Digital competence profiles of first-year, initial training students. Analysis in the Catalan university system.

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Like many other countries around the world, Catalonia is currently facing an urgent need for digitally competent teachers. Training future teachers in digital competence (DC) is one way to address the problem and finally improve the digital education of future citizens. In order to reach this goal, this paper aims to study the profile of initial training students and the factors related to teacher DC. A cluster analysis of 947 first-year students from 6 Catalan universities resulted in 3 different student groups: confident (n = 525), average (n = 311), and realistic (n = 111). These profiles show that future Catalan teachers have, in general, a high self-perception of teacher DC at the beginning of their teacher training. Our findings have implications for enhancing future teachers' perceptions of their own DC, by guiding them during the process of teacher training and formative assessment. The study also highlights the need for all Catalan universities to develop a critical perspective that takes into account key factors when designing and implementing DC training for teachers in the curriculum. This will allow us to come up with joint proposals.

Keywords: Pre-service teacher, teacher digital competence; digital technologies, teacher competencies

Introduction

Within the digital competence (DC) framework DIGCOMP 2.0 (Vuorikari, Punie, Carretero-Gómez &Van den Brande, 2016), the European Union urges people to adapt to the ongoing digitalization of society, and highlights the importance of developing citizens' DC and, specifically, fostering a critical vision of this complex competence (Mannila, Nordén & Pears, 2018). In this regard, the confident and critical use of Digital Technology (DT) is vital for participation in today's society (Ilomäki, Paavola, Lakkala & Kantosalo, 2016), where it is advisable to adopt a critical attitude in a context in which technical proficiency is prioritised. This study focuses on DC as one of the eight key competences defined by the European Commission (2007 & 2018). DC

can be broadly defined as the confident, critical and creative use of DT to achieve goals related to work, employability, learning, leisure, inclusion and/or participation in society (Ferrari, 2013). Likewise, the European Commission (2018) emphasizes that individuals should take a critical approach to DT and be aware of the legal and ethical principles involved in engaging with digital technologies.

As far as education is concerned, various international reports have shown the need to have well-trained and competent educators in an increasingly complex profession (Generalitat de Catalunya, 2018; INTEF, 2017; Redecker & Punie, 2017; Unesco, 2018). Training teachers in the field of digital technologies (DT) is a priority in the initial training of these professionals (Papanikolaou, Makri & Roussos, 2017; Sahlberg & Boce, 2010). The Education and Training 2020 Strategic Framework (European Union, 2009) highlights that teachers must have the necessary competencies for the digital age. Cuhadar (2018) states that the level of teacher digital competence (TDC) is intermediate or low. Claro and colleagues (2018) also highlight the need for teachers to be trained in digital competence. With this in mind, helping future teachers to become digitally competent as educators is crucial. Being aware of their self-efficacy in DC will allow (future) teachers to use DT not only in their own practice but, more importantly, to train future citizens who need to be digitally competent to participate in a highly digitalized society.

Teachers' level of competence in the use of DT is a relatively new term that appears in the scientific literature with different names, depending on the definition and framework of reference. In Nordic contexts, the term "teacher's professional digital competence" (Kelentric, Helland & Arstorp, 2017; Gudmundsdottir & Hatlevik, 2018) is used while in Spain and Latin-America "digital competence of educators" (Alarcón, Jiménez & Vicente-Yagüe, 2020) or "teacher's digital competence" (TDC) (Krumsvik,

Jones, Øfstegaard & Eikeland, 2016; Silva, Usart & Lázaro-Cantabrana, 2019) are the terms used. To avoid misconceptions, this latter term will be used from now on. In essence, "TDC is made up of a set of capacities, abilities and attitudes that the teacher must develop in order to incorporate DT into his or her professional practice and development" (Lázaro-Cantabrana, Usart & Gisbert-Cervera, 2019, p. 73). According to the standard proposed by (Lázaro & Gisbert, 2015) and used in several studies in Spain and South America (Lázaro, Sanromà, Molero & Gisbert, 2019; Silva et al. 2019), TDC is a sum of skills or sub-competencies divided into four dimensions or factors: Dimension 1: Curriculum, Didactics and Methodology; Dimension 2: Planning, Organizing and Managing Digital Technology Spaces and Resources; Dimension 3: Ethical, legal and security aspects; and Dimension 4: Personal and Professional development (see Figure 1).

