Construct validation of a questionnaire to measure teachers' digital competence (TDC)

Validación de constructo de un instrumento para medir la competencia digital docente de los profesores (CDD)

Javier TOURÓN, PhD. Professor. Universidad Internacional de La Rioja (UNIR) (*javier.touron@unir.net*).
Deborah MARTÍN, PhD. Lecturer. Universidad Internacional de La Rioja (UNIR) (*deborah.martin@unir.net*).
Enrique NAVARRO ASENCIO, PhD. Assistant professor. Complutense University of Madrid (*enriquenavarro.a@gmail.com*).
Silvia PRADAS, PhD. Lecturer. Universidad Internacional de La Rioja (UNIR) (*silvia.pradas@unir.net*).
Victoria ÍÑIGO, PhD. Assistant professor. Universidad Internacional de La Rioja (UNIR) (*victoria.inigo@unir.net*).

Abstract:

Teachers' digital competencies have become an essential aspect of training teachers to promote learning in their students that moves away from the knowledge transfer model and moves towards a talent development model. This work validates an instrument developed by the authors to evaluate the digital competency of teachers, in accordance with the current framework established by INTEF. A sample of 426 teachers was used in the validation process. These were approached through an online process. The total reliability of the instrument, estimated using Cronbach's Alpha, is 0.98. The reliability for the dimensions on the «Knowledge» scale varies from 0.89 to 0.94 and for the «Use» scale from 0.87 to 0.92. The construct validity has been modified from an initial model with 5 factors to another with 4 factors and 4 sub-factors. The factor loads of the items with the dimension to which they belong are mainly above 0.5 and in many cases above 0.70. On the «Knowledge» scale there is only 1 weight that does not reach this value. The overall fit results for both scales show optimum results, with values lower than 3 for the normalised chi-squared index, values below 0.06 in RMSEA, and values of 0.9 in IFI and CFI. Data is also provided regarding convergent and discriminant validity that is significant and acceptable. The construct reliability for the convergent validity in all cases approaches 0.90. As for the discriminant validity, the proposed model is better than the alternatives, with small variations in the «Use» scale that will be the object of future analyses. This instrument will make it possible to evaluate teachers' competencies and help with the planning of personalised training pathways depending on their results.

Keywords: teachers' digital competence, construct validity, convergent validity, discriminant validity, online questionnaires.

Revision accepted: 2017-09-21.
This is the English version of an article originally printed in Spanish in issue 269 of the **revista española de pedagogía**. For this reason, the abbreviation EV has been added to the page numbers. Please, cite this article as follows: Tourón, J., Martín, D., Navarro, E., Pradas, S., & Íñigo, V. (2018). Validación de constructo de un instrumento para medir la competencia digital docente de los profesores (CDD) | *Construct validation of a questionnaire to measure teachers' digital competence (TDC). Revista Española de Pedagogía, 76* (269), 25-54. doi: 10.22550/REP76-1-2018-02
https://revistadepedagogia.org/
ISSN: 0034-9461 (Print), 2174-0909 (Online)

Resumen:

La competencia digital docente se ha convertido en un aspecto esencial en la formación de los profesores que deben promover un aprendizaje en sus alumnos que se aleja del modelo de transmisión del conocimiento para acercarse a otro de desarrollo del talento. En este trabajo se valida un instrumento desarrollado por los autores para valorar la competencia digital de los docentes, de acuerdo con el marco actual establecido por el INTEF. Para el proceso de validación se utiliza una muestra de 426 profesores a los que se accede por un procedimiento online. La fiabilidad total del instrumento, estimada con el Alpha de Cronbach es de 0.98. La fiabilidad para las dimensiones de la escala de conocimiento varía entre 0.89 y 0.94 y para la escala de uso entre 0.87 y 0.92. En cuanto a la validez de constructo se ha pasado de un modelo inicial con 5 factores a otro con 4 factores y 4 subfactores. Las cargas factoriales de los ítems con la dimensión a la que pertenecen están en su mayoría por encima de 0.5 y en muchos casos de 0,70. En la escala de conocimiento sólo hay 1 peso que no alcanza ese valor. Los resultados de ajuste global para ambas escalas muestran resultados óptimos, con unos valores inferiores a 3 para el índice de chi-cuadrado normalizado, valores por debajo de 0.06 en RMSEA y de 0.9 en IFI y CFI. Se ofrecen evidencias también respecto a la validez convergente y discriminante, que resultan significativas y aceptables. La fiabilidad del constructo para la validez convergente se aproxima en todos los casos a 0.90. En cuanto a la validez discriminante el modelo propuesto es mejor que sus alternativos, con ligeras variaciones en la escala de uso que serán objeto de futuros análisis. Este instrumento permitirá valorar las competencias de los profesores y ayudar en la planificación de itinerarios de formación personalizados en función de los resultados.

Descriptores: competencia digital docente, validación de constructo, validez convergente, validez discriminante, cuestionarios online.

---

1. Introduction

The European Commission in its *Education and Training Monitor* (2016) report emphasised the educational priorities that must be invested in to improve the quality and relevance of educational systems and develop the competencies needed in contemporary society. One of the basic pillars it establishes is the development of the teaching profession, and it is forceful when explaining the role teachers and educational leaders must take on with regards to the impact teachers' professional development must have on improving pedagogical practices.

The Education and Training 2020 Strategic Framework (ET2020) also refers to the development of educational systems and the competencies students must acquire, although it particularly focuses on the ones teachers must integrate into their educational practice to provide quality education, proposing open and innovative education and training fully integrated into the digital era as a locus for priority action.

Teaching competencies could be defined as the set of knowledge, personal traits, attitudes, and skills that make it possible to perform educational actions, generally recognisably pragmatic in nature, relating to achievement in the field of education (Álvarez Rojo, 2010). In other words, we speak of competencies if there is performance, knowledge, and actions; these competencies are not constructed solely in the methodological sphere, but rather in the transformations that link curricular and methodological elements, more specifically, in the technical-didactic adaptation that is carried out to attain the objectives students must achieve in their learning (Cardona, 2008).

The learning needs of current students require other forms of teaching, and so teaching competencies will be shaped by the styles and needs of the students, who must learn to live and function in a society that produces vast quantities of information (Cardona, 2008). They must satisfy the needs of students as future active citizens of a globalised, digitised, intercultural and changing society that demands education that, to be promoted effectively, requires interaction between pedagogy (how it is taught), substantive knowledge of what is being taught, and technology (the tools used), as is proposed by the TPACK (Technology, Pedagogy, and Content Knowledge) model for the teacher of today (Koehler, Mishra, and Cain, 2013; Tourón, 2016). Each of these three components must be interconnected to produce improvements in students' learning outcomes, and although defining these teaching skills in general can be difficult, both in knowledge and in skills or experiences, in this study we focus on teachers' digital competency, defining it and, more specifically, evaluating it.

The European Commission (2006) identifies this as a key competence which it defines thus:

> Digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet (European Parliament and the Council, 2006, see annexe).

The subsequent DIGCOMP (*Digital Competence*) report identifies this as a transverse competency that enables us to acquire other competencies, and is related to many of the skills of the twenty-first century that all citizens must acquire to ensure we can participate actively in society and the economy (Ferrari, 2013).

Educational research in recent decades (Cope and Ward, 2002; Windschitl and Salh, 2002; Solmon and Wiederhorn, 2000; UNESCO, 2002) has had the objective of analysing how the use of digital tools affects teaching and learning situations, with the objective of designing proposals to improve its implementation in curriculum design. Some of it focuses on teachers' attitudes and perception of the use of technology in their teaching practice, in didactic decisions regarding the selection and use of digital tools, and even on the training needs and demands of teaching staff for integrating technology into the teaching-learning process adequately (Davis, Preston, and Sahin 2009; UNESCO 2002). Field research performed in schools and classrooms has shown that the teacher has a significant role (Sangrà and González-Sanmamed, 2010) but given developments in technology, and in particular its inclusion in the classroom, new studies have been carried out on the impact and the effects of its use in education (Cuban, 2001; UNESCO, 2003; OECD, 2003; EURYDICE 2001; Tondeur, Valcke, and Van Braak, 2008; Davis, 2009). Technology can provide immediate access to information, systematically record actions on students' progress to create new pathways, allow collaboration between classmates inside and outside school, generate new knowledge and resources, provide feedback for teachers to improve their educational practice, etc. Therefore, teacher training must focus not only on the use of technology in itself, but also on how it can support collaboration and effective interaction between the different factors in the teaching-learning process (Fullan and Donelly, 2013).

Teachers' digital competence has been linked with knowledge of the environment in which students live, and to using technology to encourage their learning and development of competencies. Accordingly, it can be defined as the group of capacities and skills that lead us to incorporate –and appropriately use– information and communication technology (ICT) as a methodological resource integrated in the teaching-learning process, thus becoming learning and knowledge technologies with a clear didactic application.

