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The digital competence of teachers and students in secondary education schools

La competencia digital de estudiantes y docentes en los centros de educación secundaria

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Abstract

The development of students' and teachers' digital competence is a key element in all educational stages. It is necessary to have a diagnosis of both competencies in order to detect possible gaps and inequalities and design appropriate training actions based on the actual needs. The objective of this study is to diagnose the level of students' and teachers' digital competence in 14 lower and upper-secondary schools in Catalonia. The results show that students assess themselves with a medium-high digital competence level, while teachers assess themselves with an expert teacher's digital competence level. Moreover, significant differences were found in teachers' digital competence level depending on gender and age, and among students' digital competence depending on their year and year retention. Results suggest an evident need for training actions among teachers and students in order to improve these competencies and reduce inequalities in terms of gender, age, educational level, and academic achievement.

Keywords: teachers' digital competence; digital competence; students; teachers; secondary education

Resumen

El desarrollo de la competencia digital de estudiantes y docentes es un aspecto clave en todas las etapas educativas. Es necesario tener un diagnóstico de ambas competencias con el fin de detectar posibles brechas y desigualdades y diseñar acciones formativas adecuadas basadas en las necesidades reales. El objetivo de este estudio es realizar un diagnóstico del nivel de competencia digital de estudiantes y docentes en 14 centros de educación secundaria y bachillerato en Cataluña. Los resultados muestran que el alumnado se autopercibe con un nivel medio-alto de competencia digital, mientras que el profesorado lo hace con un nivel experto de competencia digital docente. Asimismo, se encontraron diferencias significativas en el nivel de competencia digital docente en función del género y la edad, y en la competencia digital del alumnado en función del curso y de la repetición de curso. Los resultados sugieren una evidente necesidad de formación del profesorado y alumnado con el objetivo de mejorar estas competencias y reducir desigualdades respecto a género, edad, nivel educativo y rendimiento académico.

Palabras clave: *competencia digital docente, competencia digital, estudiantes, docentes, educación secundaria*

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1. INTRODUCTION

Digital Competence (DC) has been present in national and international educational policies for years. In 2006, the European Commission included DC as one of the 8 key competencies for lifelong learning (European Union, 2006). In the same year, it was also introduced for the first time in Spain among the basic competencies of the compulsory education curriculum (LOE 2/2006, de 3 de mayo), and since then, it has remained in the following versions. Promoting students' DC constitutes a major challenge for educational institutions at all educational stages, since ensuring an appropriate student achievement implies opportune teacher training. Regarding this training, it is necessary to develop teachers' digital competence (TDC), which would allow them to effectively use digital technologies in their professional practice to further develop students' DC. It is therefore necessary to explore TDC and students' DC with data from educational contexts, as a first step to identify actual teachers' training needs and design specific training plans. Within this purpose, it also becomes necessary to identify variables that can influence the development of both competencies, especially those that can act as a source of educational inequalities.

1.1. Students' digital competence

Over the past two decades, different frameworks have defined the dimensions and factors that compound DC. Some examples are DigComp (Vuorikari et al., 2016) and ISTE Standards for Students (ISTE, 2016). In this study, we will take as a reference the proposal from Larraz (2013, p. 118), which considers that DC consists of 4 literacies:

1) Informational literacy: management of digital information.
2) Technological literacy: data management in different formats.
3) Multimedia literacy: analysis and creation of multimedia messages.
4) Communicative literacy: participation in society with a digital identity in a safe, ethical, and civic way from a digital identity.

Results of most of the studies about students' DC that have been reviewed agree on the fact that students show a higher competency level in technical or instrumental skills, analysis and search of information, and a lower level in creation of digital content or ethical and legal aspects (González Martínez, 2012; Colás-Bravo et al., 2017).

One of the important issues concerning the study of DC over the past few decades has been the identification of inequalities, especially regarding gender. Referring to studies that have used *ad hoc* instruments of assessment and self-perception of DC, some of them do not show differences in primary and secondary students' level according to gender (Colás-Bravo et al., 2017; Hatlevik & Christophersen, 2017), while others find that girls obtain higher scores (Hatlevik et al., 2015; Martínez-Piñeiro et al., 2019). When analysed in detail, results show that boys perceive themselves as more skilled than girls in searching, selecting, and organising information (Amor Almedina & Serrano Rodríguez, 2019), while girls feel more capable of using digital technologies for creative purposes, communicating, and establishing social relationships

(Amor Almedina & Serrano Rodríguez, 2019; Martínez-Piñeiro et al., 2019). Those differences, both in self-perceived and assessed DC, jeopardize the appropriate development of this crucial competence, representing a threat to the future of such a big number of students.

Another factor studied in relation to inequalities in the development of DC is the influence of age, academic level, and other demographic factors, as some of the studies have pointed out differences in students' technical skills according to these variables. Thereby, the level of DC tends to be higher among older students or students of higher levels (Jin et al., 2020). In addition, the level of DC of secondary students has been related to previous academic achievement (Hatlevik et al., 2015), as well as socio-economic status (Amor Almedina & Serrano Rodríguez, 2019).

In short, although different studies assessing students' DC can be found in the literature, many of them assess this competence using a different framework or definition, in different contexts and with different instruments, making results hardly comparable. This would explain the absence of unanimity regarding differences in students' DC levels and depending on variables, such as gender.