These dimensions have been aligned with the two main frameworks in our context (see Table 1): those proposed by the Catalan government (Generalitat de Catalunya, 2018), and the European Framework for the Digital Competence for Educators, DigCompEdu (Redecker & Punie, 2017) which describe what it means for educators to be digitally competent.

Lázaro & Gisbert (2015)	**Generalitat de Catalunya (2018)**	**DigCompEdu (2017)**
D1. Didactic, curricular and methodological aspects	D1. Design, planning and didactic implementation	A3. Digital pedagogy A4. Evaluation and feedback A5. Students' empowerment A6. Facilitate students' digital competence
D2. Planning, organization and management of digital technological resources and spaces	D2. Organization and management of digital technological resources and spaces	A2. Digital resources

	D3. Communication and collaboration	A1. Professional commitment
D3. Relational aspects, ethics and security	D4. Ethics and digital civic mindedness	A5. Students' empowerment
		A6. Facilitate students' digital competence
D4. Personal and professional aspects	D5. Professional development	A1. Professional commitment

Table 1. Correspondence between the dimensions or areas of TDC

Studies on how to measure TDC share the point of view of self-efficacy; The Wayfind Teacher Assessment (Banister and Reinhart, 2012) is a self-assessment test for teachers; Selfie, a tool based on self-efficacy, applies the European Commission's DigCompEdu (Redecker & Punie, 2017) as a reference standard, however, this reference framework must be contextualized. In Spain, the TDC Portfolio (INTEF, 2017) is an assessment system for teachers based on the Common Framework standard of TDC. Based on this proposal, in Spain, Tourón, Martín, Navarro, Pradas and Iñigo (2018) developed an online self- questionnaire for assessing respondents' self-perception. Thus, it can be seen as a tool to guide (future) teachers in the process of becoming aware of their present competencies and to help them develop a higher level of TDC. According to different authors, teacher self-efficacy beliefs will determine their competence to engage with a task and it is crutial for their training (Lemon & Garvis, 2016; Alarcón, Jiménez & Vicente-Yagüe, 2020), However, the lack of studies on TDC self-efficacy in future teachers means that researchers have few results on the nature of future teachers' TDC profiles.

In this regard, although studies are scarce and mostly on training for secondary teachers (Napal-Fraile, Peñalva-Vélez, & Mendióroz-Lacambra, 2018), prior research has shown that there are relations between student variables and their TDC level. One of

the factors related to self-efficacy is gender. Stereotypes can influence self-perceived competence (Wang & Degol, 2017). Various studies state that girls and women tend to have a perception of lower digital competence (Björk & Hatlevvik, 2018; Hill, Corbett & Rose, 2010; Roig, Mengual & Quinto, 2015). Some studies, however, have found no significant differences among genders (Ayale & Joo, 2019). Therefore, we believe that it would be advisable to analyse future teachers' TDC in terms of gender. Students' age has also been studied in relation to TDC. Traditionally, young generations are considered to have greater competence in DT (Prensky, 2001; Vera, Torres & Martínez, 2014). However, studies on pre-service teachers show that younger students do not necessarily have a greater mastery of DT applied to teaching (Area, Hernández & Sosa, 2016) or that age only has an effect if mixed with other variables (Claro et al., 2018): for example, younger teachers with more years of teaching experience performed better than others. Finally, focusing on Spain in general, and Catalonia in particular, students in initial teacher training can choose between specialising in infant or primary education, or both (double degree). We believe that this is also related to TDC because infant and primary educators have different profiles that may influence their self-perceived level of TDC. The age of the children is a fundamental aspect that determines the digital competence of (pre-service) teachers; that is, the older their pupils are, the greater their competence (Generalitat de Catalunya, 2015), and infant education teachers usually report that they have lower TDC than their counterparts. Last but not least, there is another factor involved. Students access teacher education in Spain from two different routes: high school and vocational training. According to Chang (2016), some studies have dealt with this relationship in various countries, although more quality data is required about the age, gender and experience of the future teacher workforce. According to a study conducted in Norway, professional characteristics such

as a teacher's experience and ICT training predict teachers' level of digital competence in upper secondary school (Krumsvik, Jones, Øfstegaard, & Eikeland, 2016). Muhd and colleagues (2018) reported that teachers coming from vocational training may have less digital competence than those trained in different, more community-based disciplines. According to these studies, prior training in digital competence may be approached differently in high schools than in vocational education, where both training and assessment have a more practical standpoint. This is a factor, then, that should be taken into account.