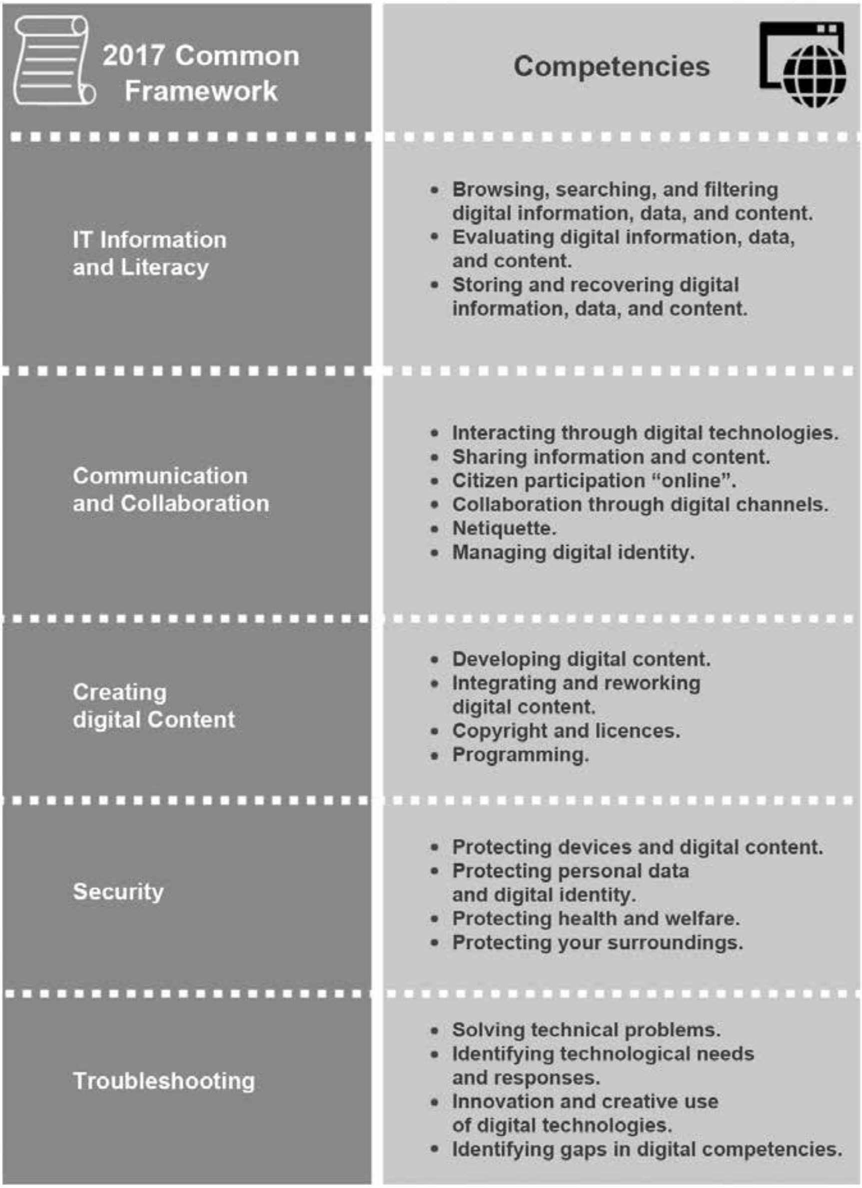
To increase teachers' awareness of the need to improve their digital competencies, states are making a considerable effort to disseminate emerging good practices by organising discussion sessions and creating informative websites. Many schools hold meetings and sessions outside teaching hours where teachers can train with the support of a colleague, the technology coordinator, or even with courses organised by institutions dedicated to teacher training (UNESCO, 2002). In these cases, evaluating competencies becomes the central element in establishing a digital training plan that meets the needs of teachers.

Under the UNESCO framework (2002) where nine IT-literacy units were described and justified on the professional development programme for teachers, subsequent programmes appeared, such as DIGCOMP and its revisions, until, in the case of Spain, the *Marco de Competencia Digital* (Digital competences framework, INTEF, 2003) appeared, followed by the current one (INTEF, 2017). This last framework, revised in September 2017, is used as a reference tool to identify the areas and levels to consider, both in teacher evaluation, and in the different training plans for its optimum development. The framework's rationale starts from the need to establish benchmarks towards which teachers should work.

> Those people who are responsible for teaching the students of the new millennium must be capable of guiding them on their educational journey through the new media. Teachers need a clear political message in this regard. This public recognition will in turn require special attention in the systems for training teachers and recognising their professional development (INTEF, 2017, p. 2).

What, therefore, is expected of digitally competent teachers? What knowledge, skills, and expertise should be developed? What should they use? The Common Framework (INTEF, 2017, p. 9) describes five dimensions, and although each one is specific, they are not self-contained or exclusive, and so they can be interrelated. These dimensions are defined thus (INTEF, 2017, p. 10):

Graph 1. Dimensions and associated competencies. Adapted from INTEF 2017.



Source: Own elaboration.

1. IT information and literacy information: identifying, finding, retrieving, storing, organising, and analysing digital data, evaluating its purpose and relevance.

2. Communicating and collaborating: communicating in digital settings, sharing resources through online tools, connecting and collaborating with others through digital tools, interacting and participating in communities and networks; intercultural awareness.

3. Creating digital content: creating and editing new content (text, images, videos, etc.), integrating and reworking prior knowledge and content, making artistic productions, multimedia content, and computer programming, knowing how to apply intellectual property rights and user licences.

4. Security: personal protection, data protection, digital identity protection, using security, secure and sustainable use.

5. Troubleshooting: identifying digital needs and resources, taking decisions when choosing the appropriate digital tool depending on the purpose or need, solving conceptual problems through digital media, solving technical problems, using technology creatively, updating one's own competencies and those of others.

Dimensions 1, 2, and 3 are presented as linear, with specific purposes, while dimensions 4 and 5 are transversal, in other words they apply to any type of activity, the last dimension (number 5, «Troubleshooting») is the «transversal [dimension] par excellence» (INTEF, 2017). These are all shown in Graph 1 along with their associated indicators.

Taking this framework as a basis, we prepared the questionnaire that is validated here in accordance with the proposed classification. It comprises 54 items that measure the five dimensions on two scales that evaluate teachers' knowledge and use of these competencies in their school and classroom. The answers as a group have the purpose of evaluating teachers' digital competencies. And, therefore, the general objective is to analyse the quality of the constructed instrument, on the one hand evaluating its reliability and, on the other, confirming the validity of the proposed theoretical construct.

2. Method

A validation study was performed for the «Teachers' Digital Competencies Questionnaire» (TDC) instrument through an analysis of its reliability and construct validity, convergent validity, and discriminant validity. Cronbach's Alpha measure of internal consistency was used to test the reliability of the tool. This test is the most widely used as it only requires one application of the questionnaire and it assumes that if the questionnaire is intended to measure a particular trait, all the items that comprise it should have this aim. To validate the structure of the theoretical dimensions the test measures, the confirmatory factor analysis technique (CFA) was used, estimating a measurement model comprising observed variables (items) and latent factors (dimensions).

2.1. Sample

This validation study does not require a strict or necessarily random sampling procedure. It does, however, require a sample with wide variance so that if there are relationships between the variables, these are not attenuated by a reduction in the size of the sample. The questionnaire was implemented through an online process using the *formsite28* commercial platform. Teachers from all educational levels were invited through social networks and institutions for training teachers who perform online activities (INTEF [National Institute of Educational Technologies and Teacher Training], CRIF [Regional Innovation and Training Centre]). The data collection tool was available to interested respondents for approximately two months. The result and composition of the resulting sample by gender, age, and experience of participants is shown in Tables 1 and 2. Other data about the composition of the sample that was available does not appear to be relevant to the results of this study.

TABLE 1. Composition of the sample by gender.

Gender	N	%
Female	276	64.8
Male	150	35.2
Total	426	100.0

Source: Own elaboration.

TABLE 2. Composition of the sample by participants' age and experience in years.

Age	N	%	Experience	N	%
21<30	42	9.9	1-5	72	16.9
31<40	124	29.1	6-10	90	21.1
41<50	151	35.4	11-15	92	21.6
51<60	99	23.2	16-20	74	17.4
61<70	10	2.3	>20	98	23.0
Total	426	100.0	Total	426	100.0

Source: Own elaboration.

2.2. Instrument

The instrument, the first validation of which was performed in this piece of work, comprises five dimensions that reflect the digital competencies framework proposed by INTEF in January 2017, the structure of which in dimensions and associated competencies is shown in Graph 1.

