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ORIGINAL

Evaluation of Teacher Digital Competence Frameworks Through Expert Judgement: the Use of the Expert Competence Coefficient

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ABSTRACT

In this paper, different proposals made by national and international organizations and institutions on Teacher Digital Literacy are taken into account. The 7 most commonly used competence frameworks in international contexts are presented for evaluation through expert judgment. Next, the most suitable for the subsequent realization of a t-MOOC on Teacher Digital Literacy was selected. The selection of these experts was based on seven criteria that helped to establish the expert knowledge coefficient (EKC). This strategy served to obtain the viability of the selected sample. A total of 412 people, 155 experts and 257 non-experts participated in this study. After conducting the expert judgment, in a single round, it was concluded that the European Framework of Digital Competence for Teachers DigCompEdu is the most valued and adequate to be used as reference for the formative t-MOOC, followed by INTEF. This result is logical, since the latter is inspired by the former. These findings do not question the validity of the other competency frameworks, but the preferences granted by the judges.

Keywords DIGITAL COMPETENCE, TEACHER TRAINING, EXPERT JUDGMENT, T-MOOC, DIGCOMPEDU

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1 INTRODUCTION

The European Union defines key competencies as "a combination of knowledge, capacities and attitudes adapted to the context" (Council of the European Union, 2018, p. 7). Being competent is related to everything that society requires to overcome the obstacles of the time in which it develops (Cabero-Almenara & Palacios-Rodríguez, 2019; Palacios-Rodríguez, 2020). In the so-called knowledge society, one of these fundamental competencies is digital competence, i.e., "that which involves the safe and critical use of information society technologies for work, leisure and communication" (Council of the European Union, 2018, p. 9). However, 44% of Europeans have not developed basic digital abilities yet, whereas 79% use the internet regularly, at least once per week (Williamson, Potter, & Eynon, 2019). At the same time, all predictions indicate that most jobs in the future

will require digital abilities (Cruz-Díaz, Ordóñez-Sierra, García, & Rabasco, 2016; Olivares, Angulo, Prieto, & Torres, 2018). Therefore, the capacity to use technology to live, work and learn throughout life is addressed as a transversal topic for the development of any educational programme (Romero-Martín, Castejón-Oliva, López-Pastor, & Fraile-Aranda, 2017). In this sense, teacher training is considered as highly important (Lázaro-Cantabrana, Usart-Rodríguez, & Gisbert-Cervera, 2019; Suárez-Rodríguez, Almerich, Orellana, & Díaz-García, 2018). This article presents and evaluates the main reference frameworks to improve teacher digital competence, which combines professional, pedagogical, technological and organisational capacities (Corsi, Domínguez, & Rodríguez, 2019; Kullaslahti, Ruhalahti, & Brauerm, 2019; Mishra, Koehler, & Bragg, 2006).

1.1 Teacher Digital Competence Frameworks

Different organisations and institutions have identified different indicators or standards that describe teacher digital competence (Muñoz-Repiso, Martín, & Gómez-Pablos, 2020). These classify the competencies that teachers must develop with different dimensions and descriptors. This work presents those which, according to different authors, are most frequently used in the international context (Cabero-Almenara & Gimeno, 2019; Cabero-Almenara & Palacios-Rodríguez, 2019; Lázaro-Cantabrana et al., 2019; Padilla-Hernández, Gámiz-Sánchez, & Romero-López, 2019; Prendes & Gutiérrez, 2013; Rodríguez, Méndez, & Martín, 2018; Silva, Morales, Lázaro, & Gisbert, 2019)

1.2 European Framework of Digital Competence for Teachers DigCompEdu (M1)

DigCompEdu was published in late 2017 by the Joint Research Centre of the European Union (JRC) (Redecker & Punie, 2017). Its main objective is to align the European educational policies with such reference framework. Moreover, it is a synthesis of scientific studies at the local, national, European and international level (Ghomi & Redecker, 2018; Redecker & Punie, 2017). DigCompEdu is a digital competence model with 6 differentiated competence areas (Figure 1). Each area has a series of competencies that "teachers must have in order to promote effective, inclusive and innovative learning strategies, using digital tools" (Redecker y Punie, 2017, p. 4).