In the light of all these studies, and given the lack of research into how demographic, personal and professional variables affect initial training TDC profiles, this study aims to shed light on the profiles of future teachers, and to help educational institutions and governments design future proposals on TDC development that can be adapted to different profiles.

The main aim of the present study is to explore the profiles of initial teacher training students in Catalonia, and to explore these profiles in terms of the factors mentioned: gender, age, access and type of studies.

In particular, we aim to answer the following research questions:

(1) Which digital competence profiles are identified among Catalan students on first-year teacher-training courses?
(2) Is there a relationship between these profiles and self-efficacy in digital competence among Catalan students on first-year teacher-training courses?
(3) Are there differences between students' TDC profiles in terms of gender, age, access and type of education?

Setting

In Spain, the training given to pre-service teachers depends on the pedagogical specialty they have chosen, the curriculum, and whether they are training to be teachers of infant education (0-6 years) or primary education (6- 12 years). In addition, they may have been admitted to university in any one of three different ways: (1) passing a university entrance exam after completing high school studies, (2) completing a vocational training course related to the teaching profession, or (3) passing a test for people over 25 years old. Within this framework, the ARMIF project was launched in 2018 with the main objective of reviewing and adapting the TDC evaluation tool developed in a previous project in order to design a certification model of TDC. In this context, COMDID-A was validated and represents the first step to achieving this goal.

Method

A non-experimental design was implemented by distributing an online instrument to measure the TDC of initial teacher training students. A descriptive analysis was carried out followed by a cluster analysis.

Participants

The data for this study comes from a larger prospective study on initial teacher training students in Catalonia (Spain), which is being conducted by all Catalan public universities with a degree in teaching training, one private university, the Open University of Catalonia (UOC), and the University of Andorra. Data was collected among first-year initial teacher training students from: Universitat Rovira i Virgili, Universitat d'Andorra, Universitat de Vic, Universitat de Lleida, Universitat de Barcelona, Universitat Autònoma de Barcelona, Universitat de Girona and Universitat Ramon Llull) between October 2018 and June 2019. Of the 1166 students who

answered the online questionnaire, 1030 completed all the items and were in the first year. After removing 83 individuals with missing values and outliers on the cluster variables, the final sample used for analysis consisted of 947 subjects. The distribution of male and female respondents was 19% and 81%, respectively. Their average age was 19.4 years (SD = 3.3), ranging from 17 to 45 years. Furthermore, 75.29% of the students had been admitted on the course after passing the Spanish university entrance exam, 23.65% had completed a course of vocational training, and only 1.06% had been admitted as students over the age of 25. As far as the specialization or type of education of these first-year students, 492 were studying to become infant teachers; 270 (28.51%) were studying to become primary education teachers, and 185 (19.54%) were studying the two degrees at the same time. This sample, although not random, is representative of Catalan first-year students because although the response rate from all universities was not the same, the gender, age and access distributions of respondents were in accordance with the national distribution of first-year pre-service teacher trainees in Catalan education (Generalitat de Catalunya, 2018). The study was ethically approved by the Catalan Government and the online questionnaire complied with all the ethical restrictions of Spanish Law.

Data collection

In order to measure TDC in our sample, an online questionnaire, COMDID-A, was distributed online to each of the nine universities participating in this study. This instrument had been developed and validated (Lázaro & Gisbert, 2015).