It includes fifty-four items distributed over the five dimensions identified. Various sources and the opinions of experts were taken into account when preparing it, in an attempt to saturate each dimension with the smallest possible number of items for reasons of practicality. Each item is answered twice using a seven-point Likert-type scale to indicate the level of «Knowledge» and «Use» of the aspect to which each item refers. For example, the content of item 3 refers to: «Specific channels for selecting teaching videos»; teachers who respond to this item must state their level of knowledge of these channels and must also indicate how much they use this knowledge. It could be said that we are validating two questionnaires: one concerning knowledge of the various elements that comprise teachers' digital competencies and another on their use. The relationship between these two dimensions is analysed below.

To encourage interviewees to focus on the content of each item, and not allow their answers to be influenced by answers to previous items with the same or similar content, the order of presentation of the items was randomised.

2.3. Procedure

Firstly, a reliability study for all of the knowledge and use scales was performed with Cronbach's Alpha index of internal consistency. This was also calculated separately for each of the five dimensions. This way of studying reliability is the most common and involves correlating the answers to the different items to ensure that they are equivalent and measure in the same direction. The index ranges from 0 to 1. Values above 0.8 are considered to be optimal and a reliability of 0.9 is very good as Nunnally and Bernstein suggest (1994). On this point, the homogeneity of the items from each dimension was also analysed using the item-total correlation and the same authors establish values of 0.3 or higher as indicating a good result.

Secondly, the construct validity was verified using the confirmatory factor analysis technique, specifically by estimating a measurement model for checking the fit of the 54 items in the five theoretical dimensions defined. The knowledge and use scales were analysed separately. This procedure involves determining whether the relationships established between items and factors, defined in the theoretical model, fit the empirical reality that the respondents' answers provide. The different models were defined and estimated using the AMOS 23 software, following a series of steps described below:

a) Imputation of missing cases: Catell (1978) recommends having between 3 and 6 subjects per item included in the analysis, but when the answers omitted exceed 10% of the cases in the sample, a process for estimating the values is recommended (Hair, Black, Babin, and Anderson, 2014). In this case, on the «Knowledge» scale, approximately 43% of the teachers did not answer one or more items, and 42% on the «Use» scale, therefore, it is necessary to impute these values. Owing to the ordinal nature of the observed variables, these cases have been replaced with the median for each item.

b) Verifying the assumption of multivariate normality: if this requirement is not met, this could affect the fit results. To test it, the multivariate kurtosis index was used with its critical ratio. Values greater than 5 show this lack of multivariate normality (Bentler, 2005). As is explained in the results, it is not possible to assume this case from this data.

c) Estimation of the model through maximum likelihood using re-sampling (bootstrapping). The lack of normality of the data requires an appropriate method for estimating the parameters of the data and this procedure is a good solution (Byrne, 2009). This estimation method extracts subsamples from the original data and estimates the parameters a particular number of times (500 in this case). The final result is not a single value but a complete distribution with mean and variance.

d) Estimating the defined model, the null model, and the saturated model. The first of these reflects the structure of items and dimensions proposed in the work, the second assumes that there is no relationship between the items and, therefore, is considered the worst possible result, and finally, the saturated model is the opposite of the null model and assumes that all possible parameters are significantly distinct from zero; this is a perfect fit model that, therefore, fully reflects all of the information from the data (Gaviria, Biencito and Navarro, 2009).

e) Checking the fit of the models. Absolute fit indices are used that analyse how the specified model fits the observed data, in other words, whether the underlying theory fits the data from the sample. Firstly, the chi-squared value divided by the degrees of freedom of the model (CMIN/df), where values below 2 are considered very good and values from 3 to 5 are acceptable (Hair et al., 2014). Another index is the root mean square error of approximation (RMSEA) that attempts to verify the fit between the proposed model and hypothetical population data. In this case, values below 0.05 are considered to be very good and between 0.05 and 0.08 acceptable (Byrne, 2009). Incremental fit indices such as the IFI and CFI are also used. These compare the defined model with the null model, and values greater than 0.9 are considered optimal (Hair et al., 2014); finally, statistics are included that evaluate the complexity of the model, such as PRatio (values above 0.9), and the appropriateness of the sample size, such as Hoelter (above 200).

f) Finally, the standardised residuals and the modification index are studied to try to improve the defined model.

As an additional analysis to validate the construct, the convergent and discriminant validity of the proposed model are also considered. The former analyses the variance that the items that comprise a dimension have in common. To do so, the factor loads are analysed (standardised latent regression coefficients). These must exceed values of 0.5. The reliability of the construct which is estimated is also calculated based on the factor loads and the error variance for each of the estimated dimensions; values above 0.7 indicate a good convergent validity. The second type of validity –discriminant– analyses whether one dimension is really different from the other. This is tested based on the comparison of different models with the defined one. These alternative models are defined starting from all possible combinations among the five dimensions, from a model with a single dimension, up to the combination of two factors or groups of three or four. Once estimated, the chi-squared test is used to analyse whether they differ significantly from the starting model.

3. Results

The results for the reliability of the scale and the homogeneity of the items are presented first, then the results referring to construct validity are described, including analyses of convergent and discriminant validity.

3.1. Reliability and homogeneity

The reliability results given by Cronbach's Alpha easily fulfil the criterion proposed by Nunnally and Bernstein (1994), both for the five dimensions and for the total of the knowledge and use scales. In all cases (Table 3), the values exceed the optimal standard of 0.8. The reliability indices obtained vary between 0.89 and 0.98 on the «Knowledge» scale and between 0.87 and 0.98 on the «Use» scale. Therefore, the internal consistency of the scales and the dimensions that comprise them can be confirmed.

TABLE 3. Reliability indices (Cronbach's Alpha) of the dimensions of the knowledge and use scales.

Dimension	Knowledge scale	Use scale
Information and communication	0.906	0.874
Communication and collaboration	0.892	0.877
Digital creation	0.944	0.930
Security	0.908	0.884
Troubleshooting	0.942	0.925
Scale total	0.984	0.979

Source: Own elaboration.

If we focus on the homogeneity indices of the items that comprise part of the 5 dimensions, it is apparent that in all cases they are greater than 0.3 (Table 4). On the «Knowledge» scale the item-total correlation values vary from 0.48 for I3 of the Communication and Collaboration dimension, up to values above 0.8 for I31 and I42 of the Troubleshooting dimension.

On the «Use» scale, the results are slightly lower, nonetheless, they are still located within the acceptable margins.

TABLE 4. Homogeneity indices of the items for each dimension of teachers' digital competence on the knowledge and use scales.

		Knowledge scale	Use scale
Dimension	**Items**	**Corrected item-total correlation**	
Information and communication	I1	0.700	0.581
	I24	0.744	0.707
	I18	0.644	0.582
	I20	0.741	0.665
	I44	0.748	0.708
	I11	0.69	0.621
	I36	0.621	0.522
	I6	0.755	0.673
Communication and collaboration	I10	0.731	0.630
	I3	0.480	0.545
	I8	0.491	0.388
	I54	0.746	0.682
	I17	0.651	0.595
	I33	0.726	0.692
	I35	0.699	0.665
	I15	0.736	0.685
	I23	0.669	0.700
Digital creation	I37	0.755	0.703
	I47	0.749	0.714
	I16	0.684	0.644
	I50	0.781	0.72
	I30	0.746	0.649
	I28	0.684	0.669
	I12	0.705	0.663
	I51	0.720	0.705

		Knowledge scale	Use scale
Dimension	**Items**	**Corrected item-total correlation**	
Digital creation	I19	0.646	0.561
	I7	0.511	0.405
	I2	0.623	0.587
	I52	0.755	0.674
	I49	0.759	0.728
	I34	0.776	0.74
	I38	0.636	0.573
	I22	0.696	0.703
Security	I29	0.711	0.641
	I39	0.753	0.718
	I5	0.695	0.615
	I27	0.718	0.695
	I43	0.716	0.684
	I53	0.682	0.623
	I32	0.728	0.696
	I13	0.510	0.451
	I46	0.684	0.593
Troubleshooting	I26	0.682	0.635
	I9	0.735	0.684
Troubleshooting	I41	0.728	0.62
	I4	0.651	0.547
	I45	0.745	0.721
	I14	0.603	0.513
	I48	0.693	0.67
Troubleshooting	I42	0.820	0.786
	I25	0.751	0.674
	I40	0.793	0.785
	I31	0.844	0.786
	I21	0.776	0.768

Source: Own elaboration.

As can be seen in Table 5, most of the items have homogeneity indices above 0.7, on both scales in over 50% of cases. And there are only 2 and 3 items on the «Knowledge» and «Use» scales respectively with a homogeneity lower than 0.5, but without it falling below the recommended value of 0.3.

