

Report on the process for evaluating and certifying Teacher Digital Competence

An international perspective

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REPORT ON THE PROCESS FOR EVALUATING AND CERTIFYING TEACHER DIGITAL COMPETENCE: AN INTERNATIONAL PERSPECTIVE

The worldwide COVID pandemic and its implications for educators

The emergency situation caused by the COVID-19 virus has put teacher digital competence (TDC) to the test. Educators have been asked to become online designers and guides with no prior notice. However, teachers need pedagogical expertise not only in order to design worthwhile learning activities and to thrive in this unknown environment, but also to understand and guide students in ethical and communication aspects.

The COVID-19 crisis has given rise to a large number of training possibilities for teachers (Bates et al., 2020); however, most of the advice offered focuses on the use of tools and materials that teachers can use to substitute their on-site classes. These training possibilities and advice have not been useful for promoting TDC, though they offer an initial approach to online education. The development of TDC requires time, reflection and self-evaluation, and therefore the skills developed in this very specific online context can hardly be applied in a regular class setting.

The closure of schools on the 13th of March 2020 highlighted two conditions that made it difficult to meet students' needs in an online format: the digital divide and the insufficient development of TDC. In fact, the main palliative policies passed rapidly by the Department of Education and the Spanish Government have been aimed at remedying these two problems (Lázaro & Gisbert, 2020).

These limitations have shown the enormous effort involved in the professional development of teachers to meet a social need. One first step in this direction is to make tools available that can be used to accurately evaluate TDC, both in initial training and in educational practice.

The importance of TDC

Social change towards digitalization raises new challenges while offering new opportunities and benefits, particularly for learning and teaching processes. In recent years, teachers have made an increasing use of digital technologies (DT); however, as described in academic literature, the use of these technologies has not transformed the educational processes. Therefore, the opportunities offered by DT have not been taken up, often in order to reproduce previously existing educational practices. TDC is essential for this evolution.

The Organic Law 2/2006, of the 3rd of May, of Education (Ley Orgánica 2/2006, de 3 de mayo, de Educación) established the creation of a reference framework for TDC, which would guide ongoing teacher training, considered as a right and a duty. Recently, the Ministry of Education and Vocational Training (Resolución de 2 de Julio de 2020, de la Dirección General de Evaluación y Cooperación Territorial, por la que se publica el Acuerdo de La Conferencia Sectorial de Educación sobre el marco de referencia de la CDD) highlighted the importance of developing the digital competence of both teachers and educational institutions in order to guarantee the development of key competences in their students. The Ministry also determined the need to create a coordination mechanism for recognizing TDC certificates.

Articles 58 and 59 of the 2009 Spanish Educational Law (Ley 22/2009, del 10 de julio, de educación), as well as article 53.1 of the Catalanian Autonomy Statute (Estatuto de Autonomía de Cataluña), state that primary and secondary education must allow students and teachers to develop an adequate level of the necessary DT

competences (Departament d'Ensenyament, 2013). Another defining element in a country's development is digital maturity. This maturity is not just limited to advanced technological infrastructure, but also includes the digital competence of citizens (Departament d'Ensenyament, 2018). DT is widespread in all areas of social development and it is therefore essential to apply these technologies in educational contexts.

According to a study conducted in four Spanish universities about the barriers against university teachers using DT (Mercader & Gairín, 2020), professional aptitudes are a relevant factor for improving the integration of DT. Therefore, one key in order to overcome these barriers is to improve TDC. In addition, Sánchez-Cruzado et al. (2021), found that teachers have a low TDC self-perception across all educational levels, particularly in areas relating to methodological transformation. Another study, carried out in Catalan primary, secondary and kindergarten schools (Escofet et al., 2019) showed that, even though teachers use DT in their educational practice, integration is limited in some aspects, including robotics or programming in order to create learning spaces, in which students lead their own learning. The greatest integration of DT in teaching processes is observed in secondary education, followed by primary education and kindergarten.

In the European Union, the number of secondary school teachers who state that they use DT in 50% of their classes did not increase significantly and it can be hypothesized that the average amount will never exceed 20% (Gisbert et al., 2019). This figure strongly contrasts with the fact that 90% of these teachers use some kind of DT in the classroom, hence it can be inferred that the predominant paradigm is to use educational technology for the simple unidirectional presentation of content. Therefore, it is necessary to continue working on TDC, not only for developing it, but also for evaluating and accrediting it.

Globally, large studies, such as PISA¹ and TIMSS², have proven that there is a positive correlation between students' academic results and how frequently they use DT. However, if this is analyzed in combination with frequency of use and positive attitudes towards educational technology, most countries achieve better results (Petko et al., 2017). These data reveal that the manner in which technology is applied conditions its effect, which is why it is essential to train teachers in TDC. There is no chance of success if teachers do not focus on understanding the potential of the tools and their use in order to promote student competences, taking on a clear mediator role between the DT and the students engaged in the learning process.

Recently, the European Commission (2020) published the Digital Education Action Plan (2021-2027), which raises two strategic priorities: fostering the development of a high-performing digital education ecosystem and enhancing digital skills and competences for digital transformation.

On a national level, the Educate Digitally (*Educa en Digital*) program was launched (Ministerio de la Presidencia, Relaciones con las Cortes y Memoria Democrática, 2020). Its aim was to boost the national technological transformation of education, both equipping schools with devices and connectivity, and addressing the development of TDC.

Recently, the Education Department presented the Digital Education Plan of Catalonia 2020-2023 (Departament d'Educació, 2020), following its historical tradition of pedagogical innovation and innovative use of DT, which goes beyond simply using technology and promotes learning and the development of student and teacher digital competences.

¹ Program for International Student Assessment.

² Trends in International Mathematics and Science Study.

What is being done to characterize and evaluate TDC?

Determining the level of TDC involves defining how this competency is understood, i.e., what frameworks exist, and what tools are available to assess it.

The definition of digital competence is complex and refers to the skills, knowledge and attitudes of teachers towards DT; however, it is still a developing concept in the field of educational research (Taddeo et al., 2016). From our perspective, TDC can be understood as "a set of skills, abilities and attitudes that teachers must develop in order to incorporate digital technologies into their practice and professional development" (Lázaro et al., 2019, p. 75).

In most European education systems, TDC is recognized as an essential competence that teachers must develop. Furthermore, in some countries, such as Spain, Croatia, Estonia, Lithuania, Norway, Austria and Serbia, specific TDC frameworks have been developed (Comisión Europea, 2019). Despite this, TDC is currently mainly evaluated based on self-perception, and a method for evaluating goals is still pending.

What frameworks and models have been developed around TDC?

At both international and national levels, various models and frameworks have been developed in order to define the aspects that are part of TDC. One of the most internationally recognized frameworks is the **National Educational Technology Standards for Teachers (NETS-T)** published by the International Society for Technology in Education (ISTE, 2008). Its first version was published in the year 2000 and establishes ICT standards that teachers must comply with. These standards include aspects relating to the use of ICT in the design, implementation and evaluation of learning experiences, as well as the improvement of professional teaching practice, among others.