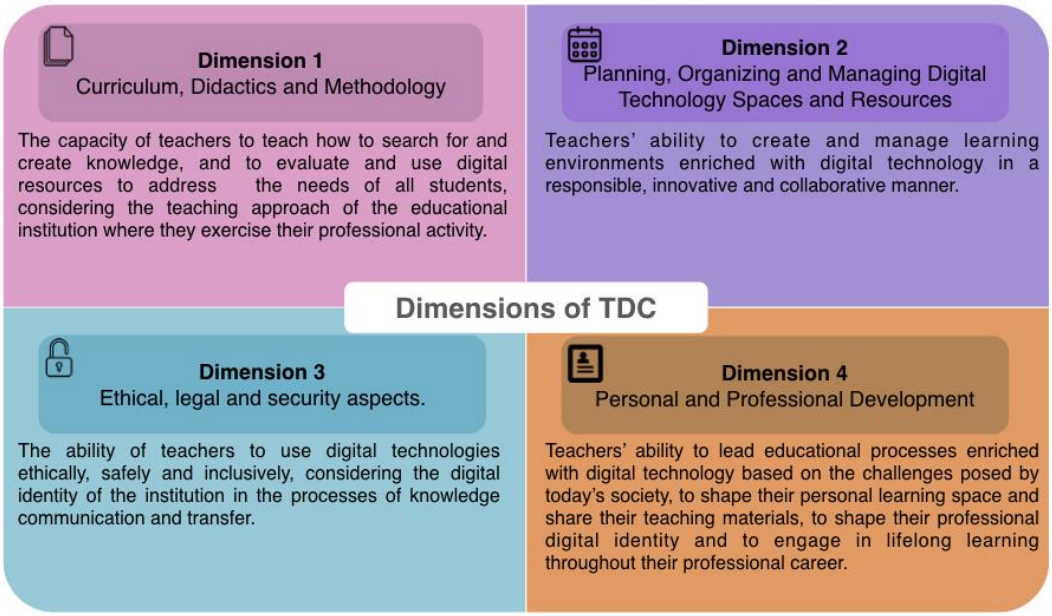

Figure 1. TDC dimensions (Silva, Usart & Lázaro-Cantabrana, 2019)

The final version contains 22 Likert-scale items (1: totally agree; 10: totally disagree), distributed among the 4 dimensions mentioned. One example of an item is the following: D3.2. *"I promote the access and use of digital technologies by all students with the intention of compensating for inequalities".* Finally, the instrument's structure was tested via Principal Component Analysis, and the internal reliability and external validity of the tool in relation to students' age, gender and access to university.

Data analysis

The dimensional structure and internal reliability of the COMDID-A for our sample was measured using CFA and Cronbach's alpha (α) coefficient (Dunn, Baguley & Brunsden, 2014), respectively. In particular, the goodness of fit of the model was first determined with absolute measures. The Chi-square test was used to contrast hypotheses (χ^2/DF, 4.983) with values between 2 and 5 indicating an acceptable fit; the most common comparative fit index (CFI, 0.937) was used to determine incremental fit with values

greater than 0.900 indicating a good fit (Hair, Black, Babin & Anderson, 2010.); and the root mean square error of approximation (CI RMSEA: 0.061 - 0.073) was also used with values below 0.08 indicating a good model fit for our sample size (Feinian, Curran, Bollen, Kirby & Paxton, 2008). These measures gave us enough information to accept the COMDID-A dimensions. The total internal reliability of COMDID-A was $\alpha = 0.96$, an excellent value. Likewise, the reliability of each of the dimensions was also good: D1, $\alpha = 0.87$; D2, $\alpha = 0.88$; D3, $\alpha = 0.84$; D4, $\alpha = 0.91$.

A cluster analysis was performed to identify natural categories for first-year, pre-service teacher trainees on the basis of their reported TDC. The questionnaire items described above produced a total of 22 possible cluster inputs, divided into 4 dimensions. To identify subgroups of pre-service teachers in terms of their TDC, a two-step clustering method was used (Hair et al., 2010). In general, this involves hierarchical clustering in the first stage. With the aid of an agglomeration schedule and a dendrogram, the number of clusters and cluster centres can be determined. In the second step, the cluster centres are used as the initial seed points in a non-hierarchical method. It is suggested that this two-stage method is more robust in that the k-means clustering method serves as a refinement of the clusters (Punj & Stewart, 1983). Furthermore, a k-means analysis was run to verify our results and similar groups emerged when forced to three clusters.

To test if there were any differences between the clusters in terms of the nominal variables – students' Gender, Access and Type of education – a chi-square (χ^2) analysis compared the column proportions of each response option with z-tests, adjusted by Bonferroni correction for p-values. For Age, an ANOVA test with a Bonferroni post-hoc test was also run; and effect size was calculated using Cohen's d (Durlak, 2009). Data analysis was conducted with the statistical software SPSS (V25).

Results

The following section presents the profiles identified among Catalan, first-year teacher trainees, their relationship with TDC levels, and profiles in terms of Gender, Age, Access and Type of education.