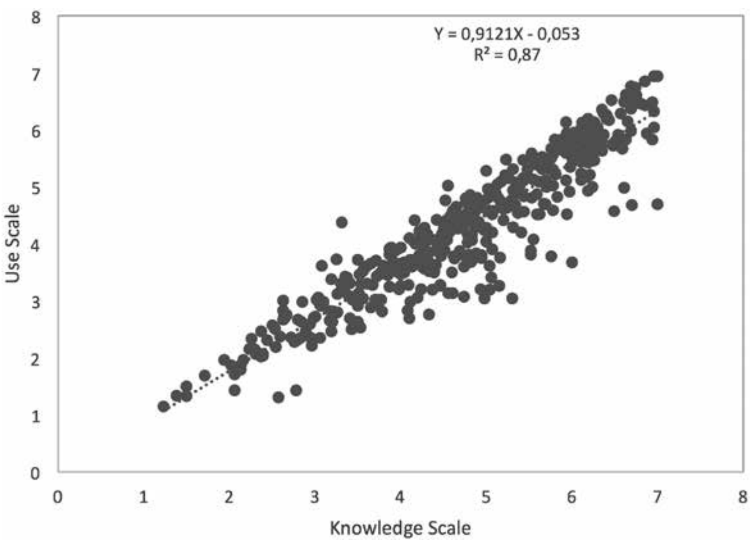
TABLE 5. Homogeneity indices for the items for the knowledge and use scales by ranges indicated.

Scale	Knowledge		Use	
Homogeneity intervals	**N**	**%**	**N**	**%**
< 0.50	2	3.7	3	5.6
0.51 – 0.69	21	38.9	23	42.6
> 0.70	31	57.4	28	51.8

Source: Own elaboration.

Finally, to analyse the relationship between the answers on the Knowledge and Use scales, a scatter plot was prepared showing the total scores for the teachers from the sample (Graph 2).

GRAPH 2. Relationship between the total «Knowledge» and «Use» scales of teachers' digital competencies.



Source: Own elaboration.

In Graph 2 the positive relationship between both scales can be seen. These share 87% of their variance. Teachers who report greater knowledge of digital competencies also report greater use. Although it can also be seen that this is not always the case and greater knowledge does not imply more use; these cases are represented by the points located below the regression line.

This structure of items and dimensions observed in the homogeneity analysis is the proposed model we are trying to validate through confirmatory factor analysis. The results obtained are described below.

3.2. Construct validity

The proposed model for validation comprises 54 observed variables (items) that are also considered to be endogenous (dependent) and their associated errors, 5 latent dimensions (Information and Communication, Communication and Collaboration, Digital Creation, Security, and Troubleshooting) that are also regarded as exogenous (independent). The model allows for correlation between the 5 factors (a total of 10 correlations). To identify the model, the variances of the dimensions are set at 1 and a total of 118 parameters are estimated (54 regression weights, 54 error variances, and 10 correlations). The process is the same for both scales (Knowledge and Use).

The multivariate normality analysis determines that the data does not fulfil this assumption (critical ratio values associated with kurtosis above 5) and, consequently, the normal estimation of maximum likelihood procedure might alter the fit indices. Consequently, a bootstrap estimation process was used.

Table 6. Multivariate normality indices of the scales.

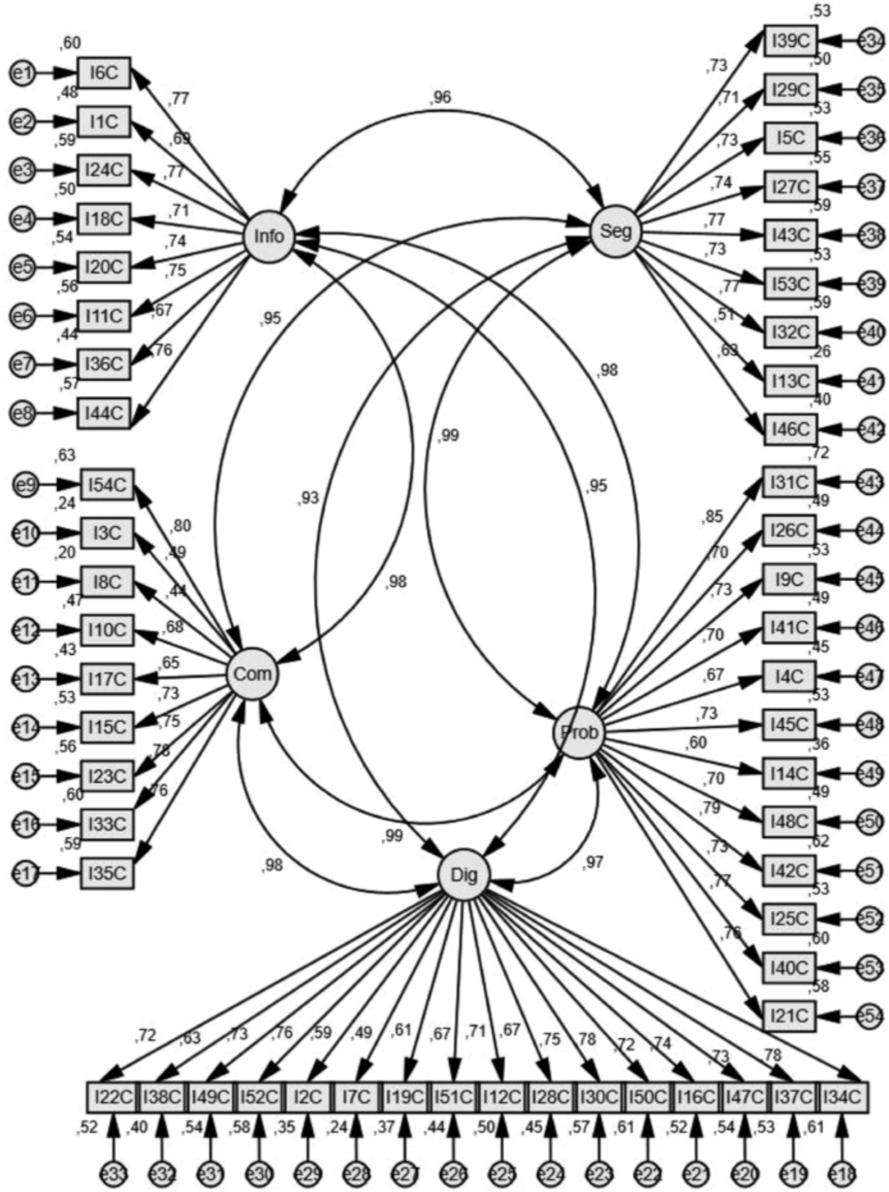
Scale	Kurtosis	Critical ratio
Knowledge	691.029	91.699
Use	478.157	63.451

Source: Own elaboration.

Once the models were estimated, as a summary, Graphs 3 and 4 show the values for the estimated parameters in the Knowledge and Use scales respectively. The regression weights and the error variances and correlations are statistically significant. And, as can be seen in the figures, these standardised regression weights or factor loads of the items with the dimension are mostly above 0.5. In the case of the Knowledge scale there are only 3 weights that do not reach this value, I3 and I8 on the Communication and Collaboration dimension and I7 on the Digital Creation dimension. On the Use scale they are I8 and I7, along with I32 from the Security Dimension.