Shortly after, Mishra & Koehler (2006) developed the TPACK model (Technological Pedagogical Content Knowledge), based on the concept of PCK (Pedagogical Content Knowledge) developed by Shulman (1986, 1987), adding knowledge of technology to knowledge of content and pedagogy.

In 2008, the first version of UNESCO's **ICT Competency Framework for Teachers** was published, the most recent update of which was published in 2018. This framework, which is mainly focused on primary and secondary school teachers, aims to be a guide for improving the use of ICTs that are available in schools, with the objective of improving student learning.

The **DigiLit Leicester** framework was published in the United Kingdom (Fraser et al., 2013) and focuses on secondary education teachers. The framework identifies six areas of TDC, including information seeking, evaluation and organization skills, as well as the use of DTs for communication, collaboration and participation, and for professional development.

Recently, the European Commission's *Joint Research Centre* published the **Digital Competence Framework for Educators DigCompEdu** (Redecker, 2017). This framework considers six areas of teacher work, including aspects such as professional engagement, digital resources, teaching and learning, assessment and the development of digital competence.

On a national level, the Spanish National Institute for Educational Technologies and Teacher Training published the **Common Framework for Teacher Digital Competence** (INTEF, 2017), using DigComp (Ferrari, 2013) and DigCompEdu (Redecker, 2017) as a primary reference. At a regional level, **the Catalan Education Department's Framework for Teacher Digital Competence** (Departament d'Ensenyament, 2018) is also noteworthy.

A timeline of some of the TDC frameworks developed around the world, as well as their corresponding updates (Figure 1) is presented below by way of summary. As it can be seen, the first ones emerged in the early 2000s. NETS-T for Teachers (ISTE, 2000) stands out as one of the most widespread frameworks today and it has continued to be updated over the years.

From 2006 onwards, new frameworks have been developed in various countries (TPACK in the United States, UNESCO standards, those of Turkey, Spain, France, Norway, etc.) and have begun to emerge in greater numbers. New frameworks are developed almost annually, though some of them are updates of previous versions (Education Department, 2016, 2018; INTEF, 2014, 2017, 2020; ISTE, 2008, 2017; UNESCO, 2011, 2018).

Despite the large number of frameworks which have been developed in the last 20 years, there has been no significant evolution of the dimensions that make up TDC. With some exceptions, in most cases, technological and pedagogical dimensions appear in addition to communication and collaboration, professional development, and ethical and safety aspects.

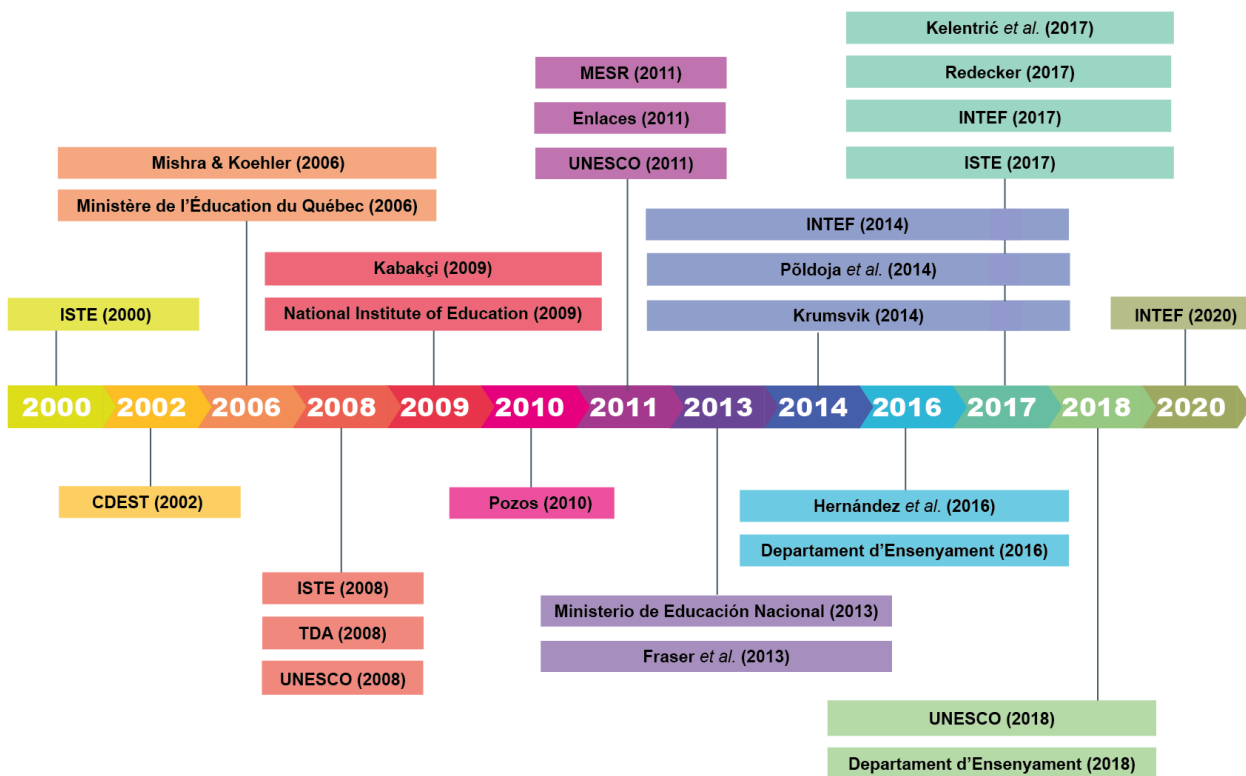


Figure 1. Timeline of TDC reference frameworks

Taking most of the previous frameworks as references, Lázaro & Gisbert (2015) developed **COMDID**, a rubric for assessing TDC. COMDID evaluates TDC based on a series of indicators, which are classified into dimensions, areas, and development levels. These frameworks are established within the context of teaching practice, which makes it a particularly useful tool for assessment and certification.

The following table shows the relationship between the COMDID dimensions and the dimensions and areas of some of the most prominent national and international TDC frameworks.