1. *Professional commitment*: Capacity to use digital technologies to improve the teaching process and interact professionally with colleagues, students, parents and different agents of the educational community. Furthermore, this communication through technology allows for individual professional development and collective and continuous innovation in the educational organisation.
2. *Digital resources*: Identifying quality educational resources. Teachers must also be able to modify, create and share these resources to adjust them to their objectives, students and teaching styles. Likewise, they must know how to use and administer the digital content responsibly, respecting the author rights and protecting personal data.

Figure 1 Competence areas and competencies of the European Framework of Digital Competence for Teachers DigCompEdu. Source: Redecker and Punie (2017)

3. *Digital pedagogy*: Knowing how to design, plan and implement the use of digital technologies in all the phases of the teaching process, promoting student-centred approaches and methodologies.
4. *Evaluation and feedback*: Digital technologies can improve the existing evaluation strategies and pave the way for new and better evaluation methods. Moreover, after analysing the large amount of available data (digital) about the individual interactions of students, teachers can provide more specific comments and support.
5. *Empowering the students*: One of the key strengths of digital technologies in education is their potential to boost the collaboration of students in the teaching-learning process and their autonomy in it. Moreover, digital technologies can be used to provide learning activities adapted to the competence level, interests and learning needs of each student.
6. *Facilitating the competence*: The capacity to facilitate the digital competence to the students is an integral part of teacher competence in ICT and the main theme of this competence area.

Jointly, DigCompEdu proposes six progressive competence levels (Figure 3). In this way, the digital competence level of a teacher is identified, from the Novice level (A1), or those with very little experience and contact with educational technology, to Pioneer (C2), or those who innovate with ICT.

1.3 ISTE standards for Teachers (M2)

The International Society for Technology in Education develops this competence framework focusing on the needs of the students of the 21^{st} century (Crompton, 2017). Its main objective is to delve into the teaching practice, promote student collaboration, rethink the traditional approaches and boost autonomous learning (Crompton, 2017; ISTE, 2018;

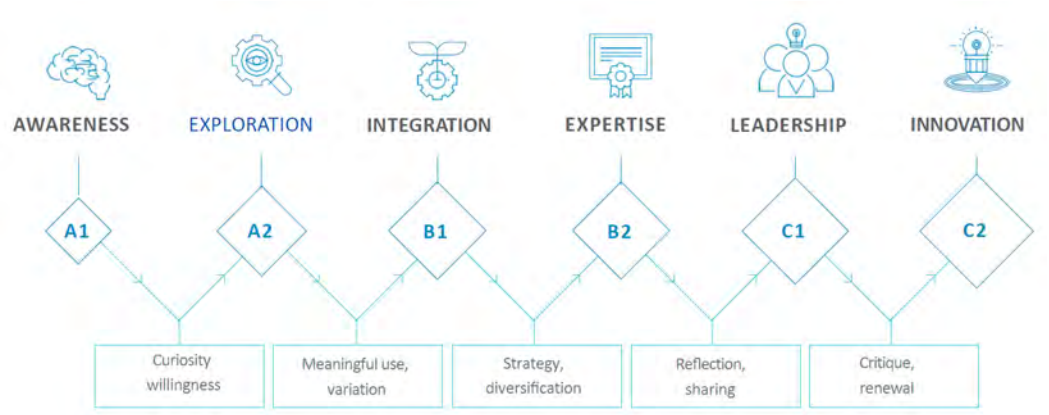

Figure 2 Competence levels and progression of the EuropeanFramework of Digital Competence for Teachers "DigCompEdu". Source: developed byauthor

Pérez-Escoda, García-Ruiz, & Aguaded, 2019). The general teacher profile is characterised by being active and innovative in the teaching-learning process (Gutiérrez-Castillo, Cabero-Almenara, & Estrada-Vidal, 2017). Thus, the ISTE standards for teachers are divided into seven roles or profiles that an educator must develop along his/her professional carreer.

1. *Learners*: Teachers improve their practice continuously by learning in collaboration with other teachers and exploring practices that make use of technology to improve the teaching and learning process.
2. *Leaders:* The search for leadership opportunities to support the empowerment and success of the students, improving their teaching-learning practices.
3. *Citizens:* Teachers are an example to students, contributing in a positive way and participating responsibly in the knowledge society.
4. *Collaborators:* Collaboration with colleagues and students to improve their practice, as well as to share and discover ideas and resources, solving problems using ICT.
5. *Designers:* Design of activities and environments with ICT adapted to the needs of the students.
6. *Facilitators:* Facilitating learning with technology to assist students develop digital competences.
7. *Analysts:* Evaluation and use of data to improve teaching and help students to meet their learning objectives.