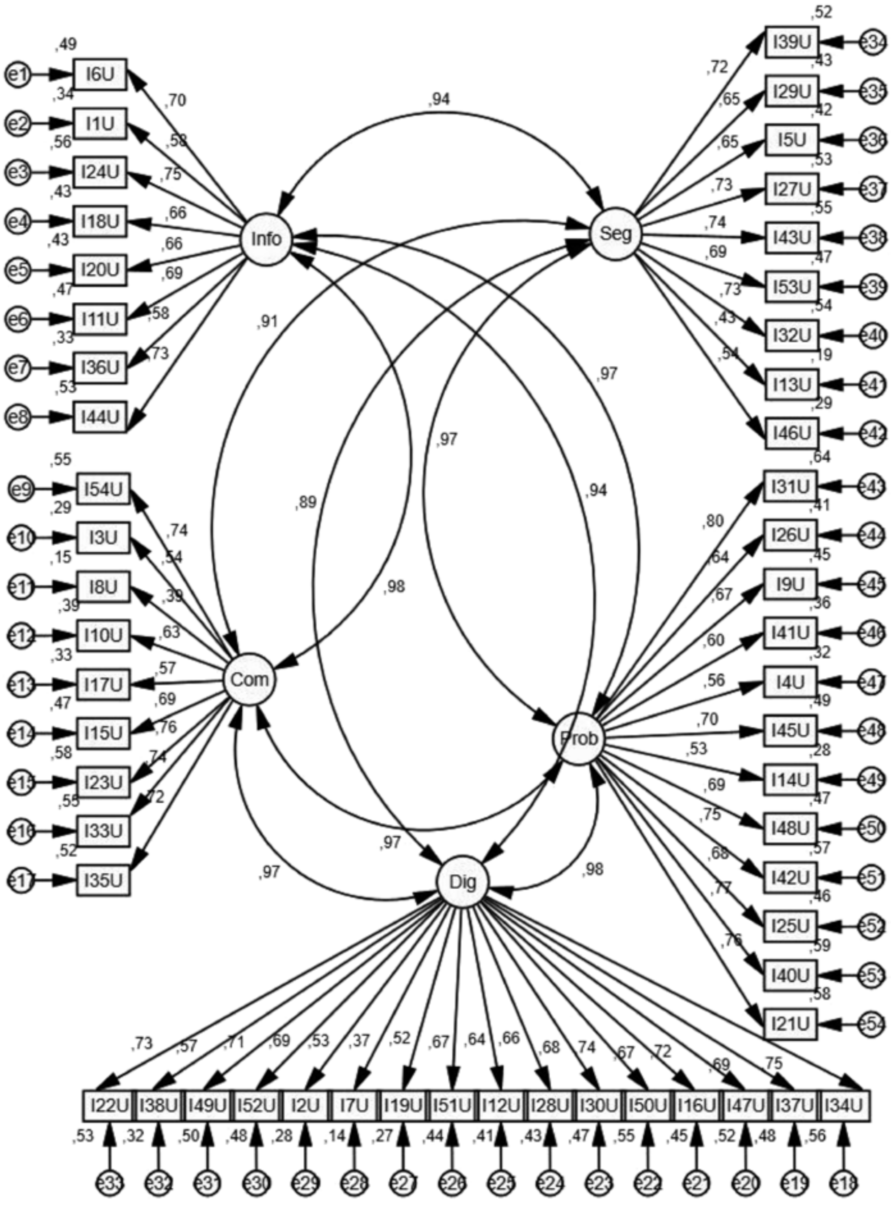
The data also shows high correlations between dimensions, something that could suggest a model with a single overall dimension or combining some of the dimensions. And, as study of the modification indices (MI) has shown, a fit of the factorial structure is pertinent.

GRAPH 3. Model of the standardised estimated «Knowledge» scale parameters.



Source: Own elaboration.

GRAPH 4. Model of the standardised estimated «Use» scale parameters.



Source: Own elaboration.

The overall fit results for both scales show acceptable results, with values close to 3 for the normalised chi-squared index and values below 0.08 in RMSEA, as shown in Table 7. In the case of the root mean square error of approximation, the confidence intervals are also below the cut-off point established for accepting the model. And, as can be seen, the results of the defined model obtain better indices of fit than the null model. Nonetheless, the incremental fit indices (IFI and CFI) and index of suitability of the sample size (Hoelter) do not indicate such a good fit of the model, with values below 0.9 and 200 respectively (see Table 7).

Table 7. Overall and incremental fit indices, parsimony and sample suitability.

	Knowledge scale			Use scale		
	Null	Initial	Final	Null	Initial	Final
CMIN/DF	13.261	3.390	2.259	11.204	3.203	2.201
RMSEA	.170	.075	.054	.155	.072	.053
RMSEA LO 90	.168	.073	.052	.153	.70	.051
RMSEA HI 90	.172	.077	.057	.157	.074	.056
IFI	0	.814	.907	0	.795	.892
CFI	0	.814	.906	0	.794	.892
PRatio	1	.955	.916	1	.955	.922
Hoelter .05	35	134	201	41	142	206
Hoelter .01	35	137	20	42	145	212

Source: Own elaboration.

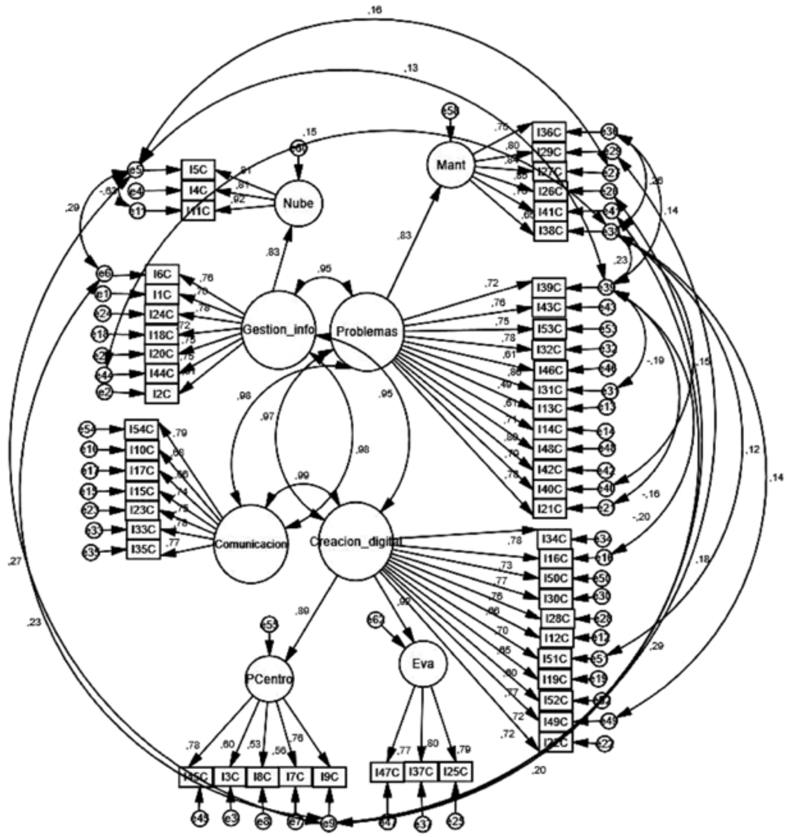
Consequently, the modification indices (MI) were analysed, finding covariances between the estimation errors of some items and also reciprocal causation between them, something that could indicate the existence of sub-dimensions within the general factors or from combining some of these dimensions. As a result of this analysis and of the study of the residual covariance matrix and the theoretical starting referent, the decision was taken to modify the starting model by adding a sub-dimension of Cloud Storage (I4, I5, and I11) linked to the Information and Communication factor; two sub-dimensions associated with the Digital Creation factor, one relating to Projects in the School (I3, I7, I8, I9, and I45) and another with Evaluation (I25, I37, and I25); also the Security and Troubleshooting factors were combined, with this new factor being added to the Maintenance sub-dimension (I26, I27, I29, I36, I38, and I41).

In this reorganisation, 8 items change factor: I3 and I8 move from the Communication and Collaboration factor to the Projects in the School sub-dimension of the Digital Creation factor. Item I9, which was part of the Information and Communication factor, also moves into this sub-dimension. Item 25 which was in the Troubleshooting factor becomes part of the Evaluation sub-dimension within the Digital Creation factor. I36, which formed part of the Information and Communication factor, moves to the Maintenance sub-dimension of the new Troubleshooting factor. Items I4 and I5 from the Troubleshooting and Security factors respectively move to the sub-dimension of Cloud Storage from the Information and Communication factor. And, finally, I2 moves from the Digital Creation factor to the Information and Communication factor.

This analysis of the MI also showed the relationship between the residuals of four items (I5, I9, I38, and I39) and a group of items from other dimensions. It appears that these questions are transversally related to the others and so correlations between these errors are included in the new model.

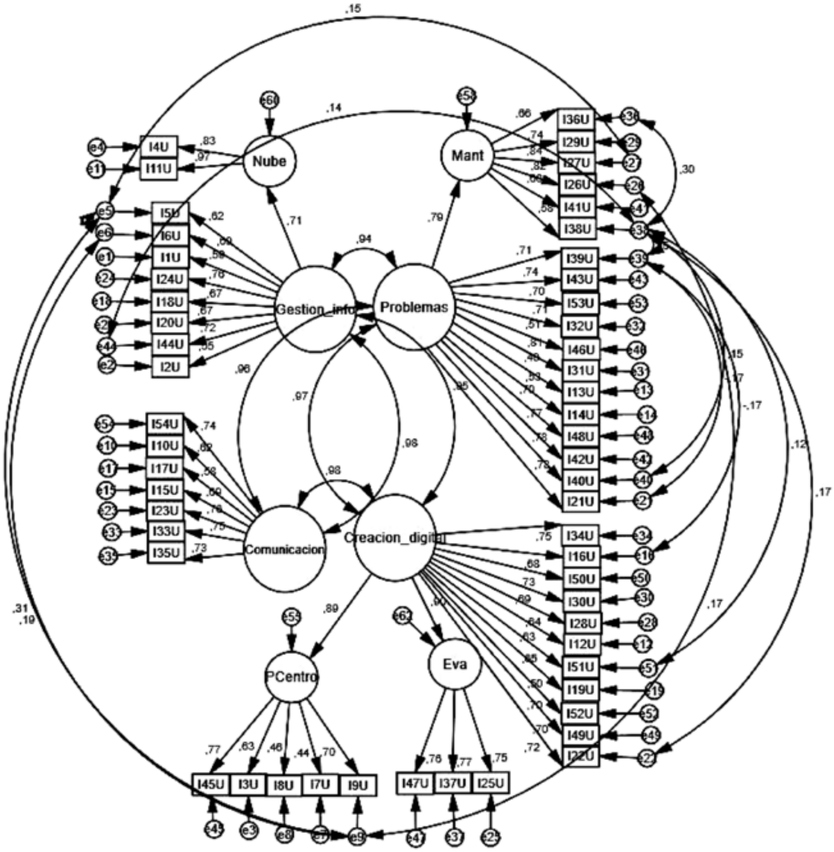
The difference between the factorial structures of the «Knowledge» and «Use» scales is located in I5, which, although it belongs to the same general dimension of Information and Communication, is not located in the new Cloud Storage sub-dimension. The correlations between the errors for I41 and I9, I29 and I9, I11 and I5, I39 and I5, I39 and I36, and I39 and I21 were not significant in the «Use» scale and were, therefore, rejected in the final model (see Graphs 5 and 6).