Table 1. Comparison between the dimensions of COMDID and those of other frameworks

COMDID (Lázaro & Gisbert, 2015)	Departament d'Ensenyament (2018)	Marco Común de la Competencia Digital Docente (INTEF, 2017)	DigCompEdu (Redecker, 2017)	UNESCO (2018)	NETS-T (ISTE, 2008)	DigiLit Leicester (2013)
D1. Didactic curricular and methodological aspects	D1. Design, planning and didactic implementation	A1. Information and informational literacy A3. Digital content creation A5. Problem solving	A3. Digital pedagogy A4. Evaluation and feedback A5. Student empowerment A6. Facilitating student digital competence	1. Understanding DT in educational policy 2. Curriculum and assessment 3. Pedagogy 4. Digital skill application 5. Organization and administration	1. Learning and creativity of students 2. Learning experiences and assessment in the digital era 3. Working and learning in the digital era 4. Digital citizenship and responsibility	1. Searching, evaluating and organizing 3. Assessment and feedback
D2. Planning, organization and management of digital technological resources and spaces	D2. Organization and management of digital technological resources and spaces	A3. Digital content creation A5. Problem solving	A2. Digital resources	3. Pedagogy 4. Digital skill application 5. Organization and administration	3. Working and learning in the digital era	
D3. Relational aspects, ethics and security	D3. Communication and collaboration	A2. Communication and collaboration A3. Digital content creation A4. Safety	A1. Professional commitment A5. Student empowerment A6. Facilitating student digital competence	4. Digital skill application 6. Professional development	3. Working and learning in the digital era 4. Digital citizenship and responsibility	2. Creating and sharing 4. Communication, collaboration and participation 5. Safety and digital identity
D4. Personal and professional	D5. Professional development	A2. Communication and collaboration A3. Digital content creation A5. Security	A1. Professional commitment	6. Professional development	5. Professional growth and leadership	2. Creating and sharing 4. Communication, collaboration and participation 6. Professional development based on TD

Taking the relationship between the different proposals into account, we can conclude that the COMDID assessment framework is a suitable reference for the assessment and certification of TDC because its dimensions are aligned with those proposed in the most prominent national and international frameworks.

Figure 2 details the correspondence between the dimensions of COMDID and those of the other reference frameworks. Each dimension is illustrated as a battery, divided into different parts, corresponding to the key concepts that make up the dimension. In turn, each line of the battery represents a different framework, so that the number of key concepts covered by each of the frameworks can be clearly observed.

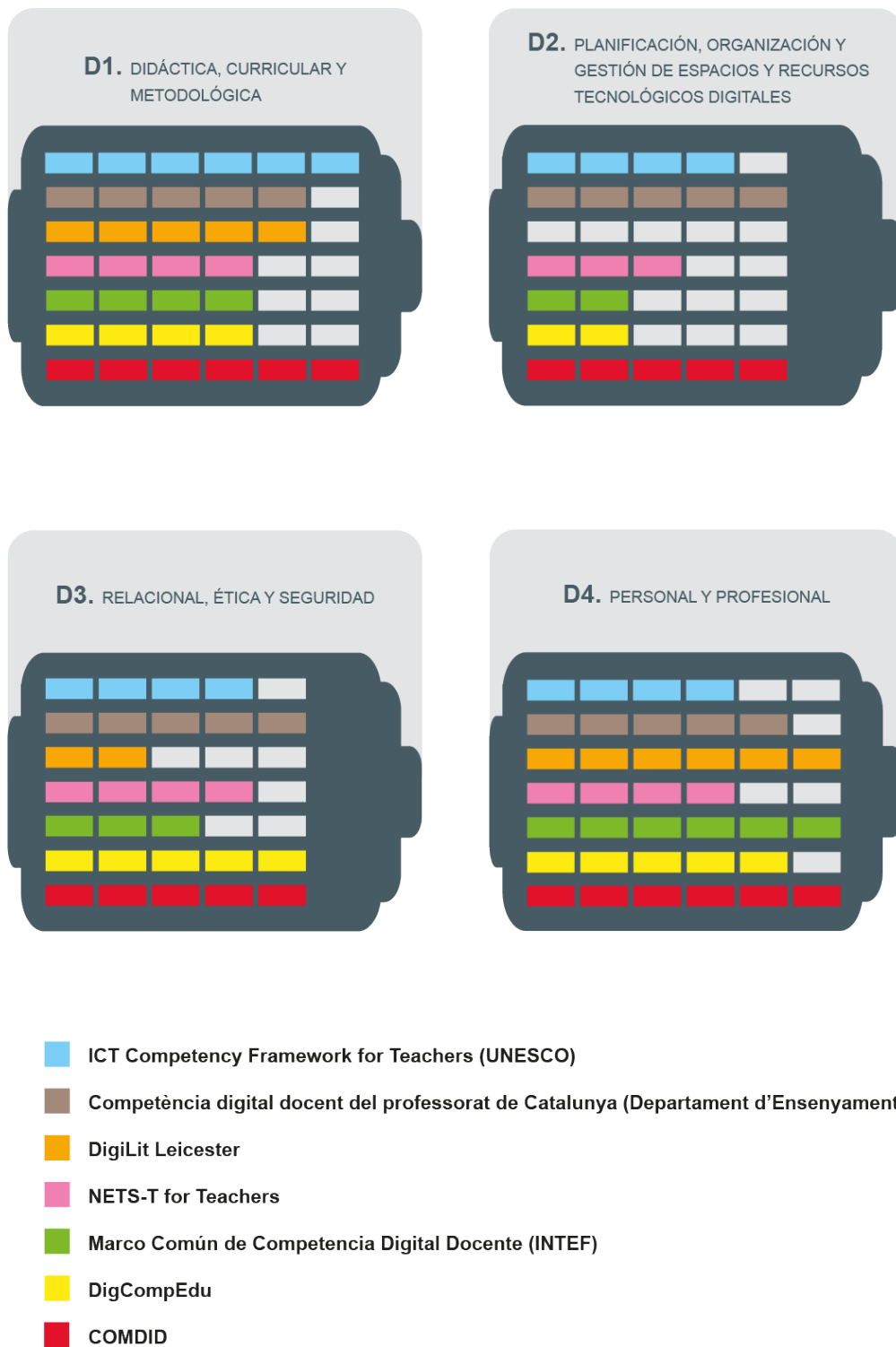


Figure 2. Relationship between the key dimensions of COMDID and the concepts included in other frameworks

As it can be seen above, not all the frameworks include each of the key concepts established in the COMDID dimensions. This is precisely one of the major strengths of the tool, since each of its dimensions offers a series of aspects that are not included in other frameworks.

- There are a wide variety of models and frameworks worldwide to characterize TDC.
- No significant evolution has been found in relation to the TDC areas in the frameworks developed over the years.
- The dimensions of the COMDID framework are aligned with those of the most prominent frameworks.

How is TDC being evaluated?

Assessment of teaching competences should be based on a shared understanding of what competences teachers require (for example through a national framework of teaching competences) so that there is general agreement on what should be assessed (Caena, 2013).

Several TDC assessment tools have been developed in recent years based on various national and international frameworks. These tools have aimed to specify the aspects to be assessed in teachers' digital competence at different educational levels. However, most of these instruments are based on a subjective, self-perceived assessment of TDC and are therefore not very adequate and reliable for developing a TDC certification system.

The following figure shows some of the existing assessment tools and the TDC frameworks on which they are based.