Three profiles of future teachers' TDC

Three clusters emerge: Cluster 1 (n = 525), Cluster 2 (n = 311), and Cluster 3 (n = 111). The three clusters significantly differed from each other for each TDC scale ($p < 0.001$). In particular, students in Cluster 1 reflect a "Highly competent and confident" profile, with the highest self-assessment on D3: Relationships, ethics and security and D4. Personal and professional. The third highest-scoring dimension is D2: Planning, organization and management, and the lowest is D1: Teaching curriculum and methodology. Cluster 2 individuals are more "Accurate" when self-assessing their PDC, and although they also see themselves as competent in D3 and D4, they score higher on D1 than on D2. Finally, Cluster 3 is the smallest, and shows a "lower self-competent" profile (see Figure 2) in which the students do not feel confident in D1 and D2.

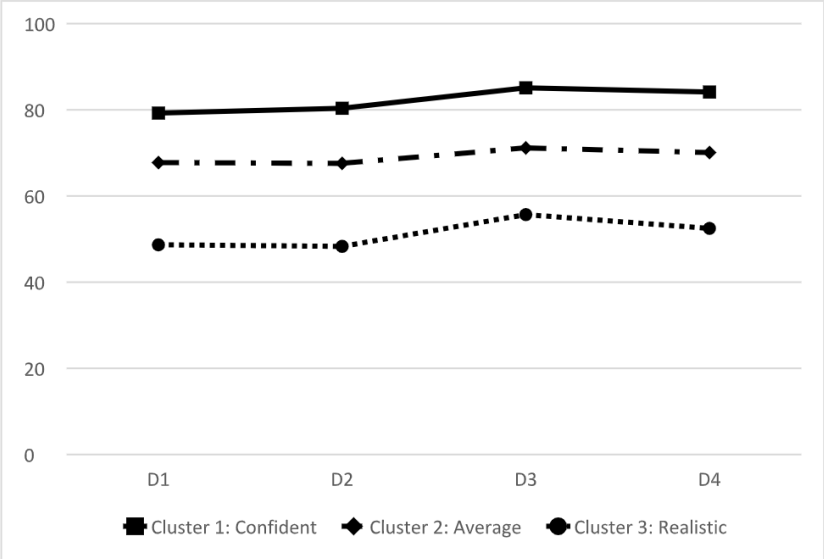

Figure 2. Mean-score profiles for the three types of TDC

Relation between students' TDC profiles and TDC dimensions

In order to test the differences between the three profiles of students, an ANOVA was conducted for each TDC dimension (D1-D4). The self-evaluation TDC profiles were entered as independent variables so that the four dimensions could be compared in each cluster. The ANOVA results shown in Table 2 reveal significant cluster effects ($p < 0.001$ for all the TDC dimensions). The differences are most significant for D3, and least significant for D1. However, the three groups of students differ significantly on all the dimensions of TDC. The results of the significance tests are presented in Table 2 and the partial effect sizes (Cohen's d) are shown.

Measure	Cluster 1 (Confident; n=525)	Cluster 2 (Average; n=311)	Cluster 3 (Realistic n=111)	F(3,947)	Cohen's d
D1, mean (SD)	79.24 (8.66)	67.75 (7.05)	48.67 (13.44)	592.37	1.72
D2, mean (SD)	80.36 (7.62)	67.57 (6.21)	48.31 (13.38)	797.28	1.98
D3, mean (SD)	85.10 (6.84)	71.16 (6.61)	55.68 (12.71)	807.64	2.16
D4, mean (SD)	84.13 (7.29)	70.08 (7.19)	52.48 (15.49)	717.94	1.98

*$p<0.001$

Table 2. Between-cluster differences for TDC dimensions

Differences between students' TDC profiles in terms of Gender, Age, Access and Type of education

The question of whether there were any differences between the clusters in terms of the

students' gender, access and type of education was tested by means of chi-square analysis with post-hoc tests, and the column proportions – of each response option – were compared with z-tests, adjusted by Bonferroni correction for p-values.

The ANOVA results for the Age variable show significant differences between groups 1 and 3 (effect size high) and 2 and 3 (effect size medium) but not between 1 and 2 (p = 0.213). This means that Cluster 3 students are older and more confident than the students in the other two groups (see Figure 3).