GRAPH 5. Final model of the standardised estimated «Knowledge» scale parameters.



Source: Own elaboration.

Graph 6. Final model of the standardised estimated «Use» scale parameters.



Source: Own elaboration.

Summaries of the modification indices used for performing the re-specification of the factor structure are included (Tables 8 and 9).

Table 8. Modification indices of the covariances between errors of the items from the sub-dimensions.

				Knowledge		Use	
Sub-Dimension	**Covariance**			**M.I.**	**Par Change**	**M.I.**	**Par Change**
Cloud Storage	e11	<-->	e4	137.995	0.627	201.487	1.359
	e5	<-->	e4	50.601	0.44		
	e11	<-->	e5	21.739	0.264		

				Knowledge		Use	
Sub-Dimension	**Covariance**			**M.I.**	**Par Change**	**M.I.**	**Par Change**
Maintenance	e27	<-->	e26	130.666	0.957	115.764	1.185
	e29	<-->	e26	78.315	0.825	51.427	0.861
	e36	<-->	e38	66.572	0.872	69.63	0.964
	e36	<-->	e27	48.11	0.589	41.608	0.64
	e36	<-->	e26	44.98	0.627	32.896	0.652
	e29	<-->	e27	36.381	0.511	43.546	0.69
	e26	<-->	e41	30.948	0.459	30.799	0.632
	e29	<-->	e41	29.919	0.457	32.196	0.615
	e38	<-->	e41	23.93	0.462	12.145	0.403
	e27	<-->	e41	22.987	0.36	14.192	0.374
	e36	<-->	e41	22.641	0.398	12.321	0.36
	e38	<-->	e26	17.592	0.442	18.44	0.551
	e36	<-->	e29	17.881	0.4	4.003	0.216
	e38	<-->	e29	6.752	0.277		
	e38	<-->	e27	10.847	0.315	6.075	0.276
Projects in School	e3	<-->	e8	38.371	0.713	14.198	0.52
	e9	<-->	e45			28.802	0.58
	e3	<-->	e45	21.002	0.451	21.338	0.155
	e7	<-->	e45	4.328	0.064	6.058	0.124
	e3	<-->	e7	12.249	0.475	11.718	0.531
	e3	<-->	e9	20.218	0.42	8.968	0.331
	e8	<-->	e7	14.701	0.476	4.499	0.273
	e8	<-->	e9	27.341	0.447	16.799	0.471
	e8	<-->	e45	4.133	0.183	5.356	0.26
Evaluation	e37	<-->	e25	40.223	0.471	34.904	0.578
	e37	<-->	e47	18.123	0.358	18.168	0.418
Sub-dimension Maintenance	e36	<-->	e29	17.881	0.4	4.003	0.216
	e36	<-->	e38	66.572	0.872	69.63	0.964
	e36	<-->	e26	44.98	0.627	32.896	0.652
	e36	<-->	e27	48.11	0.589	41.608	0.64
	e36	<-->	e41	22.641	0.398	12.321	0.36
	e29	<-->	e26	78.315	0.825	51.427	0.861

				Knowledge		Use	
Sub-Dimension	Covariance			M.I.	Par Change	M.I.	Par Change
Sub-dimension Maintenance	e29	<-->	e41	29.919	0.457	32.196	0.615
	e29	<-->	e27	36.381	0.511	43.546	0.69
	e38	<-->	e29	6.752	0.277		
	e27	<-->	e26	130.666	0.957	115.764	1.185
	e38	<-->	e27	10.847	0.315	6.075	0.276
	e27	<-->	e41	22.987	0.36	14.192	0.374
	e38	<-->	e26	17.592	0.442	18.44	0.551
	e26	<-->	e41	30.948	0.459	19.348	0.19
	e38	<-->	e41	23.93	0.462	12.145	0.403

Source: Own elaboration.

TABLE 9. Modification indices of the covariances between errors for transversal items.

			Knowledge		Use	
Covariance			MI	Par Change	MI	Par Change
e41	<-->	e9	4.047	0.136		
e26	<-->	e9	14.234	0.248	14.015	0.336
e29	<-->	e9	6.423	0.187		
e5	<-->	e9	18.4	0.289	38.633	0.597
e6	<-->	e9	17.023	0.28	11.151	0.311
e6	<-->	e5	23.584	0.313	21.649	0.435
e11	<-->	e5	13.509	-0.169		
e27	<-->	e5	12.728	0.215	10.736	0.274
e39	<-->	e5	10.288	0.241		
e36	<-->	e38	27.316	0.473	41.393	0.672
e44	<-->	e38	12.658	0.326	8.566	0.296
e49	<-->	e38	9.192	0.328	5.926	0.261
e51	<-->	e38	9.806	0.337	6.085	0.271
e40	<-->	e38	7.951	0.241	4.29	0.198
e39	<-->	e38	25.902	0.503	7.296	0.297
e39	<-->	e16	18.356	-0.243	13.809	-0.281

			Knowledge		Use	
Covariance			MI	Par Change	MI	Par Change
e39	<-->	e36	6.589	0.209		
e39	<-->	e31	12.473	-0.218		
e39	<-->	e21	14.714	-0.277	11.743	-0.287

Source: Own elaboration.

To complete the construct validity study, the convergent and discriminant validity results are presented. In the case of convergent validity, as noted above, this is the analysis of the parameters of the model. Most of the factor loads are above the acceptable value of 0.5 (except I13 in «Knowledge» and I8, I7, and I13 in «Use») and many exceed the optimum value of 0.7. However, another indicator of this type of validity is the construct reliability calculated based on these regression weights and, as is shown in Table 10, in all cases it approaches values of 0.9.

TABLE 10. Construct reliability for convergent validity.

Dimension	Knowledge scale		Use scale	
	Construct reliability			
	Initial	Final	Initial	Final
Managing Information	0.903	0.906	0.866	0.877
Communication and Collaboration	0.887	0.891	0.867	0.867
Digital Creation	0.937	0.941	0.921	0.929
Troubleshooting	0.932	0.938	0.912	0.922
Security	0.900		0.873	

Source: Own elaboration.

To study the discriminant validity (Table 11), the final defined model of 4 dimensions is compared with 10 alternative models that test all of the possible combinations of connection between the proposed factors. The first one considers a single dimension, setting all of the correlations at 1, before trying combinations of pairs of dimensions setting the correlation at 1 between them both and also groups of three. The results indicate that on the «Use» scale the defined model differs significantly from the others, with the exception of the model that combines the Communication and Collaboration factor with Digital creation. On the «Knowledge» scale, there are no differences with the alternative model that combines the Troubleshooting-Security dimensions with Communication and Collaboration, nor are there any with the model that combines Communication and Collaboration with Digital Creation. Nonetheless, it has been shown that the overall fit does not improve with any of the alternative models mentioned.