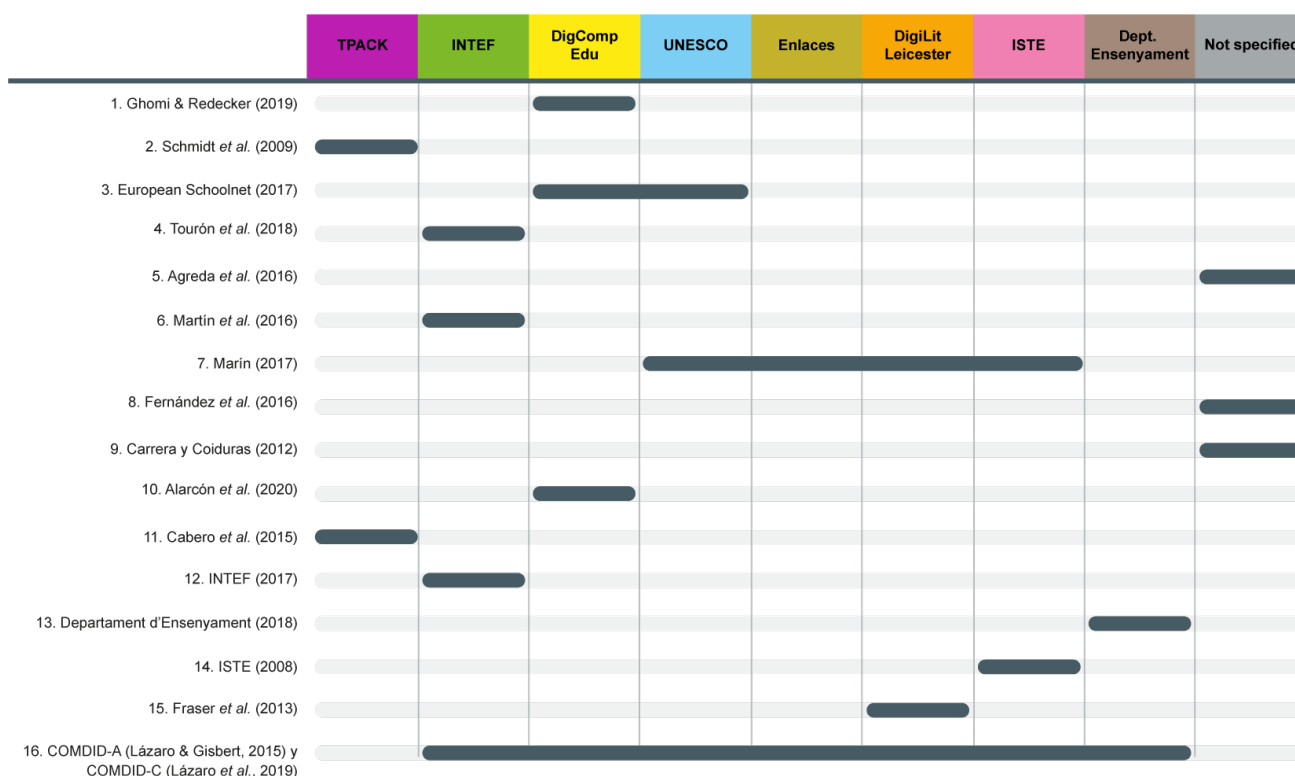


Figure 3. CDD assessment tools and the frameworks they are based on

Some of these instruments are a part of the TDC frameworks (Departament d'Ensenyament, 2018; Fraser *et al.*, 2013; INTEF, 2017; ISTE, 2008), others are directly linked to a frame of reference, although they were

published later (Ghomi & Redecker, 2019; Schmidt et al., 2009), and the rest have been developed by other authors or entities based on one or more existing frameworks (Agreda et al., 2016; Alarcón et al., 2020; Cabero et al., 2015; Carrera & Coiduras, 2012; European Schoolnet, 2017; Fernández et al., 2016; Marín, 2017; Martín et al., 2016; Tourón et al., 2018).

Finally, some instruments have also been developed, based on the COMDID rubric: COMDID-A is a self-perceived assessment of TDC (Lázaro & Gisbert, 2015), which has a version for teachers in training and a version for practicing teachers; and COMDID-C (Lázaro et al., 2019) is a TDC assessment tool aimed at teachers in initial training. Unlike the rest of the tools, it provides the possibility of an objective evaluation, which is based on resolving small cases through a series of multiple-choice questions. COMDID stands out for having a more solid base in terms of the national and international references that have been considered for developing it.

To identify the elements that the COMDID tool has in common with the other TDC assessment instruments, we compared the aforementioned assessment instruments with respect to the key concepts assessed in COMDID (Figure 4). The instruments are numbered from 1 to 15, as shown in Figure 3, indicating the key concepts of COMDID that are considered in each instrument.

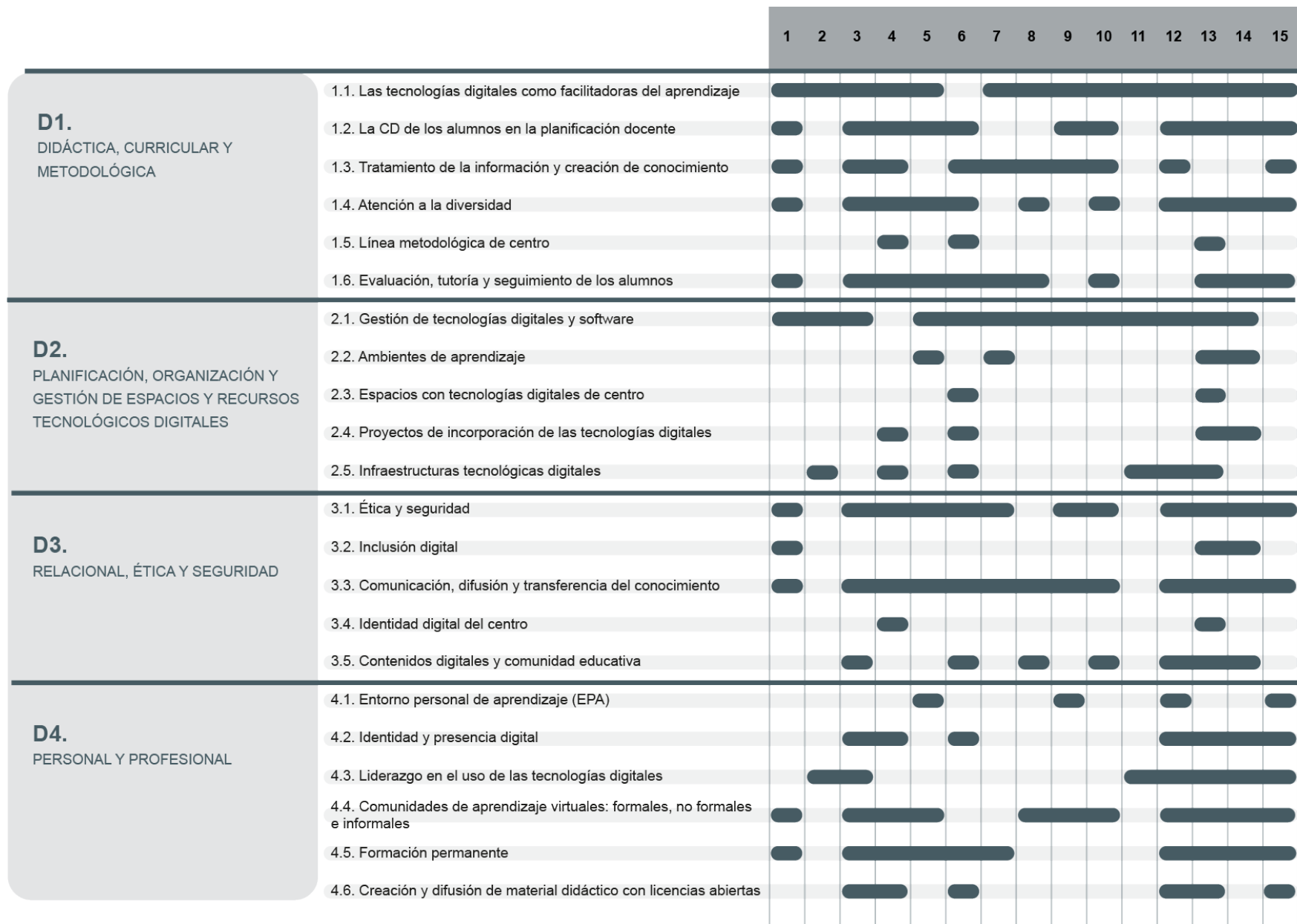


Figure 4. Relationship between the key concepts of COMDID and those of other assessment tools