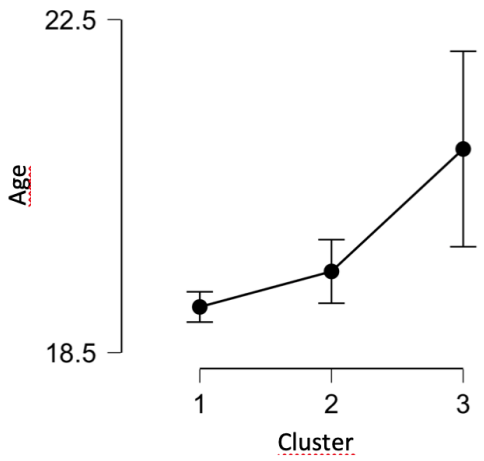

Figure 3. Age-mean distribution for the three clusters of our study

According to the Chi square test (χ^2), there are no statistically significant differences in our sample in terms of Gender, although women make up 83% of Cluster 1 and 77.5% of Cluster 3. This difference is not significant ($\chi^2(2) = 4.564$ with p=0.290).

The Access variable shows significant differences between Clusters 1 and 3 ($\chi^2(3) = 25.139$ with $p < 0.001$). In particular, students in the higher self-efficacy group were mostly admitted after passing the university entrance exams, while students in the lower self-efficacy group came from vocational studies.

Finally, the "Type of education" variable does not show significant differences between clusters ($\chi^2(3) = 7.826$ with $p = 0.251$). In general, half of each group is composed of future infant teachers, one third of future primary teachers and the rest of students on double degrees (see Table 3).

	Confident (n=525)	**Average (n=311)**	**Realistic (n=111)**
Gender, female (%)	438 (83.43%)	243 (78.13%)	85 (76.58%)
Age, mean (SD)	19.05 (2.12)	19.48 (3.42)	20.94 (6.24)
Access			
PAAU (%)	413 (78.67%)	227 (72.99%)	73 (65.77%)
Professional Modules (%)	110 (20.95%)	80 (25.72%)	34 (30.63%)
>25, 45 (%)	2 (0.38%)	4 (1.29%)	4 (3.60%)
Type of education			
Infant (%)	276 (52.57%)	154 (49.52%)	413 (78.67%)
Primary (%)	138 (26.29%)	98 (31.51%)	110 (20.95%)
Double degree (%)	111 (21.14%)	63 (18.97%)	8 (1.52%)

Table 3. Percentages of students per cluster: demographic data

Discussion

The main aim of this research was to explore the profiles of initial teacher training students in terms of gender, age, access to university and type of studies. We divided our study into three research questions:

Three clusters or profiles were identified in our sample. Students in the first group, the most numerous, were "Highly competent and confident", in agreement with Flannelly (2001), which showed that students are overconfident in general, and particularly when using tests (Foster, Was, Dunlosky & Isaacson, 2017). The students in

the second group were also confident when rating their own TDC, although not overconfident. This group represents approximately a third of the sample. Finally, the last group shows the least confident profile although, according to prior research, they seem to be the most accurate group (Cuhadar, 2018), as we will discuss below. However, they are only 10% of our sample.

Related to the second question, the results show that the dimensions most related to the personal use of TD (D3 and D4) are those in which students perceive they are most competent. On the other hand, D1 and D2 are closely related to the teaching profession (see Figure 2). Students in this sample were in the first year of their degree, so they have not yet completed their work experience programme, which may be why they feel less competent in the more pedagogical dimensions than in the personal dimensions. Previous research in Spain found similar results. Napal-Fraile, Peñalva-Vélez and Mendióroz-Lacambra (2018) studied pre-service teachers' perceptions (in secondary education) of their own level of DC. Results showed higher scores on information, safety and communication. Scores were lower on content creation and problem solving (dimensions closely related to the use of DTs to transform teaching-learning processes). These authors highlight the need to purposefully incorporate relational and didactic aspects of DT integration.

Finally, Research question 3 aimed to measure the differences between students' TDC profiles in terms of Gender, Age, Access and Type of education. First, we found no Gender differences in our groups; this is in agreement with the studies conducted among initial teacher training students in Chile and Uruguay (Silva, Usart & Lázaro-Cantabrana, 2019) and in Spain (Area Hernández and Sosa, 2016), and in other countries (He & Zhu, 2017; Stosic & Fadiya 2017). The ratio of women is higher in the overconfident cluster, but the difference is not significant. This seems to agree with

previous findings that females have better digital skills than males (Røkenes & Krumsvik, 2014). On the other hand, Roig, Mengual and Quinto (2015) found that male students of initial teacher training had a higher level of TDC than female students. Because of these discrepancies and the fact that the results come from a self-evaluation, we suggest that experience in the personal use of DT (access to information, mobile devices, games, Internet management, blogs, social networks, etc.) can be a determining factor for students to regard themselves as more or less competent in the use of DT in teaching (Area, Hernández & Sosa, 2016; Kim, Kim, Lee, Spector & De-Meester, 2013). It may be interesting to include this variable in future research.