1.4 UNESCO ICT Competence Framework for Teachers (ICT-CFT) (M3)

This framework, developed by UNESCO, presents "a wide range of competencies that teachers need in order to integrate ICT in their professional practice" (Butcher, 2019, p. 2). It fosters the practical knowledge of the advantages that ICT provide in education systems. Moreover, it suggests that teachers, apart from acquiring competencies related to ICT, must

be able to use these to help their students to become collaborative, creative, innovative, committed and decisive citizens (Rodríguez et al., 2018). This framework presents 6 fundamental areas or aspects of the professional teaching practice:

1. *Understanding ICT in the educational policies*: Using ICT to support the specific objectives identified in the curriculum and contributing to the evaluation process.
2. *Curriculum and evaluation:* Acquiring abilities with ICT to support effective teaching and learning methods.
3. *Pedagogy:* Using ICT to support effective teaching and learning methods.
4. *Application of digital abilities*: Acquiring abilities with ICT to integrate them in the teaching-learning processes.
5. *Organisation and administration:* Administering the digital devices of the education centre, protecting the people who use them.
6. *Professional learning*: Using digital competence in the professional environment.

1.5 Common Spanish Framework of Digital Competence for Teachers (M4)

The Spanish Ministry of Education, Culture and Sport launched a project in 2012 to define the Common Framework of Digital Competence for Teachers, updated four times (Instituto Nacional de Tecnologías Educativas y Formación del Profesorado. INTEF., 2017a, 2017b). It is based on the DigComp Framework of Digital Competence for Citizens (Carretero, Vuorikari, & Punie, 2017; Vuorikari, Punie, Carretero, & Van-Den-Brande, 2016). It is a generic digital competence model for educators. The competence areas (5) and competences (21) are those of the DigComp framework. Such areas are specified in Figure 3.

It is important to mention that this framework has 6 competence levels with a structure similar to that of DigCompEdu. The teacher digital competence level is identified in a similar way as the Common European Framework of Reference for Languages (Instituto Cervantes., 2002). This progressive level of autonomy and development begins at the basic level (A1) and ends at the advanced levels (C2).

1.6 Brittish Framework of Digital Teaching (M5)

The Brittish Framework of Digital Teaching was created by the Education and Teaching Foundation (ETF) in association with the JISC company (Education and Training Foundation., 2019). Its main objective is to increase the understanding of teachers in the use of digital technologies to enrich their teaching practices and improve their professional development (Pérez-Escoda et al., 2019). This framework consists of 7 key areas, with 3 levels for each of them: exploration, adaptation and leadership. The seven elements are:

1. *Pedagogical Planning*: using digital technology to help in the teaching-learning processes.
2. *Pedagogical Approach*: using digital resources to engage the students in face-to-face, mixed and online learning.