1.2. Teachers' digital competence

It is reasonable to think that one element that can be related to the students' development of DC is the level of development of their teachers' digital competence (TDC). Defining TDC is particularly complex since it not only implies the development of teachers' digital literacies, but also its implementation in teaching and its close relationship with teachers' professional development and digital leadership. Lázaro Cantabrana et al. (2019, p. 75) consider this competence as a "set of capacities, skills and attitudes that teachers must develop to incorporate digital technologies into their practice and professional development". Over the past decades, different models and reference frameworks have been developed nationally and internationally with the aim of defining the dimensions and indicators that are part of this competence, including the ISTE Standards for Educators (ISTE, 2017), the European Framework DigCompEdu (Redecker, 2017), the TDC Common Framework of INTEF (2022), or the ICT Competency Framework of UNESCO (2018). Based on these frameworks, many instruments have been designed for the measurement of self-perceived TDC (European Commission, 2021; Lázaro Cantabrana & Gisbert Cervera, 2015; Tourón et al., 2018).

The instrument used in the present study is COMDID-A (Lázaro Cantabrana & Gisbert Cervera, 2015) which is built by grouping all aspects of the national and international frameworks and TDC reference models and includes new aspects that complete these proposals.

Results of studies about TDC in pre-university contexts show that teachers generally assessed their competence level as medium (Más García et al., 2022). Within these results, a lower self-perception is observed in the pedagogical dimension or in the didactic use of digital technologies when compared with technological dimension or more instrumental aspects (Krumsvik et al., 2016; Suárez-Rodríguez et al., 2018).

Other studies go into further detail and show that the aspects with the greatest deficiencies are those related to the creation of digital content and ethical and safety aspects (Pozo Sánchez et al., 2020; Rojo-Ramos et al., 2020), while the highest levels of competency occur in the areas of information and digital literacy, communication, and collaboration (Pozo Sánchez et al., 2020; Prieto-Ballester et al., 2021). Regarding communication, results are diverse, as some studies also found low levels in this area (Rojo-Ramos, et al., 2020).

Regarding the influence of demographic variables on TDC, some studies find differences according to gender, showing a lower overall self-perception in women than in men (Gudmundsdottir & Hatlevik, 2018; Portillo et al., 2020). In relation to the dimensions of TDC, men have a better self-perception in the technological dimension, while women perceive themselves as more competent in the pedagogical dimension (Ortiz-Colón et al., 2020). However, other studies find no differences (Claro et al., 2018; Falcó, 2017) or even show a better self-perception among women (Krumsvik et al., 2016), evidencing how the use of different frameworks of TDC can affect the identification of inequalities, and thus highlighting the need of a tool that takes all the frameworks (international and national) into account, in order to minimize this possible bias.

In this sense, concerning the relationship between age and TDC level, several studies agree that younger teachers show a higher level of self-perception (Krumsvik et al., 2016; Portillo et al., 2020). However, age differences are not always found in teachers' general self-perception of TDC (Falcó, 2017; Napal-Fraile et al., 2018), or even sometimes, age differences are only found in certain dimensions, such as communicative, collaborative, and digital content creation (López Belmonte et al., 2020; Pozo Sánchez et al., 2020).

Finally, teaching experience is another factor that might be related with the self-perceived TDC. According to Krumsvik (2016), the teachers with more years of experience have the lowest levels of TDC. Nevertheless, studies such as the one from Claro et al. (2018) found a positive association in some specific respects, such as the creation of digital products, being more experienced teachers the ones with higher levels of TDC.

Due to the need to design appropriate training actions for teachers and students and as a part of two Spanish research and innovation projects focused on the diagnosis of DC and TDC, this study aims at determining the relationship of some variables with the DC level of lower-secondary (12-16 years old) and upper-secondary education students (16-18 years old), and the TDC level of secondary education teachers. This general aim is divided into two specific objectives:

1) Analyse self-perceived students' DC level according to gender, year, and year retention.
2) Analyse self-perceived TDC level according to gender, age, and teaching experience.

2. METHOD

2.1. Sample

A total of 1372 students and 256 teachers are the sample of this study. The average age of the students participating in the study was 15.3 (SD = 2.618), 687 (50%) identified themselves with male gender, 644 (47%) with female gender, 16 with non-binary (1%), and 25 did not answer. Regarding teachers, the average age was 44.3 (SD = 8.891) and 87 identified themselves with male gender (34%), 161 with female gender (63%), 3 with non-binary (1%), and 5 did not answer (2%). These proportions are similar to the official population data in the same age ranges: 52% men and 48% women (students) and 61% women and 39% men (teachers) (Generalitat de Catalunya, 2020, 2021).

Due to the need of a fast and economical way to access the participants, a non-probabilistic convenience sampling was performed. All secondary schools (stages 12–16 and 16–18 years old) were contacted through the institutional addresses and territorial educational services of Catalonia (Spain) and participation in the study was voluntary.

2.2. Instruments and procedure

Students' DC was measured with the questionnaire Digitalis-ESO (Niño-Cortés et al., 2023), an updated version of INCOTIC-ESO (González Martínez et al., 2012). Digitalis-ESO evaluates students' self-perception of their DC through 20 items distributed in 4 literacies: information literacy (α= 0.71), technological literacy (α = 0.62), multimedia literacy (α = 0.66), and communicative literacy (α = 0.78). An initial diagnosis is obtained at three levels (low, medium or high). The items of this questionnaire are on a 5-point Likert-scale, and students have to rate themselves as totally disagree to totally agree with the statements, divided into four literacies of DC. The design of the tool and its validation were published by Niño-Cortés et al. (2023).

The level of self-assessed TDC was measured with the questionnaire COMDID-A for in-service teachers (Lázaro Cantabrana & Gisbert Cervera, 2015). This instrument consists of 22 items divided into 4 dimensions: Didactic, curricular, and methodological (6 items); planning, organisation and management of digital technological spaces and resources (5 items); relational, ethics and safety (5 items); and personal and professional (6 items). In addition, it distinguishes 4 areas (classroom, school, educational community and environment, and professional development) and 4 levels of development (initial, medium, expert, and transformative).