As far as students' age is concerned, the significant difference between clusters suggests that older students have a more realistic or accurate self-perception, while younger students are overconfident (Flannelly, 2001; Foster et al., 2017). Furthermore, there was a negative correlation in the level of DC with age, mostly because content creation decreased with age. This is related to the fact that TDC level can be affected by students' age (Gudmundsdottir & Hatlevik, 2018). In particular, as also found by Napal-Fraile, Peñalva-Vélez and Mendióroz-Lacambra (2018), there is a significant, negative correlation between age and TDC. In their study of in-service teachers, Area, Hernández & Sosa (2016) concluded that younger teachers with less professional experience make less use of DT in teaching. This contrasts with Prensky's (2001) postulates about digital natives, according to which young people tend to use DT more and better. In teaching practice, it seems clear that experience and age will determine the awareness and sureness with which teachers appropriate and incorporate DTs naturally (Schalk, 2010) into their daily activities.

Next, in terms of Access, students in the higher self-efficacy group had mostly accessed university via the entrance examinations, while students in the lower self-

efficacy group had accessed via the entrance examinations and also vocational studies. This agrees with the findings of Krumsvik, Jones, Øfstegaard and Eikeland (2016), which show prior education as a predictor of teachers' high or low digital competence in upper secondary school. Also, Muhd and colleagues (2018) reported that teacher trainees who had been admitted to university from vocational training courses could have lower digital abilities than those trained in different and more community-based disciplines.

Finally, Type of Education shows no significant differences between the three groups. Although this result seems to contradict existing data (Generalitat de Catalunya, 2015), it could be explained by the sample of students. Access has a greater loading on TDC self-efficacy than the Type of studies they have just started. For further insight into this result, both in-service teachers and final-year students who have completed their work experience programme should be studied.

Conclusions and implications

The digital competence of (future) teachers as professionals is not the same as their digital competence as citizens, as methodological and ethical aspects have sometimes been misunderstood or ignored in teacher training. This study helps to understand that students who are mostly over-confident about their TDC and will help institutions to design future proposals for developing this key competence, adapted to each student profile and focusing on the formative assessment that makes students more aware of their real level of TDC. In particular, COMDID-A allows future teachers to reflect on and develop their own TDC so that they can guide students as they develop as digital citizens (Redecker & Punie, 2017). The results of our study highlight the usefulness of a TDC tool with only 22 items that provides a valid measure of four main teaching dimensions and which gives instant feedback to future teachers, and a clear picture of

student profiles for teacher trainees to adapt the curriculum to real needs. Finally, this instrument may be useful for future teachers to reflect on, and be more aware of, their own level of TDC from the beginning of their training. Learning institutions can also use COMDID-A feedback to leverage students who are overconfident about their ability to use TDC.

Limitations and future research

Our study is obviously limited by the fact that the sample has been taken from first-year Catalan university students, so the results may not be totally generalizable to different teacher training contexts. One task for future research is, therefore, to replicate this study in other years and countries that may adapt our instrument, thus enabling replication and cross-cultural comparisons and debate on the measure of TDC self-efficacy around Europe, in the framework of the UNESCO goals.

Another limitation of this study is its focus on a self-efficacy tool, not a TDC assessment instrument. As we have discussed, this may explain the high scores on each of the four dimensions of the competence. Nevertheless, in the context of the 3-year research project and in the same sample of Catalan students, the COMDID-C assessment tool is now also being tested and validated (Lázaro-Cantabrana, Usart & Gisbert-Cervera, 2019) to compare and gain greater insight into the differences between self-efficacy and assessment of TDC. The student profiles in both measures are being explored and the differences in terms of student overconfidence are being analysed (Foster et al., 2017).

Finally, it would also be interesting to study other levels of teacher training, not just first-year students, including teachers who have experience. In this way, it could be determined whether the factors Type of Education and Years of Experience are related to TDC (Palau, Usart & Ucar, 2019), and how feedback on self-efficacy results

influences the professional use of DT among teachers. One suggestion for future research is to validate the COMDID-A teachers' version and compare it with the initial teacher training results outlined in this study.

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