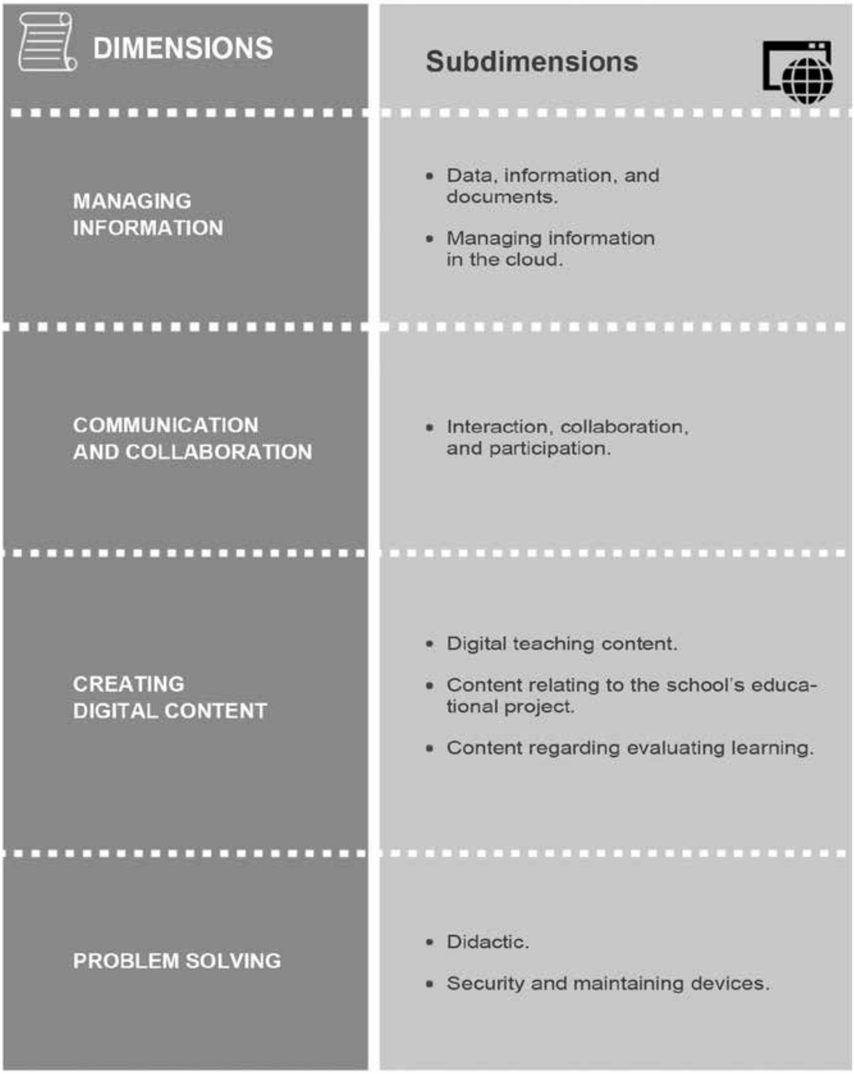
TABLE 11. Significant differences between the defined model and the alternatives for discriminant validity.

Model	gl	Knowledge scale		Use scale	
		CMIN	P	CMIN	P
Info/Prob/Com/Dig	6	54.01	0	57,224	0
Info/Prob	1	32.817	0	36,954,232	0
Info/Com	1	5.545	0.019	5,105	0.024
Info/Dig	1	31.219	0	21,249	0
Prob/Com	1	2.367	0.124	14,375	0
Prob/Dig	1	20.494	0	19,044	0
Com/Dig	1	0.653	0.419	3,342	0.068
Info/ProbCom	3	33.221	0	45,507	0
Info/ProbDig	3	53.475	0	50,176	0
Prob/Com/Dig	3	21.09	0	28,117	0

Source: Own elaboration.

In summary, the initial five-dimension model has reasonably good fit and displays overall fit indices that are acceptable but could be improved. Nonetheless, the incremental fit and sample appropriateness indices suggest changes should be made. After making the modifications, the new structure comprises four dimensions or general factors («Managing information», «Communication and Collaboration», «Problems and Security», and «Creating Digital Content») and four sub-dimensions («Cloud Storage», «Security and Maintenance», «Projects in the School» and «Evaluation»). The resulting overview Table is shown in Graph 7, thus improving, the model proposed by INTEF (2017) and shown in Graph 1.

Graph 7. Improved structure of teachers' digital competence.



Source: Own elaboration.

The convergent validity is also confirmed, although the high correlations between factors might affect the discriminant validity. None of the alternative models that combines the different dimensions improves the fit indices.

4. Discussion and conclusions

Any validation process is always an unfinished process. Dividing validity into types, as the APA rules suggest, could lead to confusion as people might think that testing one type of validity is enough to validate a test or questionnaire. Testing one type of validity is not enough to decide that a test is valid (see Messick 1980). It is important to bear in mind that validity refers to the validity of the inferences, not the test itself. As the third version of the APA states (1986), validity refers to the appropriate use of the inferences drawn from the scores from a test or some other form of evaluation.

Construct validity is understood as the concept that best integrates the different types of validity. In effect, a construct is understood as a concept that represents a quality or attribute of the subjects that can be more or less abstract in nature and that is supposedly represented in the scores for a given instrument, something for which Cattell (1964) prefers the term concept since, in his opinion, this better combines the theoretical conceptualisation with pure psychometry (although his idea has not prevailed). It is, in any case, a matter of untangling the trait or construct underlying the variance of the scores for an instrument. Studying this type of validity requires proof, experimental evidence, and so it accepts gradations and is not restricted to an index or coefficient. This is a complex process that requires numerous studies, and in a way, is always unfinished, as Nunnally (1978) and Cronbach (1971) note. Furthermore, quantitative data is insufficient, and a solid logical rationale is required to complement it. As Messick notes (1980), the data and the reasoning harmonise and integrate in a given interpretation.

In this work, sufficient proof is provided, albeit always incomplete, to consider the educational applications of the instrument developed for evaluating teachers' digital competencies, although the authors plan to continue analysing more data with larger samples.

The quality of the tool has, therefore, been proven by obtaining high reliability indices and confirming the validity of the theoretical construct it measures. Nonetheless, the fit values produced by the confirmatory factor analysis, while acceptable, could be improved. This has led us to propose some modifications to the initial model, something that has enabled us to refine the structure and achieve better levels of fit. New studies will allow us to verify whether this modified structure is plausible over time and with different samples to the one used in this preliminary study.

In any case, this is a practical instrument that is intended to facilitate analysis of the position regarding knowledge and use of certain digital strategies by teachers, so that training pathways can be offered based on the results that are appropriate and are personalised. The results presented here suggest that the use of this instrument is feasible given its appropriate metric characteristics that will be the object of new studies with larger samples in the future since, as stated above, validating an instrument is an always-unfinished process.

Annexe. Validated Teachers' Digital Competence Questionnaire.

Please note this questionnaire has been validated for its use in Spain. In the event that this questionnaire is to be used outside of Spain, this should be validated accordingly.

Order	Item no.	DIMENSION
Computer information and literacy		
1	1	Internet browsing strategies (e.g.: searches, filters, using operators, specific commands, using search operators, etc.).
24	2	Strategies for searching for information in different media or formats (text, video, etc.) to find and select information.
18	3	Specific channels for selecting teaching videos.
20	4	Rules or criteria for critically evaluating the content of a website (updates, citations, sources).
44	5	Criteria for evaluating the reliability of the sources of information, data, digital content, etc.
11	6	Tools for storing and managing shared files and content (e.g.: Drive, Box, Dropbox, Office 365, etc.).
36	7	Tools for recovering files that are deleted, damaged, inaccessible, have formatting errors, etc.
6	8	Strategies for managing information (using tags, recovering information, classification, etc.).
Communication and collaboration		
10	9	Online communication tools: forums, instant messaging, chats, video conferencing, etc.
3	10	Projects in my school relating to digital technology.
8	11	Software available in my school (e.g.: marks, attendance, communication with families, content, evaluating tasks, etc.).
54	12	Spaces for sharing files, images, work, etc.
17	13	Social networks, learning communities, etc. for sharing educational information and content (e.g.: Facebook, twitter, google+ or others).
33	14	Other people's educational experiences or research that might provide me with content or strategies.
35	15	Shared and collaborative learning tools (e.g.: blogs, wikis, specific platform such as Edmodo or others).
15	16	Basic rules for behaviour and etiquette in internet communication in the educational context.
23	17	Ways of managing digital identities in the educational context.

Order	Item no.	DIMENSION
Creating digital content		
37	18	Herramientas para elaborar pruebas de evaluación.
47	19	Herramientas para elaborar rúbricas.
16	20	Herramientas para crear presentaciones.
50	21	Herramientas para la creación de videos didácticos.
30	22	Tools to facilitate learning such as infographics, interactive graphs, concept mapping, time lines, etc.
28	23	Tools for producing QR codes (Quick Response).
12	24	Tools for creating voice recordings (podcasts).
51	25	Tools that help gamify learning.
19	26	Tools for content based on augmented reality.
7	27	The interactive whiteboard software in my centre.
2	28	Open educational resources (OERs).
52	29	Tools for reworking or enriching content in different formats (e.g.: texts, tables, audio, images, videos, etc.).
49	30	Different types of licences for publishing my content (copyright, copyleft, and creative commons).
34	31	Sources for finding rules concerning copyright and licences.
38	32	The basic logic of programming, compressing the structure, and basic modification of digital devices and their set-up.
22	33	The potential of ICT for planning and creating new products.
SECURITY		
29	34	Protecting devices against threats from viruses, malware, etc.
39	35	Protecting information relating to people from your immediate surroundings (colleagues, students, etc.).
5	36	Systems for protecting devices and documents (access control, privileges, passwords, etc.).
27	37	Ways of eliminating data/information for which you are responsible about yourself or third parties.
43	38	Ways of controlling use of technology when it becomes a distraction.
53	39	How to maintain a balanced attitude in use of technology.
32	40	Rules about the responsible and healthy use of digital technologies.
13	41	Recycling points to reduce the environmental impact of technological waste on the environment (unused devices, mobile phones, printer toner, batteries, etc.).