Firstly, it should be taken into consideration that each of these instruments was developed for a specific purpose and for a specific educational level and/or context; therefore, this analysis does not question the suitability of each instrument for their initial purpose.

It is notable that many of these instruments focus on aspects related to instrumental competence, such as knowledge and management of digital tools, leaving pedagogical competence in the background, which would focus on the application of these skills and knowledge in a specific teaching task.

Of all the TDC assessment instruments analyzed, COMDID shows an assessment which is more oriented towards pedagogical competence, integrating aspects related both to the classroom and the educational institution. Other items included in COMDID, which in general are not covered by the other instruments, are those relating to digital inclusion, digital identity, personal learning environments, leadership in using ICTs and the creation and distribution of didactic material, among others.

However, if we analyze the different proficiency levels of development proposed in the assessment instruments, some assessment tools of self-perception, such as DigCompEdu establish levels of development that emulate those of the Common European Framework of Reference for Languages (A1, A2, B1, B2, C1, C2). However, COMDID makes a more simplified proposal with four development levels (beginner, intermediate, expert and transformative), which makes the task of assessing TDC simpler. TDC is more complex to assess than languages due to the very small difference between one level and another.

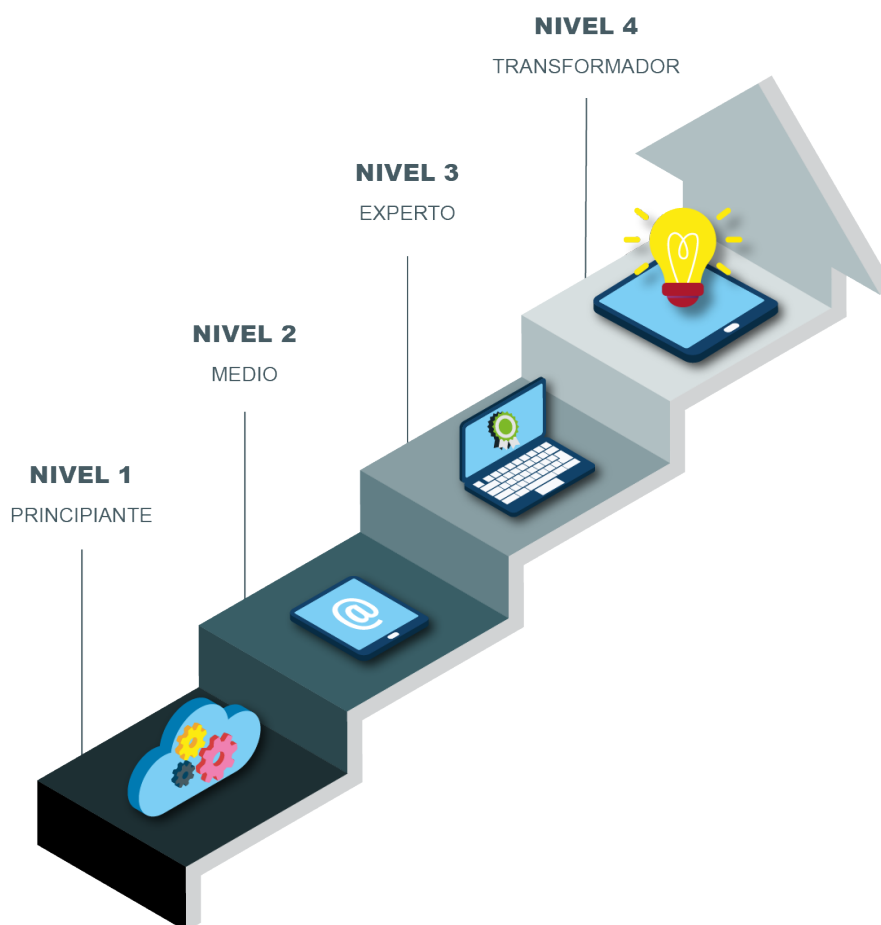


Figure 5. Levels of COMDID development

COMDID-A and COMDID-C

Both COMDID-A (self-perceived assessment) and COMDID-C (objective assessment) have been used in recent years to collect data on the self-perception and evaluation of the TDC of undergraduate education students throughout Catalonia (Appendix 1), yielding results that reaffirm that teachers in their initial training stage need education in TDC.

First year undergraduate students take the COMDID-A self-assessment test, while the COMDID-C test is administered to second- and fourth-year students. Second-year students receive specific training in TDC through a subject that is worked on transversally in all activities, while fourth-year students receive "unstructured" training in TDC, carried out by various centers where application of DT is quite heterogeneous.

In the test for objective evaluation (COMDID-C), the group which received specific training in TDC obtained a mean score of 7.7 out of 10, passing the test and obtaining the expected result (79.4% of all students obtained a score of 7 out of 10, which was the necessary passing score). It must be noted that the students did the test in their second year of training (after their internship period).

However, fourth-year students who had not received specific TDC training did not pass the test, obtaining a mean score of 6.9 out of 10. In this case, only 55.3% of students obtained a score over 7; therefore, nearly half of these students would not obtain a certificate that accredited them with having achieved the basic level of TDC.

In the self-perception test, the means exceed the pass mark in all dimensions, indicating that, in general, the self-perception of the TDC level of the first-year students is higher than the results of the objective assessment taken by the second- and fourth-year students. This could be because students perceive themselves to be more competent than they actually are.

These results serve to confirm the importance of initial TDC training for teachers and the need to continue to work on developing a certification tool for determining their TDC level as well as guaranteeing that this competence has been developed at the end of undergraduate studies.

- **Most of the instruments developed measure self-perception of TDC.**
- **In general, emphasis is placed on instrumental competence, leaving the pedagogical dimension in the background.**
- **COMDID-C focuses on pedagogical competence and provides an objective assessment tool.**
- **Self-perceived assessment (COMDID-A) is always higher than knowledge assessment (COMDID-C).**
- **Specific TDC training is required to pass the COMDID-C test.**

How is TDC being certified?