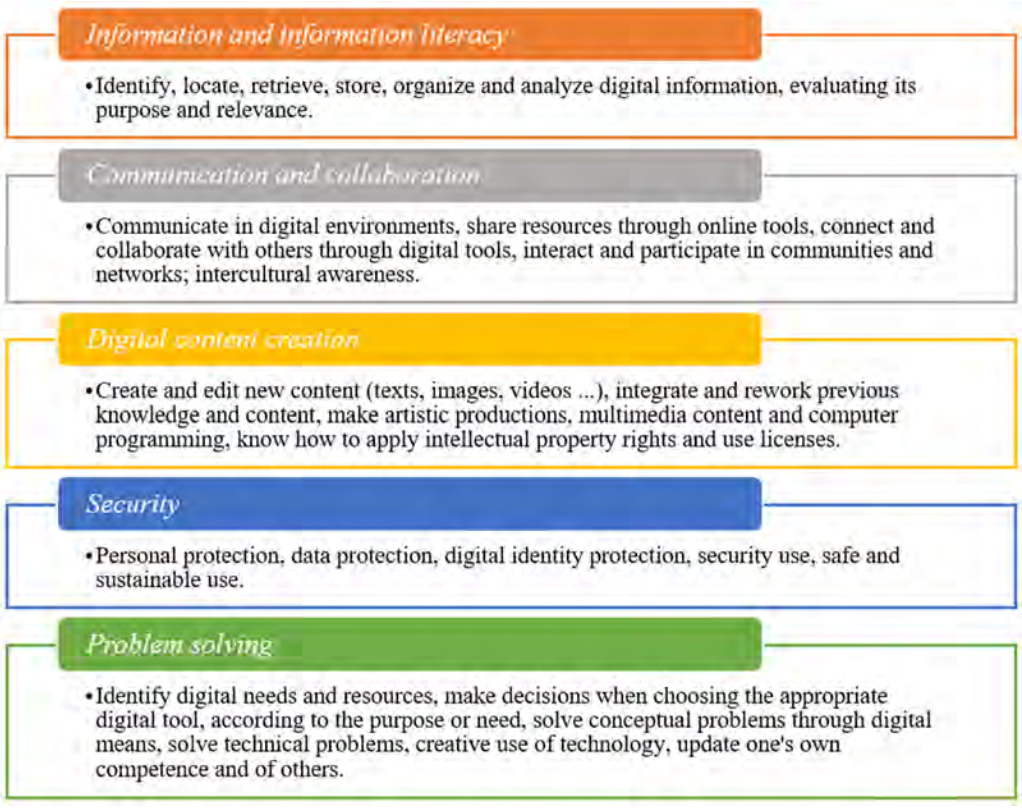

Figure 3 Areas of the Common Framework of Digital Competence for Teachers. Source: Instituto Nacional de Tecnologías Educativas y Formación del Profesorado. INTEF. (2017b)

3. *Employability of the Students*: using digital technologies to improve the employment perspectives of the students.
4. *Specific Teaching*: developing the specific knowledge of the subject and entrepreneurship through technology.
5. *Evaluation*: using digital technology to improve the evaluation process and provide feedback.
6. *Accesibility and Inclusion*: guaranteeing that all students can benefit from digital technology.
7. *Self-development*: reflecting on professional practice, developing digital competence and promoting a safe digital identity.

1.7 Competencies for the Professional Development of Colombian Teachers (M6)

The model proposed by the Colombian Ministry of Education aims to guide the professional development of teachers to improve educational innovation with ICT (Fernanda, Saavedra, Pilar, Barrios, & Zea, 2013) . It is targeted at both designers of traning programmes and teachers interested in generating ICT-enriched environments: relevant, practical, estab-

lished, collaborative and inspirating (Hernández-Suárez, 2016). This framework has 5 competences that teachers must develop:

1. *Technological*: Selection and use of ICT tools (principles, combination types and author rights).
2. *Communicative*: Types of communication through virtual environments (synchronous and asynchronous).
3. *Pedagogical*: Related to teaching-learning processes mediated by ICT.
4. *Management*: Planning, managing, organising and evaluating the teaching-learning and institutional processes.
5. *Research:* Transforming and generating new knowledge using and reflecting on Information and Communication Technologies.

There are 3 specific levels of educational innovation with ICT (Figure 4).

Figure 4 Competencies and levels of the Colombian framework ofICT competencies for the professional development of teachers. Source: Fernanda et al. (2013)

1.8 ICT Competencies and Standards for Chilean Teachers (M7)

The Education and Technology Centre of the Chilean Ministry of Education published this framework in the year 2011, as an updated version of a previous framework published in 2006 (Elliot, Gorichon, Irigoin, & Maurizi, 2011). It presents 5 dimensions (Figure 5) aligned with the UNESCO Framework of ICT Competencies for Teachers (Butcher, 2019).

All 5 dimensions work through descriptors, criteria and compe-tencies. Moreover, each standard allows teachers to recognise how to use and integrate ICTs, identify their training needs and define personalised training itineraries (Ríos, Gómez, & Rojas, 2018).

Figure 5 Structure of the Framework of ICT Competencies and Standards for Chilean Teachers. Source: developed by author.

2 THE INVESTIGATION

This study is part of a larger research project entitled "Design, production and evaluation of t-MOOC for the teachers' acquisition of Teaching Digital Competencies (DIPROMOOC)". One of the aims of this investigation is to create and evaluate a training environment under the t-MOOC architecture for the training of non-university teachers in the acquisition of the teaching digital competence.

To this end, the first objective is to identify the framework of digital competencies through expert judgement.