COMDID-A presents teachers different situations which are specific to their professional task. They must reflect on their abilities and choose the answer which better describes their level of competence among 4 options. Each answer relates to a different TDC level of development. The instrument was validated, and its reliability was measured in a sample of secondary school teachers (Salgado, 2019). In addition, an analysis of the reliability of the questionnaire was

carried out for the sample of this study using the Cronbach's Alpha coefficient. The reliability of the instrument is derived from this analysis, with coefficients between 0.844 and 0.906.

Both questionnaires gathered complementary demographic data. Thus, students and teachers were asked about their gender identity (female, male, non-binary, NR/DK), according to The GenIUSS Group (2014). Students were asked about their year and whether they had repeated any previous year (and which year or years they had repeated). Teachers were asked to provide their age, years of teaching experience, initial training, and teaching speciality.

The questionnaires were distributed within the last semester of the 2019–2020 academic year and the first semester of the 2020–2021 academic year. Data was hosted on the university's server, anonymised, and transferred into a spreadsheet to create the database. The entire process of preparing the selection of the sample, elaboration, and application of the instruments, as well as data processing, strictly followed the ethical principles of anonymity and conformity of data transfer established by the British Educational Research Association (2018).

2.3. Data analysis

To accomplish the research objectives, a first descriptive analysis of students' DC and TDC self-perception gathered data by dimensions and literacies was carried out. Secondly, students' scores were categorised into three levels of development depending on the average score: low ($1 \leq x < 3.2$), medium ($3.2 \leq x < 3.8$) and high ($3.8 \leq x \leq 5$), following the recommendations of Digitalis-ESO (Niño Cortés et al., 2023). Equivalently, TDC was categorised according to four levels depending on the average score: initial ($0 \leq x \leq 25$), medium ($25 < x \leq 50$), expert ($50 < x \leq 75$), and transformative ($75 < x \leq 100$), based on Lázaro Cantabrana & Gisbert Cervera (2015).

Subsequently, a multiple linear regression was performed with ANOVA to study whether the age of teachers, as well as their years of experience, can significantly predict their TDC self-perception. To study possible differences in gender, educational level, and year retention factor both in students and teachers, chi-square tests (χ^2) were applied (Cohen et al., 2018) because of the ordinal and nominal nature of variables. Regarding gender, non-binary answer options were offered in both questionnaires, however, only binary gender responses will be considered due to the fact that only 16 students classified themselves as non-binary. Data has been analysed with IBM SPSS Statistics v28 for Windows.

3. RESULTS

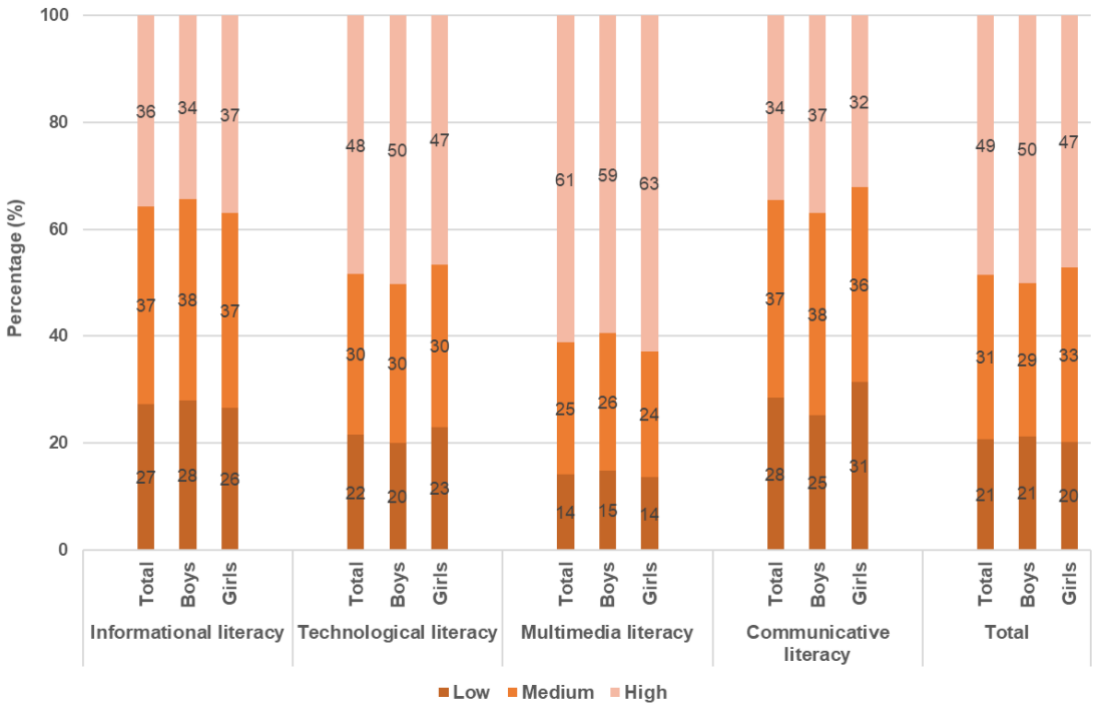
3.1. Analysis of students' DC self-perceived level according to gender, year, and year retention

Among the students participating in this study (N=1372), 623 pupils were from second year of lower-secondary school (13–14 years old), 517 students were from fourth year (15–16 years

old), and 232 students were from second year of upper-secondary education (17–18 years old). 6.7% of the students (93) said they had repeated a year. Overall, 21% of the participating students perceived themselves with a low DC level, 31% at a medium level, and 49% at a high level (Figure 1).

