, female teachers (M = 3.27) perceived a level slightly higher than male teachers (M = 3.24); however, no significant differences were found regarding their level of global digital competence (sig. = .717> .05). In respect to the type of institution, the teachers who worked in charter centres (3.40) obtained a higher level of digital competence compared to those who worked in public centres (M = 3.22), with significant differences between them (sig. = .037 <0.05). Finally, Primary Education teachers (M = 3.31) obtained a higher level of digital competence compared to Early Childhood Education teachers (M = 3.12), finding significant differences between them (sig. = .020 <0.05).

Table 8. *Descriptive and inferential analyses according to study variables*

	Sex		Type of centre		Type of teaching staff	
	Female	Male	Public	Charter	Childhood education	Primary education
Mean	3.27	3.24	3.22	3.40	3.12	3.31
Typical deviation	0.74	0.94	0.81	0.90	0.85	0.82
Sig.	.717		.037		.020	

Discussion and conclusion

The current socio-health situation requires all teachers, and specifically teachers working in Early Childhood Education and Primary Education, reinvent themselves to become more innovative and digitally competent, according to Othman (2020). In this reinvention process, tutorials, delivered through ICT, play a priority role in continuing to provide students with a quality education (Hill et al., 2018; Neely et al., 2017; Tanis & Barker, 2017) through accompaniment, guidance, and orientation (Pardo & Peñalvo, 2008). In this situation, it is essential to have effective, valid, and reliable tools which allow measuring the level of digital competence of teachers in relation to their use of ICT to perform adequate online tutorial activities.

Therefore, in this work, the psychometric properties of the instrument designed by Rufete et al. (2020) were measured. Taking into account the findings of this study, it can be confirmed that the final version of the instrument that is presented to measure the level of digital competence of Early Childhood Education and Primary Education stage teachers, in relation to online tutorial activities, constitutes a valid and reliable instrument with a total of 25 items.

It can further be said that the sample used in this study was adequate, according to the recommendations of Hair et al. (2009), to estimate the reliability and validity of the instrument. Furthermore, after calculating the instrument reliability using different indices, it was observed that the values were adequate, with coefficients obtained above .8 points.

Regarding the comprehension validity, and in accordance with Pérez and Medrano (2010) and Meroño et al. (2018), in this first analysis, no items were eliminated, because the asymmetry and kurtosis coefficients were within the established ranges. Despite this, after analysing the construct validity, items 1 and 4 were eliminated because they showed a saturation level lower than 0.30. This EFA explained 61.03% of the total variance. After creating different models of structural equations, the third model was selected, since it was the simplest and most parsimonious model (Thompson, 2004). From this model, taking into account the RMSEA, CFI, TLI, and NFI indices, 7 additional items were eliminated; thus, the instrument was configured with a total of 25 items, obtaining a highly acceptable convergent validity. Furthermore, in the analysis of invariance by gender, it was shown that there was no invariance as a function of the variables analysed; that is, the instrument is valid regardless of the teacher’s sex, education stage, and type of centre in which it is applied.

In regard to the external validity, this showed the absence of significant differences based on sex. These results corroborate those obtained by Hammou and Effatihi (2019), Barahona et al. (2019), and Usart et al. (2021). Although there is no doubt that women showed slightly higher levels of competence development than men, this finding conflicts with the findings reported by Erdogan and Sahin (2010), Jang and Tsai (2013), Akpabio and Ogiriki (2017), Cabero and Barroso (2016), and Portillo et al. (2020), since, according to these studies, male teachers have a higher level of competence than female teachers. In this study, significant differences were found between charter education centres and public education centres, where charter centres had greater ICT resources than public centres; these results are in alignment with those obtained by Akpabio and Ogiriki, (2017), Zia et al. (2017), García-Martín and Cantón-Mayo (2019) and Portillo et al. (2020). Finally, the data from the present study showed that, as the education stage increased, the level of teaching digital competence also increased in relation to tutorial activities, a result that coincides with the findings of Portillo et al. (2020).

For all these reasons, it can be affirmed that this instrument, which was originally developed in a study by Rufete et al. (2020), after the elimination of the items identified in the current work, constitutes an effective tool to measure the level of digital competence of teachers in relation to online tutorials using ICT, at the levels of both Early Childhood Education and Primary Education.

Received: March 30, 2021
Accepted: June 12, 2021
Published: September 30, 2021

Guillén-Gámez, F. D., Mayorga-Fernández, M. J., & Contreras-Rosado, J. A. (2021). Validity and reliability of an instrument to evaluate the digital competence of teachers in relation to online tutorials in the stages of Early Childhood Education and Primary Education. *RED. Revista Educación a Distancia*, *21(67)*. http://dx.doi.org/10.6018/red.474981

Financing

This work has not received any specific grants from funding agencies in the public, commercial, or non-profit sectors.

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