The expert judgement consists of "requesting a series of people to judge a teaching object, instrument or material, or to give their opinion regarding a specific aspect" (Cabero & Llorente, 2013, p. 14). This strategy is expanding in educational research-evaluation (Galicia, Balderrama, & Edel, 2017; Robles & Rojas, 2015) and it is strongly associated with Delphi studies (López-Gómez, 2018; Mengual-Andrés, Roig-Vila, & Mira, 2016). However, the concept of expert is quite polysemic. There is no unambiguous conceptualisation of the term "expert" that can help to specify its defining characteristics and what it means to be an expert. Therefore, the obtained results depend directly upon the quality of the experts selected for the evaluation process. To this end, different procedures can be applied, which range from contemplating the profile of the selected expert to more complex procedures, such as the expert competence coefficient (ECC) (Cabero-Almenara & Barroso-Osuna, 2013; López-Gómez, 2018).

The present study establishes two mechanisms for the selection of experts. Firstly, the experts must meet two or more of the following criteria:

- University teaching in subjects related to the educational use of digital technologies.
- Experience in the field of training and improvement of teachers in ICT.

- Publications about educational technology literacy, digital competencies or audiovisual literacy in Spanish or international journals (in the last five years).
- Member of a prestigious research group in the field of educational technology.
- Participation in Spanish and international conferences on technologies applied to education.

One of the issues associated with expert judgements is the number of experts required for their application. The proposals are in the ranges of 15-20 (Malla & Zabala, 1978), 15-35 (Landeta, 2002) o 15-25 (Witkin & Altschuld, 1995).

As was already pointed out, their number is determined by different aspects: having different experts related to ICT, avoiding the reduction in the number of experts when several rounds are considered, the volume of work to analyse, the ease of access to information and the urgency at which the data is required (Cabero-Almenara & Barroso-Osuna, 2013). In this case, since problems emerge when working with a large database and only one round could be conducted, it was decided to work with the largest number of experts possible.

Considering these criteria, a total of 412 emails were sent. Finally, after the two weeks in which the questionnaire was open, 155 replies were received.

The interest to improve the identification of the final judges led to the application of the ECC (Cabero-Almenara & Barroso-Osuna, 2013; López-Gómez, 2018; Martínez, Travieso, Sagaró, Urbina, & Martínez, 2018). This index is obtained from the self-perception of the expert about his/her level of knowledge regarding the analysed topic, as well as about the sources that allow him/her to argue his/her decision.

To obtain it, the following formula is used: $K = \frac{1}{2}$ (Kc + Ka), where Kc is the "knowledge coefficient". It is obtained from the score given directly by the expert in the question:

> A) Tick the box that corresponds to your degree of knowledge about the following topics: teacher training in ICT, digital competencies, digital literacy... Value yourself on a scale of 0 to 10 (considering 0 as having absolutely no knowledge and 10 as having full knowledge about the topic in the question).

Ka, the argumentation coefficient, is obtained by adding up the options specified by the expert in the table of the question:

> B) Self-value the degree of influence (low, medium or high) that each of the following sources had on your knowledge and criteria about teacher training in ICT, digital competencies, digital literacy… *1.* Theoretical analyses performed by you. *2.* Your experience obtained from practical activity. *3.* Research on the topic, from Spanish authors. *4.* Research on the topic, from international authors. *5.* Your own knowledge about the state of the problem outside of the Spanish context. *6.* Your intuition about the approached topic.

If the values used to determine the position of the expert suggest that the K score is between 0.8 and 1, his/her competence level is high; if K is between 0.5 and 0.8, his/her competence level is moderate or medium; lastly, if K is below 0.5, the competence level is low.

Once the ECC of all subjects was analysed, it was decided to work with those who obtained a high competence level (ECC $\geq$ 0.8). Thus, the sample was composed of 119 experts: 76.66% of the people who completed the questionnaire.

It is important to mention that 73.88% (f=88) of the judges had a PhD and 17.6% (f=21) had a master's degree. Most of them worked in a university centre (f=86, 72.3%) and their professional activity was basically teaching (f=110, 9.4%), followed by administration (f=35, 29.4%).

Table 1, presents other characteristics of these experts.

Table 1 Table1. Some of thecharacteristics of the judges selected from ECC $\geq$ 0.8.