Figure 1

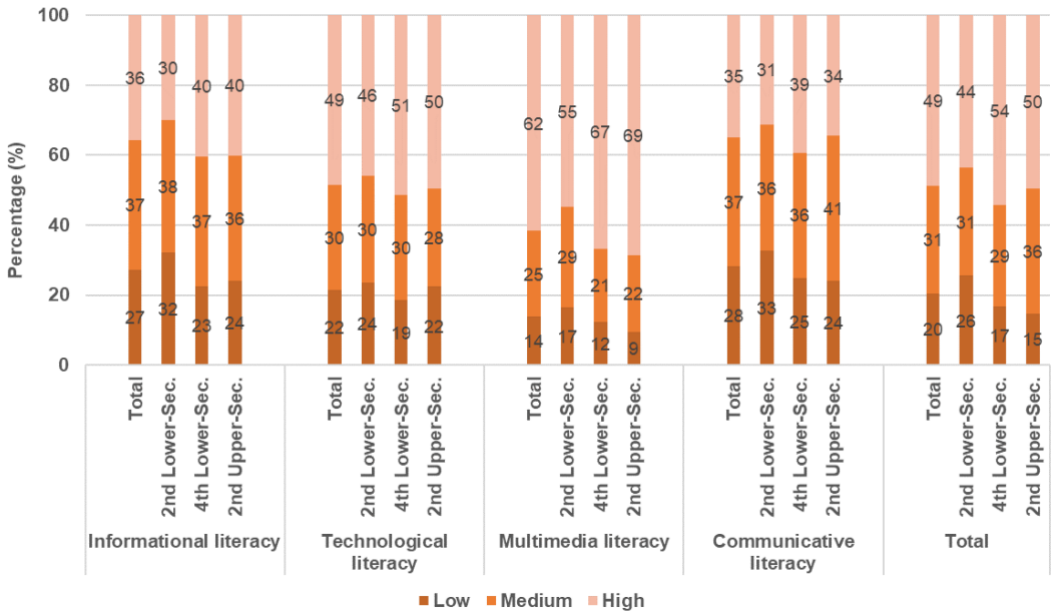
Percentage of students in each level of DC according to gender.



Statistically significant differences according to gender were only found for communicative literacy: boys perceived themselves as more proficient than girls (χ^2 = 7.03; df = 2; p = 0.03). Considering the students' year, differences between students were significant for all literacies except for technological, as shown in Figure 2. Regarding informational literacy, multimedia literacy and communicative literacy, as well as general DC, self-perception improved significantly with year. Specifically, upper-secondary and fourth year lower-secondary students perceived themselves as more competent than second year students: informational literacy (χ^2= 20.93; df = 4; p < 0.001), multimedia literacy (χ^2 = 23.38; df = 4; p < 0.001), communicative literacy (χ^2 = 14.21; df = 4; p = 0.007), and general DC (χ^2 = 24.17; df = 4; p < 0.001).

Figure 2

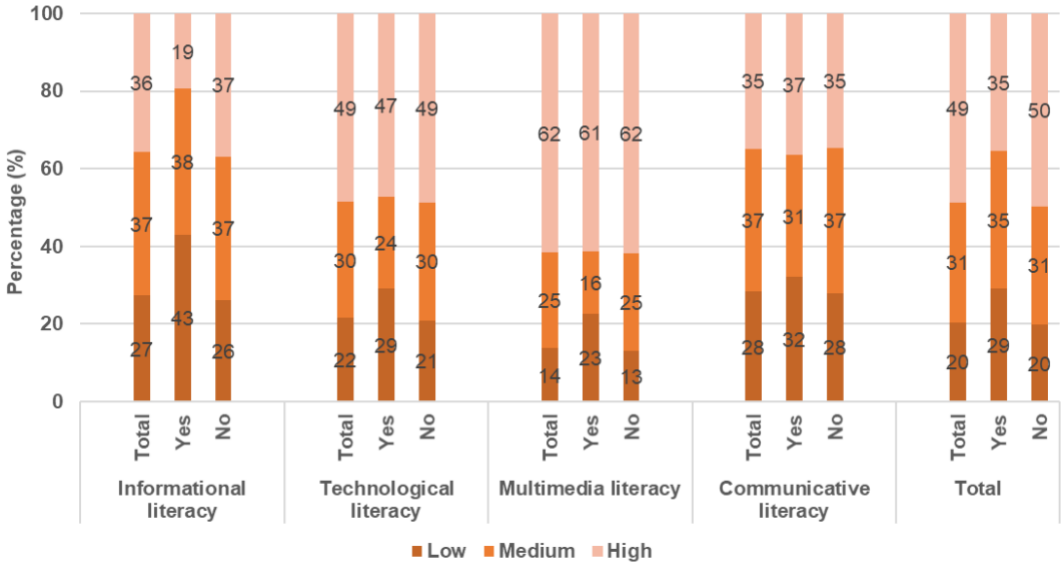
Percentage of students in each level of DC according to year.



Finally, students who had repeated a year showed a lower level of general self-perception than those who had not repeated any year (Figure 3). These differences were observed at a significant level for informational literacy ($\chi^2 = 16.51$; df = 2; $p < 0.001$), multimedia literacy ($\chi^2 = 8.5$; df = 2; $p = 0.014$), and general DC ($\chi^2 = 7.84$; df = 2; $p = 0.02$).

Figure 3

Total percentage of students at each DC level according to year retention.