Recently, the Spanish Ministry of Education and Vocational Training published the Resolution of 2 July 2020, of the General Management of Evaluation and Territorial Cooperation, by which the Agreement on the Sectorial Conference of Education within the framework of TDC was published, which stresses the need to establish a coordination mechanism with all Spanish Autonomous Communities in order to facilitate mutual recognition of TDC certifications. To do this, the Autonomous Communities should use the reference framework as the basis for developing the TDC certification procedures.

On the other hand, in the Catalan context, one of the lines of action of the Catalan Plan for Digital Education 2020-2023 is the lifelong learning of teachers and coordination with universities in order to establish mechanisms for the accreditation of new teachers, as well as for recognizing and evaluating the TDC of active and new teachers, so that it becomes a requirement for entering the teaching profession.

In order to achieve these objectives, it is necessary to develop instruments for TDC accreditation that, in the words of Gisbert et al., "contribute to a transparent, global and efficient certification process from the point of view of the use of material, time and human resources" (2016, p. 80).

Most of the existing certification tools at the European level have been developed for digital citizenship competence, while only a few specifically assess TDC (Taddeo et al., 2016), and those that do, again focus entirely on instrumental aspects.

On a national level, there are several certifications for DC, such as ACTIC in Catalonia, CODIX in Galicia, TuCertiCyL in Castilla y León and the Accreditation of Digital Competences in Asturias. On an international level, there are certifications such as IC3 Digital Literacy Certification, developed by Pearson; I-SKILLS, aimed at students and designed by the Educational Testing Service (ETS); ECDL (European Computer Driving License), a European system for accrediting digital citizen competence; and the *Certificat informatique et internet C2i*, the national certification of digital competencies of students in France.

The following are some certifications specifically related to TDC:

- **Microsoft Certified Educator** is a certificate created and offered by Microsoft as part of the Microsoft Certified Educator (MCE) program, which is based on UNESCO standards and is aimed at both practicing teachers and teachers in initial training. It evaluates the skills that allow teachers to use ICT in order to be an effective educator and facilitate certain student skills (collaboration, communication, self-regulation, problem solving, innovation and use of ICT tools).
- **Google for Education certificates.** Google offers two levels of certification for teachers. The level 1 certificate recognizes the standard skills for implementing digital technologies in education, while level 2 validates advanced skills for technological integration. Both levels are oriented towards using Google tools in the educational field.
- **Apple Teacher** is a free learning program offered by Apple for using their tools in education. It is addressed to kindergarten, primary and secondary school teachers and establishes various badges, which are obtained by overcoming a series of interactive questionnaires. Teachers get the Apple Teacher official certificate when they achieve six iPad or Mac badges.

- **ECDL / ICDL for Teachers (ICT in Education)** is an ICDL Professional module aimed at practicing teachers and teachers in initial training. Its contents are related to key concepts and skills for the pedagogical use of ICT.
- **EIPASS Teacher** is a certification program for digital skills. It is aimed at practicing teachers at all levels of education in Italy, and is based on the UNESCO ICT competency framework for teachers. The exam modules relate to topics such as digital content creation, virtual classrooms, good practices with ICT and the use of ICT for inclusion, among others.
- **EUN Academy** is a series of open digital badges, earned by taking a series of MOOCS offered by European Schoolnet, and is aimed at both practicing teachers and teachers in initial training. These MOOCS are related to innovation in teaching through technology.
- **ISTE Certification for Educators** is a certification offered by the International Society for Technology in Education (ISTE) based on the TDC standards established by ISTE and is aimed at practicing teachers. This certification focuses on the use of technology to transform learning and must be obtained through hybrid or online training.
- **Certificat Informatique et Internet, Enseignant (C2i2e)** is an IT and Internet certificate for teachers, developed by the French Ministry of Education, which focuses on the professional competences related to the educational use of ICT. It includes general competences related to the exercise of the profession and skills for integrating ICT in teaching practice.
- **TDC certification tool for university teachers (Durán, 2019):** This certification tool was developed in a doctoral thesis related to the digital competence of university teachers and is based on the digital competence model developed by Prenses (2010). The test covers nine areas of TDC: technical, informational, communication, privacy and security, content creation, teacher professional development, curriculum design and development, university management, and research and innovation.

Annex 2 details the TDC content included in each of the previous certifications.

After reviewing these certifications, it is clear that most of them revolve around the instrumental dimension of competence, which was also the case with the instruments for self-perceived assessment. Another important aspect is the lack of a clear link between the certifications and the evaluation instruments analyzed in the previous section. Furthermore, it is worth noting that several of them are based directly on the TDC frameworks, while others are not supported by a sufficiently solid framework or have no model or framework at all.

Finally, it is important to emphasize that most of the certifications found in relation to TDC are the result of the initiative of private companies or organizations, with very few initiatives stemming from public entities.

- **At national and regional levels, coordination mechanisms have begun to be established to facilitate the certification of TDC.**
- **Very few specific certifications have been found for TDC, with most of them being the initiatives of private companies or organizations and lacking a sufficiently solid base.**

Conclusions and future directions

Of all aspects discussed in this report it is worth highlighting that, although the last two decades have produced numerous TDC frameworks and reference models on a worldwide scale, there is still no consensus on the definition of this competence or on its assessment and certification. Most of the instruments aimed at measuring the TDC level have been found to determine self-perceived assessment and are mainly focused on instrumental competence. However, the few existing certifications for TDC are mostly the initiative of private organizations and lack a solid foundation.

The need to evaluate and certify TDC

Considering that teachers work in a digital society, they "must have the skills that will enable them to perform their profession effectively" (Cela-Ranilla et al., 2017, p. 404). Therefore, certification, as the last part of the training process for developing TDC in degrees in education, is a key aspect that will make it possible to recognize this competence and make it visible, as well as highlight its importance, both in initial teacher training and in the continuing education of practicing teachers. The training of teachers in TDC is essential, as they need sufficient mastery to enable them to incorporate these skills into their education activities in order to contribute to the development of the students' digital competence (Carrera & Coiduras, 2012).

In the field of initial teacher training, universities have the responsibility to guarantee an initial level of DC so that, when students are completing their degree, they become digitally competent teachers. In this regard, there is still a long way to go for the unification of TDC in the curricula of master's degrees, since TDC is treated unequally in the curricula of the different universities (Sánchez et al., 2017). This curricula unification, as well as requiring and validating TDC at the end of the degree, is precisely one of the priority actions proposed by Domingo-Coscollola et al. (2019) for developing TDC in teacher certification.

Moreover, Educational Administrations should require this competence in order to access educational training as well as ensure that it is constantly updated (Gisbert, 2017). Nevertheless, in order for these conditions to be fulfilled, further conditions are necessary: first, the development of adequate planning of both initial and ongoing training, as well as reliable evaluation tools; and second, a process of certification for the objective evaluation of TDC, as well as the creation of an official certificate in the form of an administratively recognized document.

COMDID-C: an instrument for evaluating TDC

One of the primary needs relating to DC during initial teacher training is methodological knowledge related to DT (Domingo-Coscollola et al., 2019). In line with this, and as has been expressed in the previous analysis, COMDID (Lázaro & Gisbert, 2015), unlike the other analyzed frameworks and tools, has been shown to take the methodological and professional dimension of TDC into account. Furthermore, it has been shown that there is a clear correlation between the dimensions of COMDID and those of the main frameworks of TDC (Table 1). It can therefore be stated that it is a consistent tool for evaluating this competence.