Dimension		f	%
Throughout your professional life, have you taught subjects / contents / subjects / training actions related to the field of Educational Technology?	Yes	113	95
	No	6	0.05
Have you conducted or participated in any research related to aspects of virtual training, distance learning, ICT teacher training, digital skills of teachers and students, digital literacy...?	Yes	112	94.1
	No	7	5.9
Have you carried out or participated in any publication related to aspects of virtual training, distance learning, ICT teacher training, digital skills of teachers and students, digital literacy...?	Yes	104	87.4
	No	15	0.126
Throughout your professional life, have you taught subjects / contents / subjects / talks / conferences related to teacher training in ICT, digital skills or digital literacy?	Yes	114	95.8
	No	5	4.2

As can be observed, most of the identified experts claimed to have teaching experience, publications and research on topics related to ICT and the digital competence and literacy of teachers.

The information gathering instrument contains two main sections. The first section gathers information about some characteristics of the expert (title, professional activity, workplace...) and incorporates the questions aimed at determining the ECC. The second section requests the valuation of the different frameworks of digital competencies for teachers that were previously described:

- European Framework of Digital Competence for Teachers (M1).
- Framework of the "International Society for Technology in Education" (ISTE) for teachers (M2).
- UNESCO ICT Competence Framework for Teachers (ICT-CFT) (M3).
- Common Spanish Framework of Digital Competence for Teachers of the "Spanish Institute of Educational Technology and Teacher Training" (INTEF) (M4).
- British Framework of Digital Teaching (M5).
- ICT Competencies for Teachers' Professional Development of Colombian Ministry of Education (M6).
- ICT Competencies and Standards for the Teaching profession of the Chilean Ministry of Education (M7).

This instrument is administered digitally and can be found in: https://bit.ly/3c62Ix4

Its application was conducted in January 2020.

3 RESULTS

Firstly, the values obtained by the experts in the knowledge (Kc) and argumentation (Ka) coefficients are presented. Table 2 shows the means of such scores; Kc was obtained from the mean of the scores given by the experts, and Ka was obtained by assigning 1 point to the "low" option, 2 to the "medium" option and 3 to the "high" option.

Table 2 Means obtained in the knowledge (Kc) andargumentation (Ka) coefficients.

Variable	M	SD
Knowledge	8.66	0.92
Theoretical analysis carried out by you.	2.63	0.52
Your experience gained from your practical activity.	2.82	0.39
Working study on the subject of Spanish authors.	2.63	0.53
Working study on the subject of foreign authors.	2.54	0.58
Your own knowledge about the status of the problem abroad.	2.22	0.64
Your intuition on the topic addressed.	2.38	0.55

As can be observed, the self-valuations assigned by the experts could be considered high and very significant. This suggests that the initial criteria used to identify them are valid and significant for the pursued objective.

Next, the results of the values assigned for the different frameworks by those experts with ECC $\geq$ 0.8 are presented, including the means obtained both in the total and in each of the standards of each framework. The aim was to select the framework with the highest mean score (Table 3).

Table 3 Means and standard deviations of the differentframeworks

EUROPEAN FRAMEWORK FOR DIGITAL COMPETENCE OF EDUCATORS (EUROPEAN UNION) (F1)	M	SD
Professional commitment	5.69	0.55
Digital resources	5.70	0.48
Digital pedagogy	5.67	0.57
Evaluation and feedback	5.52	0.72
Empower students	5.52	0.72
Facilitate students' digital competence	5.69	0.53
TOTAL SCALE	5.63	0.39
ISTE STANDARDS FOR EDUCATORS (F2)	**M**	**SD**
Apprentices	5.37	0.71
Leaders	5.15	0.95
Citizens	5.36	0.95
Collaborators	5.29	0.87
Designers	5.33	0.76
Facilitators	5.51	0.70