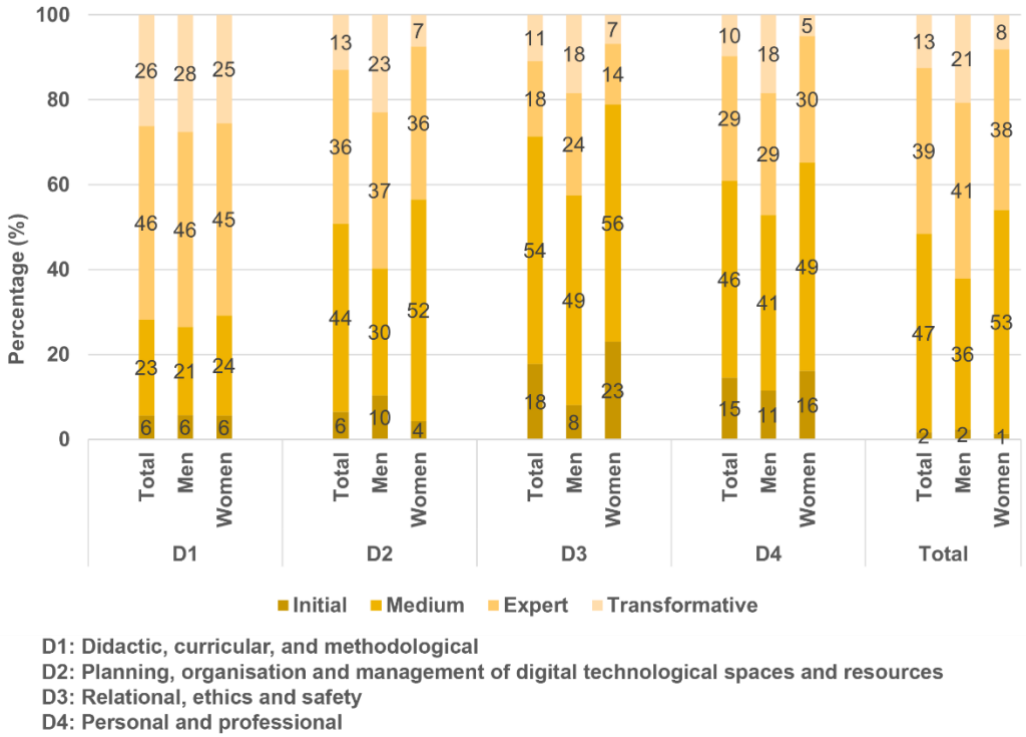
3.2. Analysis of TDC self-perceived level according to gender, age, and teaching experience

Regarding teachers (N=256), 2% of participant teachers perceived themselves at the initial TDC level, 46% at the medium level, 40% at the expert level, and 13% at the transformative level (Figure 4). Results show that a bigger proportion of women perceived themselves at the medium level of general TDC, while men mostly perceived themselves at the expert level. These gender differences were statistically significant (χ^2 = 11.31; df = 3; p = 0.01).

Analysing the results by dimensions, although in D1 there were no significant differences, in D2 most women perceived themselves at the medium level, significantly lower than men, who mostly perceived themselves at the expert level, and with a higher proportion than women at the transformative level (χ^2 = 20.05; df = 3; p < 0.001). Similarly, in D3 women perceived themselves at the initial and medium level, again with a lower level than men (χ^2 = 17.56; df = 3; p < 0.001), who perceived themselves at the medium and expert levels. Finally, in D4, women mostly perceived themselves at the medium level and men at the medium and expert level, also with a higher proportion than women in the transformative level, being these differences significant (χ^2 = 12.09; df = 3; p = 0.007).

Figure 4

Total percentage of teachers and according to gender at each TDC level.



Results of multiple regression between the variables of age and teaching experience and the mean TDC scores (for each dimension and for the total), showed that the model explains between 3.5% and 5% of the variance, and that it is a significant predictor of the general TDC level: F (2.253) = 5.24; p = 0.006. While teachers' age contributed significantly to the model (B = -0.256, p = 0.047), teaching experience did not (B = -0.131; p = 0.266). Analysing each

dimension, we observed that age acted as a predictor, especially for D4 competence (F = 7.15; $p < 0.01$). We also observed a similar relationship in D2 ($p = 0.011$), and in D1 ($p = 0.01$). In contrast, D3 does not appear to be related to age or teaching experience ($p = 0.193$; F = 1.655). In other words, in general, the older the teaching staff is, the lower their TDC self-perception level, and although to a lesser degree, the greater the teaching experience is, the lower their TDC self-perception level.

4. DISCUSSION AND CONCLUSIONS

Results presented in this study correspond to the first phase of two national research projects focused on the diagnosis of students' DC and teachers' DC in Spain. Our interest was to measure self-perceived students' DC and TDC as a first approach, as well as to identify possible differences according to gender and other variables that have been found to be related to the self-perception of these competences in previous studies.

4.1. Analysis of students' DC self-perceived level according to gender, year, and year retention

Regarding students, they mostly perceive themselves as highly competent. These results contrast with previous studies, where students showed a medium level of DC self-perception (Colás-Bravo et al., 2017; Martínez-Piñeiro et al., 2019). Thus, students who participated in our study seem to have a significantly higher self-perceived DC than the usually reported in literature, which is based on different frameworks. Additionally, it must be considered that this study was developed during the pandemic caused by COVID-19, during which students might have improved their skills with digital technologies.

Regarding gender, differences were only clearly found in the communicative literacy, which is related to D3 (relational, ethics, and safety) of TDC. Particularly, boys assess themselves as more proficient in communicative literacy than girls. These results contrast with other recent studies showing that girls feel more capable than boys to use digital technologies to communicate and establish social relationships (Amor Almedina & Serrano Rodríguez, 2019; Martínez-Piñeiro et al. 2019). Nevertheless, no significant differences were found in general DC and the rest of literacies, coinciding with prior research in secondary education (Colás-Bravo et al., 2017; Hatlevik & Christophersen, 2013). Thus, although previous results in literature are inconclusive regarding gender differences, the use of Digitalis-ESO allows identifying inequalities that are aligned with normative gender stereotypes and, consequently, it represents an appropriate tool to demonstrate these disparities.