The COMDID-C instrument (Lázaro et al., 2019) specifies the COMDID model (Lázaro & Gisbert, 2015) into an evaluation tool for teachers in initial training, in a way that makes it possible to identify whether the teacher is qualified according to the first TDC development level, and therefore, if they have the minimum qualifications for carrying out their educational practice in the education system.

Future directions

In order to achieve digitally competent teachers, and based on the evidence (Usart, 2020), it is necessary to create opportunities for professional development in the digital realm that promote the development of TDC in learning communities.

Therefore, teachers in Spain are key actors in the successful application of DT. This refers to the specific training in digital technologies and tools, as well as an increase in specialized technical support and policies about specific devices. However, most importantly, we are talking about initial training in which TDC is developed consciously from the beginning stages of the educational degree, so that the competence is developed formatively, aiding the reflection, evaluation and certification of new teachers, always before they begin their teaching tasks.

In order to ensure that teachers develop an adequate TDC level, university training must be complemented with training in specific professional contexts through collaboration between universities and schools. Therefore, teachers in initial teacher training will be able to put their knowledge and abilities into practice in real contexts.

Finally, a unification of all formative university programs and evaluation strategies in relation to TDC is necessary to ensure that students can successfully complete the evaluation and certification process when they finish their degree.

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Annex 1: Results for the self-perceived evaluation and the objective evaluation of TDC in students of education degrees in Catalonia.

Report of the results in the application of COMDID tools
Tarragona, November 2020.

COMDID-A description (SELF-EVALUATION)

Test for pre-service and in-service teachers. It is a self-perceived assessment test based on the user's own perception of their ability to cope with certain situations. It comprises 22 questions or items and the estimated time for taking the test is about 15-20 minutes, an indicative maximum time of 30 minutes could be set to answer all the questions and send the questionnaire. The test has formative value because once it is completed, the user receives a report on their level of competence, overall and by dimensions, as well as recommendations for improvement.

COMDID-C description (OBJETIVE EVALUATION)

COMDID-C is a test for the objective evaluation of the user's knowledge in relation to TDC. The test is made up of 88 multiple-choice questions based on resolving "micro-cases" or problems which are inherent to the teacher's professional function. Administrating the test takes between 50 minutes and an hour. Once the test is completed and the user submits the test, they receive immediate feedback by e-mail with the overall test result and sorted by TDC dimensions. In addition, the test offers a report on whether the test-taker is fit or unfit, based on what is defined in the first level of TDC development (novice teacher). This test measures the level required to access the system and is the tool that should be used to certify (by the universities) that the students of the teaching degree, once they have finished their studies, have the level they need to be accredited by the Department of Education of Catalonia (2025).

COMDID-A / COMDID-C publications:

- Grimalt-Álvaro, C., Usart, M., & Esteve-González, V. (2020). La Competencia Digital Docente desde una perspectiva de género. Estudio de caso en el máster interuniversitario de tecnología educativa. In R. Roig-Vila (Coord.), J. M. Antolí & R. Díez (Eds.), *XARXES-INNOVAESTIC 2020. Llibre d'actes / REDES-INNOVAESTIC 2020. Libro de actas*(pp. 41-43). Universitat d'Alacant. ISBN: 978-84-09-20651-3. <https://web.ua.es/es/ice/redes-innovaestic2020/documentos/libro-de-actas-2020.pdf>
- Lázaro Cantabrana, J. L., Usart Rodríguez, M., & Gisbert Cervera, M. (2019). Assessing Teacher Digital Competence: the Construction of an Instrument for Measuring the Knowledge of Pre-Service Teachers. *Journal of New Approaches in Educational Research*, 8(1), 73-78. <https://doi.org/10.7821/naer.2019.1.370>

Reliability and validity:

COMDID-A

- **Validated language:** Catalan
- **Sphericity test and KMO:**
 - KMO=0.952
 - Bartlett's sphericity: 2263.07, gl=231, Sig.=0.00
- **Reliability:**
 - Cohen's alpha for each scale:
 - D1) Didactics, curricular and methodological = 0,906
 - D2) Planification, organization and management of ICT spaces and resources = 0.885
 - D3) Relational, ethics and safety = 0.889
 - D4) Personal y profesional = 0.884

COMDID-C

- **Validated language:** Catalan
- **Test type:** TRN (selfevaluation in 22 items, levels 1 to 10, with 4 dimensions)
- **Reliability:**
 - **Cohen's Kappa:** $k = 0.603$ ($p \leq .005$, $n = 25$ categories).
 - **Livingston's Coefficient:** $k_2 = 0.723$ ($p \leq .005$, $n = 25$).

Status of the current data collection through the ARMIF project:

COMDID-A

- **Year 18-19: 1144**
- **Year 19-20: 750**
 - URV: 105
 - UVIC: 91
 - URLL: 88
 - ULL: 223
 - UdG: 23
 - UdA: 19
 - UAB: 201
- **Year 20-21: 490**
 - URV: 140
 - UVIC: 107
 - UdG: 212
 - UAB: 24
 - ULL: 7

COMDID-C

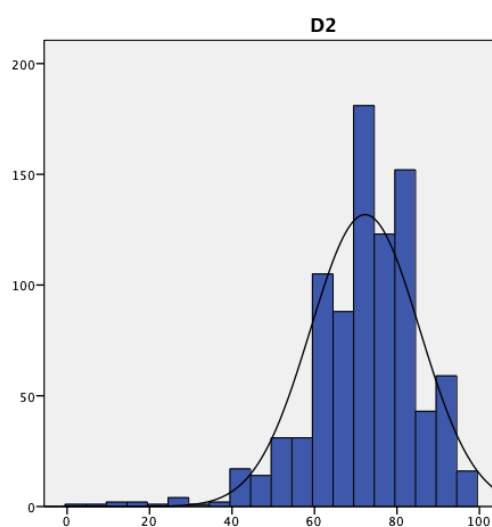
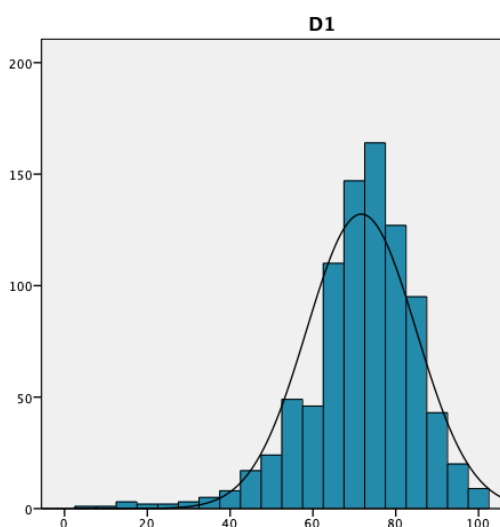
- **Year 19-20:**
 - URV: 184 resultados
- **Year 20-21:**
 - UVIC: 133 resultados
 - URV: 103 resultados