Continued on next page

Table 3 continued

Analysts	5.11	0.97
TOTAL SCALE	5.30	0.63
ICT COMPETENTIAL FRAMEWORK FOR TEACHERS (UNESCO) (F3)	**M**	**SD**
Understanding ICT in educational policy	5.13	0.90
Curriculum and evaluation	5.54	0.65
Pedagogy	5.68	0.60
Digital skills application	5.60	0.64
Organization and administration	5.19	0.89
Professional learning	5.57	0.72
TOTAL SCALE	5.45	0.54
COMMON FRAMEWORK FOR DIGITAL TEACHING COMPETENCE OF INTEF (SPAIN) (F4)	**M**	**SD**
Information and information literacy	5.51	0.67
Communication and collaboration	5.54	0.69
Digital content creation	5.40	0.87
Security	5.48	0.80
Problem solving	5.50	0.79
TOTAL SCALE	5.49	0.57
DIGITAL EDUCATION FRAMEWORK (UK) (F5)	**M**	**SD**
Pedagogical planning	5.48	0.72
Pedagogical approach	5.34	0.96
Student employability	5.09	1.02
Specific teaching	5.02	1.10
Evaluation	5.34	0.86
Accessibility and inclusion	5.61	0.75
Self-development	5.41	0.86
TOTAL SCALE	5.33	0.68
ICT COMPETENCES FOR TEACHING PROFESSIONAL DEVELOPMENT (COLOMBIA) (F6)	**M**	**SD**
Technological	5.32	0.77
Communicative	5.32	0.77
Pedagogical	5.32	0.77
Management	5.32	0.77
Investigation	5.32	0.77
TOTAL SCALE	5.36	0.67
COMPETENCES AND ICT STANDARDS FOR THE TEACHING PROFESSION (CHILE) (F7)	**M**	**SD**
Pedagogical	5.51	0.75
Technical or instrumental	5.16	0.85
Management	5.13	0.86
Social, ethical and legal	5.30	0.90
Development and social responsibility	5.39	0.87
TOTAL SCALE	5.30	0.69

After arranging the mean score obtained by each framework in descending order, the following ranking was obtained:

- 5.63 European Framework of Digital Competence for Teachers.
- 5.49 Common Spanish Framework of Digital Competence for Teachers of the "Spanish Institute of Educational Technology and Teacher Training".
- 5.45 UNESCO ICT Competence Framework for Teachers (ICT-CFT).
- 5.36 ICT Competencies for Teachers' Professional Development of Colombian Ministry of Education.

- 5.33 British Framework of Digital Teaching.
- 5.30 Framework of the "International Society for Technology in Education" (ISTE) for teachers.
- 5.30 ICT Competencies and Standards for the Teaching profession of the Chilean Ministry of Education.

With the aim of determining the validity of the ECC and verifying the existence of significant differences between the answers given by the experts with an ECC below 0.8 and the answers of those with an ECC equal to or higher than 0.8, the Mann-Whitney U-test was used (Siegel, 1976) as well as the calculation of Cohen's *d* (Cohen, 1988) to analyse the effect size.

Table 4 presents the mean scores and standard deviations reached by the experts based on having a score below or equal to/higher than 0.8.

Table 4 Mean scores and standard deviations obtained bythe experts based on the score equal to or higher than 0.8.

Marco	**Expert $\geq$ 0.8**			
	Yes		No	
	M	SD	M	SD
M1	5.63	0.39	5.06	0.88
M2	5.3	0.63	4.9	0.77
M3	5.45	0.54	4.89	0.8
M4	5.49	0.57	4.9	0.73
M5	5.33	0.68	5.01	0.82
M6	5.36	0.67	4.92	0.81
M7	5.3	0.69	4.86	0.81

To analyse the H0 (null hypothesis), which refers to the non-existence of differences between the scores assigned by the experts based on whether or not they had an ECC $\geq$ 0.8, at a significance level of 0.05, the Mann-Whitney U-test was applied. Table 5 presents the average ranges and the Mann-Whitney U-test. Table 6 shows the U values obtained for the fulfillment or rejection of the H0.

Table 6 shows the values obtained in the Mann-Whitney U-test

The obtained values allow rejecting all the formulated H0 at a significance level of 0.05 or lower. Therefore, it can be concluded that the valuations of the different experts who participated in this study are different based on the score of 0.8 obtained in the ECC.

Such differences, when applying Cohen's *d* (Table 7), to analyse the effect size and according to the proposition of Cohen (1988), can be considered as high (M1, M3 and M4) and moderate (M2, M3, M4, M5 and M7).