The analysis also reveals that, generally, students in upper years present a higher self-perception, being the level of DC in upper-secondary and fourth year of lower-secondary education higher than in second year of lower-secondary education. This improvement is significant in all literacies, except technological. This correlation is to be expected, as suggested in previous studies (Jin et al., 2020). Thus, the results show how students' DC self-perception develops as they progress in the educational stages, strengthening the validity of the use of Digitalis-ESO as a tool to evaluate students' DC.

Likewise, it is observed how repeating students have a lower level of self-perception than those who have not repeated any year. These significant differences are observed in general DC and in two of the four dimensions (informational and multimedia literacy), suggesting that repeating students would have a lower self-perception of their abilities than their non-repeating peers, in line with the results of the study carried out by Hatlevik et al. (2015), which found that previous academic achievements predicted DC level. Thus, although students could develop their DC level as they progress in the different educational stages, this evolution would be conditioned by other factors, such as their general academic performance, reflected in year retention. Therefore, these results show how year retention could represent an exclusion factor in students, together with gender.

4.2. Analysis of TDC self-perceived level according to gender, age, and teaching experience

Teachers participating in this study perceived themselves with a medium TDC level, in line with the previous results of Rojo-Ramos et al. (2021) and Moreno-Guerrero et al. (2021). However, the detailed analysis of TDC by dimensions offers a different perspective that allows to go deeper into the relationship of certain factors with this competence. The dimension in which teachers perceived themselves at lower TDC levels is the relational, ethical, and safety dimension (D3) and the personal and professional dimension (D4), while they perceived themselves at higher levels in the didactic, curricular, and methodological dimension (D1). These results are similar to previous studies such as the ones of Falcó (2017) and Pozo Sánchez et al. (2020), which show that the aspects in which teachers have the greatest deficiencies are digital safety and content creation (related to D3 and D4), while the highest levels of competence occur in the area of information and digital literacy (related to D1). These similarities give consistency to the use of COMDID-A as a tool for the self-perception of TDC.

In addition, the results of the TDC analysis reveal significant differences according to gender. In general, women perceive themselves with a lower TDC level than their peers. Similar differences have been evidenced in previous studies, such as those from Gudmundsdottir and Hatlevik (2018) and Portillo et al. (2020). Specifically, it is observed that, while in the didactic, curricular, and methodological dimension (D1) there are no significant differences, men perceive themselves as more competent in the dimension of planning, organisation and management of digital technological spaces and resources (D2), the relational, ethical, and safety dimension (D3), and in the personal and professional dimension (D4). These differences could be explained by the nature of the activity, since men are socially and usually perceived as more competent in the dimensions related to management and personal and professional development (more linked to digital leadership). Nevertheless, the results in D3 contrast with the studies carried out by Pozo Sánchez et al. (2020) and Ortiz-Colón et al. (2020), where women were more competent than men around digital content creation, closely related to this dimension.

The results of multiple regression with the variables age and teaching experience indicate that a higher age of teachers contributes significantly to a low TDC self-perceived level, and that teaching experience is also related to TDC self-perception, although to a lesser degree than age. In literature, as in our study, these differences are only found when age is combined with teaching experience (Claro et al., 2018). When looking at TDC dimensions, differences in

competence level according to age are significant in three of the four dimensions. This, again, shows that a certain level of technical skill is necessary for a desirable TDC development, which is usually difficult for the older age range. This difficulty could be related to Prensky's (2001) digital natives' theory, in which younger generations are the ones who would have a better DC level, although differences in TDC levels have not always been found in teachers of different ages (Falcó, 2017; Napal-Fraile et al., 2018).

4.3. Conclusions

The aim of this study was to determine the relationship of some variables with the development of students' DC and TDC in a sample of secondary education students and teachers in Catalonia. The results show how teachers perceive themselves at a medium level of TDC, while students have a high self-perception of their DC. Students perceive themselves with a higher level in multimedia literacy and a lower level in communicative and informational literacies. On the other hand, among teachers, the highest levels of competence occur in the didactic, curricular, and methodological dimension (D1), while the relational, ethical, and safety dimension (D3) and the personal and professional dimension (D4) have the lowest scores.

From a gender perspective, the instruments used (COMDID-A and Digitalis-ESO) make it possible to identify relevant differences when considering the dimensions that make up TDC and students' DC. However, these differences are minor among the students, showing that, although teachers have a self-perceived medium level of TDC, it is necessary to develop training strategies to achieve a truly equitable professional development, enabling them to guide the development of students' DC. The results also show how the age of the teaching staff is another of the key factors that is negatively related to the development of TDC, which highlights the need to provide continuous training throughout the teaching career that can accompany teachers in their professional development.

In short, there is a need for continuous teacher training, especially aimed at older and experienced female teachers who perceive themselves to be less capable when it comes to incorporating digital technologies into their teaching practice. In the case of students, it must be considered that their year and their previous academic performance are related to their self-perceived DC level, so specific educational actions should be developed focussing on students who have repeated a year, along with the development of educational strategies aimed at improving DC. The fact that DC level improves in higher years suggests that the progressive work of different aspects of DC could have an accumulated impact, even if the TDC level of the teaching staff is not optimal. On the other hand, although there are fewer differences according to gender in DC, this does not mean that the observed differences should not be considered.