Order	Item no.	DIMENSION
Troubleshooting		
46	42	Basic energy saving measures.
26	43	Basic computer maintenance tasks to avoid possible operational problems (e.g.: updates, cleaning cache or disc, etc.).
Troubleshooting (cont.)		
9	44	Basic solutions for technical problems resulting from the use of digital devices in class.
41	45	The compatibility of peripherals (microphones, headphones, printers, etc.) and connectivity requirements.
4	46	Solutions for management and storage in the «cloud», sharing files, granting access privileges, etc. (e.g.: Drive, OneDrive, Dropbox and others).
45	47	Digital resources adapted to the educational centre's project.
14	48	Tools that help respond to diversity in the classroom.
48	49	Ways of solving problems among peers.
42	50	Options for combining digital and non-digital technology to find solutions.
25	51	Tools for carrying out the evaluation, mentoring, or monitoring of students.
40	52	Creative didactic activities for developing students' digital competency.
31	53	Ways to update myself and include new devices, apps, and tools.
21	54	Spaces for me to train and update my digital competencies.

Source: Own elaboration.

References

Álvarez Rojo, V. (2010). *Evaluación de competencias en la Universidad. Material del curso «Evaluación de competencias en el proceso de enseñanza aprendizaje»*. Secretariado de Formación y Apoyo a la Calidad, Universidad de Granada.

American Psychological Association (1986). Standards for Educational and Psychological Testing: Six Reviews. *Journal of Educational Measurement*, *23*, 83-98.

Bentler, P. M. (2005). *EQS 6 Structural equations program manual*. Encino: Multivariate Software.

Byrne, B. M (2009). *Structural Equation Modeling with AMOS*, 2nd Ed. New York: Routledge.

Cardona, A. J. (2008). *Formación y desarrollo profesional del docente en la sociedad del conocimiento*. Madrid: Ed. Universitas.

Catell, R. B. (1964). Validity and reliability: a proposed more basic set of concepts. *Journal of Educational Psychology*, *55*, 1-22.

Cattell, R. B. (1978). *The scientific use of factor analysis*. New York: Plenum.

Cope, C.H. and Ward, P. (2002). Integrating learning technology into classrooms: The importance of teachers' perceptions. *Educational Technology & Society*, *5* (1), 67-74.

Cronbach, L. J. (1971). Test validation. In R. L. Thorndike (Ed.), *Educational Measurement*, 2nd Ed., (p. 143). Washington: American Council on Education.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.

Davis, N., Preston, C. and Sahin, I. (2009). ICT teacher training: Evidence for multilevel evaluation from a national initiative. *British Journal of Educational Technology, 40* (1), 35-48.

European Commission (2001). *Basic indicators on the incorporation of ITC into European Education Systems: 2000-01 Annual Report*. Bruselas: Eurydice.

European Commission (2009). *Marco estratégico Educación y Formación 2020 (ET2020)*. Euridyce España. Retrieved from http://www.mecd.gob.es/educacion-mecd/mc/redie-eurydice/prioridades-europeas/et2020.html

European Commission (2016). *Education and training. Monitor 2016. Portugal*. Retrieved from https://ec.europa.eu/education/sites/education/files/monitor2016-pt_en.pdf

European Parliament and Council (2006). *Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning*. Official Journal of the European Union.

Ferrari, A. (2013). *DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe*. Sevilla: European Commission. Joint Research Centre. Institute for Prospective Technological Studies.

Fullan, M. and Donelly, K. (2013). *Alive in the Swamp: assessing digital innovations in education*. London: Nesta.

Gallego, M. J., Gámiz, V. and Gutiérrez, E. (2010). El futuro docente ante las competencias en el uso de las tecnologías de la información y comunicación para enseñar. *EDUTEC, Revista Electrónica de Tecnología Educativa*, *34*.

Gaviria, J. L., Biencinto, M. C. and Navarro, E. (2009). Invarianza de la estructura de covarianzas de las medidas de rendimiento académico en estudios longitudinales en la transición de educación primaria a secundaria. *Revista de educación*, *348*, 153-173.

Hair, J. F., Black, W. C., Babin, B. J. and Anderson, R. E. (2014). *Multivariate Data Analysis* (7th Ed.). Essex: Pearson.

INTEF (2017). *Marco de Competencia Digital*. Madrid: Ministerio de Educación, Ciencia y Deportes.

Koehler, M. J., Mishra, P. and Cain, W. (2013). What Is Technological Pedagogical Content Knowledge (TPACK)? *Journal of Education*, *193* (3), 13-19.

Mesick, S. (1980). Test Validity and the Ethics of Assessment. *American Psychologist*, *35*, 1012-1027.

Nunnally, J. C. (1978). *Psychometric theory* (2nd Ed.). New York: McGraw-Hill.

Nunnally, J. C. and Bernstein, I. H, (1994). *Psychometric Theory* (3rd Ed.). Nueva York: McGraw-Hill.

OECD (2003). *Education at a glance. OECD INDICATORS 2003*. Paris: Organisation for Economic Co-operation and Development.

Sangrá, A. and González-Sanmamed, M. (2004). *La transformación de las universidades a través de las TIC: Discursos y prácticas*. Barcelona: Ediuoc.

Solmon L. C. and Wiederhorn J. A. (2000). *Progress of technology in the school: 1999. Report on 27 states*. Santa Monica, CA: Milken Family Foundation.

Tondeur, J., Valcke, M. and Van Braak, J. (2008). A multidimensional approach to determinants of computer use in primary education: Teacher and school characteristics. *Journal of Computer Assisted Learning, 24* (6), 494-506.

Tourón, J. (2016). *TPACK: un modelo para los profesores de hoy*. *Educación, Tecnología y Talento*. Retrieved from http://www.javiertouron.es/2016/05/tpack-un-modelo-para-los-profesores-de.html (Consulted on July 18, 2017).

UNESCO (2002). *Information and communication technology. A curriculum for schools and programme of teacher development*. Paris: UNESCO.

UNESCO (2003). *Communiqué of the ministerial roundtable on 'Towards Knowledge Societies'*. Paris: UNESCO.

UNESCO (2008). *ICT competency standards for teachers: Competency standards modules*. Paris: UNESCO.

Windschitl, M. and Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal*, *39* (1), 165-205.

Authors' biographies

Javier Tourón is a professor and the vice-rector for Innovation and Educational Development at the Universidad Internacional de La Rioja (UNIR). Past-President of the European Council for High Ability (2000-2004) and a member of the National Advisory Board of the Center for Talented Youth (CTY) at Johns Hopkins University (2003-2011). His research focuses on high ability and talent development; educational evaluation and educational technology.

Deborah Martin is a lecturer at the Universidad Internacional de La Rioja (UNIR). She was awarded her PhD in Education by the Complutense University of Madrid. She is Forensic and Criminology Psychologist. She is a member of the Adaptive Pedagogy research group at the Complutense, and the Flipped Mastery Learning in Online Settings and Secondary Evaluation and Analysis of the Educational System research groups at the Universidad Internacional de La Rioja (UNIR).

Enrique Navarro Asencio is an assistant professor at the Complutense University of Madrid (UCM). He was awarded his PhD in Pedagogy by the Complutense in 2013, and received the special PhD prize. His work relates to psychometry and evaluating academic performance and associated factors.

Silvia Pradas is a lecturer and the director of the Master's in Neuropsychology and Education, and of the Master's in Educational Technology and Digital Competencies at the Universidad Internacional de La Rioja (UNIR). Her PhD in Educational Sciences was awarded by Camilo José Cela University (UCJC). Her research focusses on neuropsychology and technology applied to education.

Victoria Íñigo is an assistant professor at the Universidad Internacional de La Rioja (UNIR) and is the director of the Master's in Teacher Training in the Faculty of Education at the UNIR. Her PhD is from the University of La Rioja, her current research focuses on training teachers in digital competencies and flipped classroom.

revista española de pedagogía
año LXXVI, nº 269, enero-abril 2018
Spanish Journal of Pedagogy
year LXXVI, n. 269, January-April 2018

Table of Contents

Sumario

Book reviews

This is the English version of the research articles and book reviews published originally in the Spanish printed version of issue 269 of the **revista española de pedagogía.** The full Spanish version of this issue can also be found on the journal's website http://revistadepedagogia.org.

ISSN 0034-9461 - Depósito legal: M. 6.020 - 1958
e-ISSN 2174-0909 Rev. esp. pedagog. (Internet)
INDUSTRIA GRÁFICA ANZOS, S.L. Fuenlabrada - Madrid