After conducting this analysis, the next step was to verify the existence of significant differences between the different scores given by the judges to the different frameworks. To this end, two statistics were applied. Firstly, Friedman's test, which is a non-parametric alternative to the analysis of variance (Siegel, 1976), with the aim of identifying which of

Table 5 Average ranges and Mann-Whitney U-test values

Framework	Expert ≥ 0.8	Average range	Sum of ranges
M1	Yes	82.93	9868.5
	No	53.32	1759.5
M2	Yes	81.8	9734
	No	57.39	1894
M3	Yes	83.97	9993
	No	49.55	1635
M4	Yes	84.54	10060.5
	No	47.5	1567.5
M5	Yes	80.43	9571
	No	62.33	2057
M6	Yes	82.15	9775.5
	No	56.14	1852.5
M7	Yes	81.91	9747.5
	No	56.98	1880.5

Table 6 Mann-Whitney U-test values

Framework	U de Mann-Whitney	W de Wilcoxon	Z	Sig.
M1	1198.5	1759.5	-3.488	.000 (**)
M2	1333	1894	-2.831	.005 (**)
M3	1074	1635	-4.008	.000 (**)
M4	1006.5	1567.5	-4.337	.000 (**)
M5	1496	2057	-2.103	.035 (*)
M6	1291.5	1852.5	-3.037	.002 (**)
M7	1319.5	1880.5	-2.906	.004 (**)

Note: *= significant at p≤ 0.05, and **= significant at p≤ 0.01

Table 7 Cohen's values

Cohen statistic	
M1	1.057
M2	0.599
M3	0.918
M4	0.963
M5	0.446
M6	0.622
M7	0.609

Note: *= significant at p≤ 0.05, and **= significant at p≤ 0.01

the different frameworks proposed had obtained the highest range. Then, the Wilcoxon signed-rank test for related samples was used (Siegel, 1976). Lastly, Cohen's *d* was applied to determine the effect size.

Table 8 presents the average range values, the most relevant framework and the arrangement of all the frameworks, as well as the significance of the obtained results.

Table 8 Friedman's test

Average range		Friedman's test	
M1	4.93	N	119
M2	3.46	Chi squared	50.624
M3	4.14	gl	6
M4	4.32	Sig.	0
M5	3.75		
M6	3.91		
M7	3.49		

The obtained results indicate that there are significant differences ($p \leq 0.000$) at least between the first range obtained (M1) and the last (M7), that is, between the highest range obtained and the lowest.

Then, the Wilcoxon signed-rank test was used to analyse the differences between the highest range and the rest (Table 9).

Table 9 Wilcoxon signed-rank test

Null hypothesis (H0) tested	Sig
M1-M2	.000
M1-M3	.000
M1-M4	.000
M1-M5	.000
M1-M6	.000
M1-M7	.000

The obtained valued reject the H0. Consequently, this suggests that there are significant differences between the highest range (M1) and the rest of the ranges at a significance level of $p \leq 0.05$.

Lastly, to determine the size of such differences, Cohen's *d* was applied, obtaining the values presented in Table 10.

These values indicate that the obtained differences are low or moderate.

4 CONCLUSIONS AND DISCUSSION

The conclusions of this study go in different directions. The first one refers to the significance of the ECC as a strategy to select experts. As was demonstrated, the scores given by the experts are very different, which supports the idea of conducting a preliminary screening,

Table 10 Cohen's d values

Cohen statistic	
M1-M2	0.63
M1-M3	0.38
M1-M4	0.30
M1-M5	0.55
M1-M6	0.49
M1-M7	0.60

as in the present study.

After the round performed by the judges, an outstanding DCT framework was obtained, i.e., DigCompEdu, followed by INTEF. This is logical considering that the latter is inspired by the former. Such findings will be used in the research project DIPROMOOC to approach the teacher training plan from the perspective selected by the experts, as well as to provide our institutions with the proper guidelines to establish teacher training plans in DCT.

In any case, it is important to avoid missinterpreting the results and inferring that the other frameworks are not significant to acquire the DCT; on the contrary, the results are based on the preferences given by the judges, since there are considerable similarities between the different frameworks (Padilla-Hernández et al., 2019). In our study, although the reasons are unknown, such differences can be due to the fact that the instrument was answered by Spanish judges.

The above-mentioned leads to suggest different research lines, such as replicating the present study for two or three rounds in which frameworks are progressively removed from the possible options. This would require a smaller number of experts and their previous commitment to participate in the investigation for a longer period of time. Moreover, it would also be necessary to request their nationality, in order to correlate it to the chosen framework, and to analyse whether this is a determining factor.

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