Few studies have jointly investigated secondary students' DC and teachers' TDC in our country. In addition, due to the use of different instruments and frameworks, data is not always comparable with other educational contexts. The research presented in this article represents a first step in the joint assessment of TDC and students' DC when identifying specific strengths and needs within the above-mentioned projects. In future studies, it may be relevant to consider expanding the sample not only in the number of teachers and students, but also focusing on some of the teaching specialities to enable the development of specific training to

maximise the impact. Likewise, it might be relevant to consider other factors that could affect the level of students' DC development, such as their socioeconomic level. Finally, the contrast between assessed and self-perceived TDC and students' DC could also offer complementary results on the adjustment of self-perception capacity and its relationship to gender. These limitations can be opportunities for the development of future research lines and support for teachers in their professional task.

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6. REFERENCES

Amor Almedina, M. I., & Serrano Rodríguez, R. (2019). An evaluation of primary-school pupils' digital competence. *Revista Espacios, 40*(21). https://www.revistaespacios.com/a19v40n21/19402112.html

British Educational Research Association [BERA]. (2018). *Ethical guidelines for educational research* (4th Ed). https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2018

Claro, M., Salinas, A., Cabello, T., & San Martin, E. (2018). Teaching in a digital environment (TIDE): Defining and measuring teachers' capacity to develop students' digital information and communication skills. *Computers & Education, 121*, 162-174. https://doi.org/10.1016/j.compedu.2018.03.001

Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods in Education* (8th ed.). Routledge.

Colás-Bravo, P., Conde-Jiménez, J., & Reyes-De Cózar, S. (2017). Competencias digitales del alumnado no universitario. *Revista Latinoamericana de Tecnología Educativa*, *16*(1), 7–20. https://doi.org/10.17398/1695-288x.16.1.7

European Commission. (2021). *New online tool to support teacher digital skills*. https://education.ec.europa.eu/news/new-online-tool-to-support-teacher-digital-skills

European Union. (2006). *Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning* (2006/962/EC). https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:394:0010:0018:en:PDF

Falcó, J. M. (2017). Evaluación de la competencia digital docente en la comunidad autónoma de Aragón. *Revista Electronica de Investigacion Educativa, 19*(4), 73-83. https://doi.org/10.24320/redie.2017.19.4.1359

Generalitat de Catalunya. (2020). *Estadística de l'ensenyament. Curs 2019-2020*. Departament d'Educació. https://educacio.gencat.cat/ca/departament/estadistiques/estadistiques-ensenyament/visualitzacio/

Generalitat de Catalunya. (2021). *Anuari estadístic de Catalunya. Població a 1 de gener. Per sexe i grups d'edat.* Institut d'Estadística de Catalunya. https://www.idescat.cat/indicadors/?id=aec&n=15231

González Martínez, J. (2012). *El proyecto educat1x1 y su impacto en la asignatura de lengua castellana. Un primer análisis desde las Terres de l'Ebre* [Doctoral dissertation, Universitat Rovira i Virgili]. Tesis Doctorals en Xarxa. http://hdl.handle.net/10803/84032

González Martínez, J., Espuny Vidal, C., de Cid Ibeas, M. J., & Gisbert Cervera, M. (2012). INCOTIC-ESO. Cómo autoevaluar y diagnosticar la competencia digital en la Escuela 2.0. *Revista de Investigación Educativa, 30*(2). https://doi.org/10.6018/rie.30.2.117941

Gudmundsdottir, G.B. & Hatlevik, O. E. (2018). Newly qualified teachers' professional digital competence: implications for teacher education. *European Journal of Teacher Education, 41*, 214-231. https://doi.org/10.1080/02619768.2017.1416085

Hatlevik, O. E., & Christophersen, K. A. (2013). Digital competence at the beginning of upper secondary school: Identifying factors explaining digital inclusion. *Computers & Education*, *63*, 240–247. https://doi.org/10.1016/j.compedu.2012.11.015

Hatlevik, O. E., Guðmundsdóttir, G. B., & Loi, M. (2015). Examining factors predicting students' digital competence. *Journal of Information Technology Education: Research, 14*, 123-137. http://www.jite.org/documents/Vol14/JITEV14ResearchP123-137Hatlevik0873.pdf

INTEF. (2022). *Marco de Referencia de la Competencia Digital Docente*. https://intef.es/wp-content/uploads/2022/03/MRCDD_V06B_GTTA.pdf

ISTE. (2017). *ISTE Standards for Educators.* https://iste.org/standards/educators

ISTE. (2016). *ISTE Standards for Students.* https://iste.org/standards/students

Jin, K. Y., Reichert, F., Cagasan, L. P., de la Torre, J., & Law, N. (2020). Measuring digital literacy across three age cohorts: Exploring test dimensionality and performance differences. *Computers & Education*, *157*, 103968. https://doi.org/10.1016/j.compedu.2020.103968

Krumsvik, R. J., Jones, L. Ø., Øfstegaard, M., & Eikeland, O. J. (2016). Upper secondary school teachers' digital competence: Analysed by demographic, personal and professional characteristics. *Nordic Journal of Digital Literacy, 11*(3), 143-164. https://doi.org/10.18261/issn.1891-943x-2016-03-02

Larraz, V. (2013). *La competència digital a la universitat* [Doctoral dissertation, Universitat d'Andorra]. Tesis Doctorals en Xarxa. http://hdl.handle.net/10803/113431

Lázaro Cantabrana, J. L., & Gisbert Cervera, M. (2015). Elaboración de una rúbrica para evaluar la competencia digital del docente. *UT. Revista de Ciències de l'Educació, 1*, 30-47. https://revistes.urv.cat/index.php/ute/article/view/648/781