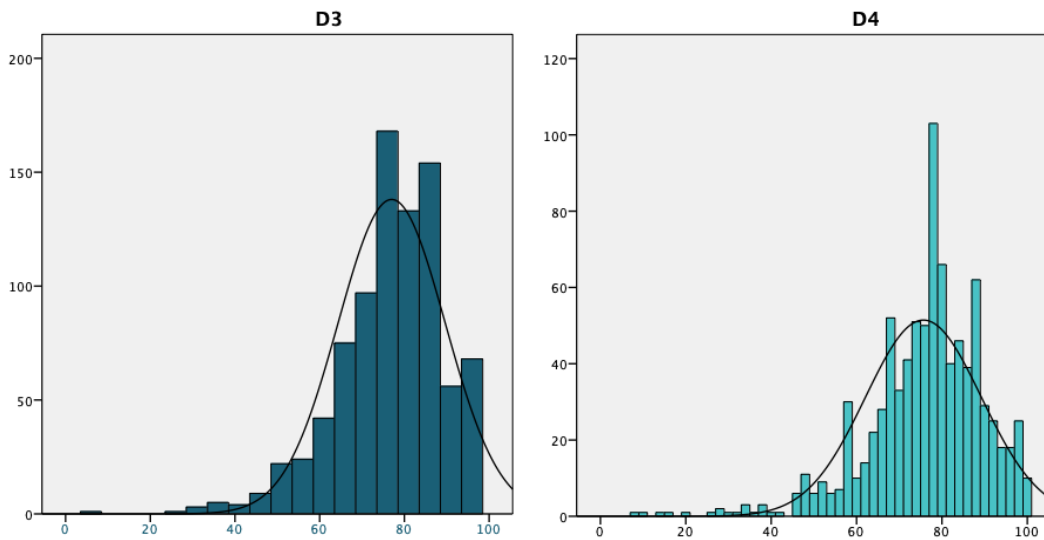
COMDID-A mean for the last 3 years (ARMIF):

	D1. Didactic, curricular and methodological aspects	D2. Planning, organization and management of digital technological resources and spaces	D3. Relational, ethics and security aspects	D4. Personal and professional
Mean 2018-19	71.88	72.40	77.07	75.80
Standard deviation	13.33	13.29	12.65	13.69
Mean 19-20	71.61	72.31	77.48	75.92
SD	12.68	12.54	12.11	13.05
Mean 20-21	79.00	79.55	85.71	83.09
SD	11.11	10.69	9.54	10.12

Demographical data:

	Age	D1 Didactical	D2 Planning	D3 Relational	D4 Personal
Mean	19.41	71.88	72.40	77.07	75.80
St. deviation	3.347	13,332	13.287	12.650	13.690
Variance	11.200	177.731	176.537	160,021	187.418
Minimum	17	5	2	6	8
Maximum	57	100	100	100	100
Skewness	6.053	-1.029	-1.110	-.925	-1.220
SE of skewness	.079	.079	.079	.079	.079
Kurtosis	53.120	2.461	3.109	1.769	3.260
SE of kurtosis	.159	.159	.159	.159	.159





COMDID-C evaluation means (URV):

Mean	72.11	83.83	74.70	58.75
SD	11.49	9.781	9.05	10.47

Second year group with specific training for each dimension:

	D1	D2	D3	D4
Mean	73.14	87.01	77.08	70.55
SD	11.82	89.53	13.21	12.70
Min	41.08	66.70	42.60	43.83
Max	88.92	100	97.50	93.75

This group was created specifically for TDC. During the second year of their university studies, students carry out a specific and mandatory 12 ECTS subject: "Organization of school spaces, materials and teaching abilities". This subject is carried out throughout the entire academic year with an ABP methodology. TDC is studied in cross-curricular way throughout all the activities that are carried out by the students. The mean grades for TDC are high and over 70% (passing limit).

Groups without training, only with internships in educational institutions:

	D1	D2	D3	D4
Mean	66.91	80.73	68.56	62.47
SD	13.95	13.92	14.38	12.99
Min	32.08	37.60	31.80	34.83
Max	97.92	100	100	93.75

In this case, even though the students are in their last year, the means in all four dimensions range between 62% and 80%, they "fail" in three dimensions and the results are lower overall in relation to the self-perception of new students. **This could be strongly related to the fact that TDC training has been carried out in an "unstructured" way for the older students, leaving it to be developed in the practice internship periods in the schools, which use DT heterogeneously.**

Annex 2: Contents in each of the TDC certifications

Certification	Contents
Microsoft Certified Educator	<ul style="list-style-type: none"> • Educational policy • Curriculum and evaluation • Professional development • ICT tools • Pedagogy • Organization and administration
Google for Education certificates	<ul style="list-style-type: none"> • Educator Level 1: Standard skills for technology use • Educator Level 2: Advanced skills for technology integration
Apple Teacher	<ul style="list-style-type: none"> • Skills for iPad use in education • Skills for Mac use in education
ECDL / ICDL for Teachers (ICT in Education)	<ul style="list-style-type: none"> • Key concepts <ul style="list-style-type: none"> ◦ Benefits ◦ Pedagogy and ICT • Planning <ul style="list-style-type: none"> ◦ Class planning ◦ Security, protection and well-being • ICT selection <ul style="list-style-type: none"> ◦ ICT tools for teaching and learning ◦ ICT tools for evaluation ◦ Supply and evaluation of ICT resources • Management of learning environments <ul style="list-style-type: none"> ◦ Class technologies ◦ Learning platforms
EIPASS Teacher	<ul style="list-style-type: none"> • Digital content creation • Virtual classes • Byod, eLearning and computational thinking for innovative teaching • Best practices: ICT integration, educational software and electronic registry • ICT for inclusion • Crowdfunding
EUN Academy	<ul style="list-style-type: none"> • Classroom future scenarios • Innovative practices to involve STEM teaching • How to teach computer science: introduction to concepts, tools and resources for secondary school teachers • Competences for XXI century schools • Creative use of tablets in schools • Introduction to better teaching through technology • Introduction to computer science in the classroom • ...
ISTE Certification for Educators	<ul style="list-style-type: none"> • Design for diversity • Personalized learning • Digital learning environments • Digital citizenship
Certificat Informatique et Internet, Enseignant (C2i2e)	<ul style="list-style-type: none"> • General teaching competences <ul style="list-style-type: none"> ◦ Professional digital environment control ◦ Development of competences for life-long learning ◦ Professional responsibility in the framework of the education system • Key abilities for ICT integration in teaching practice <ul style="list-style-type: none"> ◦ <i>Networking</i> through the use of collaborative work tools ◦ Design and creation of didactical contents and learning situations ◦ Educational implementation ◦ Implementation of evaluation procedures
TDC certification tool for university teachers (Durán, 2019)	<ul style="list-style-type: none"> • Technical area • Informational area • Communication area • Privacy and security • Content creation • Professional teacher development • Curricular design and development through the use of ICTs • University management • Research and innovation