Lázaro Cantabrana, J. L., Usart Rodríguez, M., & Gisbert Cervera, M. (2019). La evaluación de la competencia digital docente: construcción de un instrumento para medir los conocimientos de futuros docentes. *Journal of New Approaches in Educational Research, 8*(1), 75-81. https://doi.org/10.7821/naer.2019.1.370

López Belmonte, J., Pozo Sánchez, S., Vázquez Cano, E., & López Meneses, E. J. (2020). Análisis de la incidencia de la edad en la competencia digital del profesorado preuniversitario español. *Revista Fuentes, 1*(22), 75-87. https://doi.org/10.12795/revistafuentes.2020.v22.i1.07

Martínez-Piñeiro, E., Gewerc, A., & Rodríguez-Groba, A. (2019). Nivel de competencia digital del alumnado de educación primaria en Galicia. La influencia sociofamiliar. *RED. Revista de Educación a Distancia, 61*(1). https://doi.org/10.6018/red/61

Más García, V., Gabarda Méndez, V., & Peirats Chacón, J. (2022). Competencia digital del profesorado de Educación Secundaria: Análisis del estado del arte. *ReiDoCrea: Revista Electrónica de Investigación y Docencia Creativa*, *11*, 418–430. http://doi.org/10.30827/Digibug.76068

Moreno-Guerrero, A. J., Manuel, A., García, R., Ramos Navas-Parejo, M., & Rodríguez Jiménez, C. (2021). Competencia digital docente y el uso de la realidad aumentada en la enseñanza de ciencias en Educación Secundaria Obligatoria. *Revista Fuentes, 23*(1), 108-124. https://doi.org/10.12795/revistafuentes.2021.v23.i1.12050

Napal-Fraile, M., Peñalva-Vélez, A., & Mendióroz-Lacambra, A. M. (2018). Development of digital competence in secondary education teachers' training. *Education Sciences*, *8*(3), 104. https://doi.org/10.3390/educsci8030104

Niño-Cortés, L. M., Grimalt-Álvaro, C., Lores-Gómez, B., & Usart, M. (2023). Brecha digital de género en secundaria: diferencias en competencia autopercibida y actitud hacia la tecnología. *Educación XX1*, *26*(2), 299–322. https://doi.org/10.5944/EDUCXX1.34587

Ortiz-Colón, A. M., Ágreda Montoro, M., & Rodríguez Moreno, J. (2020). Autopercepción del profesorado de Educación Primaria en servicio desde el modelo TPACK. *Revista Electrónica Interuniversitaria de Formación del Profesorado, 23*(2), 53-65. https://doi.org/10.6018/reifop.415641

Prieto-Ballester, J. M., Revuelta-Domínguez, F. I., & Pedrera-Rodríguez, M. I. (2021). Secondary school teachers self-perception of Digital Teaching Competence in Spain following COVID-19 confinement. *Education Sciences*, *11*(8), 407. https://doi.org/10.3390/EDUCSCI11080407

Portillo, J., Garay, U., Tejada, E., & Bilbao, N. (2020). Self-perception of the digital competence of educators during the COVID-19 Pandemic: A Cross-Analysis of Different Educational Stages. *Sustainability, 12*(23), 10128. https://doi.org/10.3390/su122310128

Pozo Sánchez, S., López Belmonte, J., Fernández Cruz, M., & López Núñez, J. A. (2020). Análisis correlacional de los factores incidentes en el nivel de competencia digital del profesorado. *Revista Electrónica Interuniversitaria de Formación del Profesorado, 23*(1), 143-159. https://doi.org/10.6018/reifop.396741

Prensky, M. (2001). Digital Natives, Digital Immigrants, Part II. Do they really think differently? *On the Horizon, 9*(6), 1-6. https://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part2.pdf

Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu* (P. Yves (ed.)). https://doi.org/10.2760/159770

Rojo-Ramos, J., Carlos-Vivas, J., Manzano-Redondo, F., Fernández-Sánchez, M. R., Rodilla-Rojo, J., García-Gordillo, M. Á., & Adsuar, J. C. (2020). Study of the Digital Teaching Competence of Physical Education Teachers in Primary Schools in One Region of Spain. *International Journal of Environmental Research and Public Health*, *17*, 8822. https://doi.org/10.3390/ijerph17238822

Salgado, C. (2019) *Análisis de la autopercepción del nivel de competencia digital docente en la ciudad de Valls.* [Unpublished master dissertation]. Universitat Rovira i Virgili.

Suárez-Rodríguez, J., Almerich, G., Orellana, N., & Díaz-García, I. (2018). A basic model of integration of ICT by teachers: competence and use. *Educational Technology Research and Development, 66*, 1165-1187. https://doi.org/10.1007/s11423-018-9591-0

The GenIUSS Group. (2014). *Best practices for asking questions to identify transgender and other gender minority respondents on population-based surveys.* (J. L. Herman, Ed.). The

Williams Institute. https://williamsinstitute.law.ucla.edu/wp-content/uploads/Survey-Measures-Trans-GenIUSS-Sep-2014.pdf

Tourón, J., Martín, D., Navarro, E., Pradas, S., & Íñigo, V. (2018). Validación de constructo de un instrumento para medir la competencia digital docente de los profesores (CDD). *Revista Española de Pedagogía, 76*(269), 25-54. https://doi.org/10.22550/REP76-1-2018-02

UNESCO. (2018). *UNESCO ICT competency framework for teachers.* https://unesdoc.unesco.org/ark:/48223/pf0000265721

Vuorikari, R., Punie, Y., Carretero, S., & Van Den Brande, L. (2016). *DigComp 2.0: The digital competence framework for citizens.* https://doi.org/10.2791/11517

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