



The big challenge: Integrating digital teaching competence in the training of pre-service teachers

El gran desafío: integrar las competencias digitales docentes en la formación de los futuros profesores

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Abstract

Preparing teacher candidates for teaching in the 21st century is a great challenge for universities. Teacher training programs must provide trainees with both theoretical and practical knowledge and opportunities for developing professional competences in the digital world. The aim of this study is to explore the perceptions of a group of pre-service teachers from a Catalan university on whether their training program and internship enabled them to develop their digital teaching competence. While developing this study, we deployed various qualitative and quantitative instruments of data collection and analysis. Results reveal there are weaknesses in their current training practices but also suggest that a process of change is taking place.

Keywords: Digital Skills; Competence Areas; Teacher Training Programs; School Internship

Resumen

Preparar a futuros docentes para la enseñanza en el siglo XXI es un gran desafío para las universidades. Es fundamental que los programas de formación integren conocimientos teóricos y prácticos y ofrezcan oportunidades para el desarrollo de la competencia profesional en un mundo digital. Nuestro estudio tiene como objetivo explorar las percepciones de un grupo de docentes en formación con respecto a si sus estudios de grado, les han permitido desarrollar su competencia digital docente; para ello, se utilizaron varios instrumentos cualitativos y cuantitativos de recogida y análisis de datos. Los datos muestran debilidades en su proceso de formación, pero también sugieren un incipiente proceso de innovación y cambio.

Palabras clave: Competencias digitales; Áreas de competencia; Programas de formación de docentes; Prácticas

INTRODUCTION

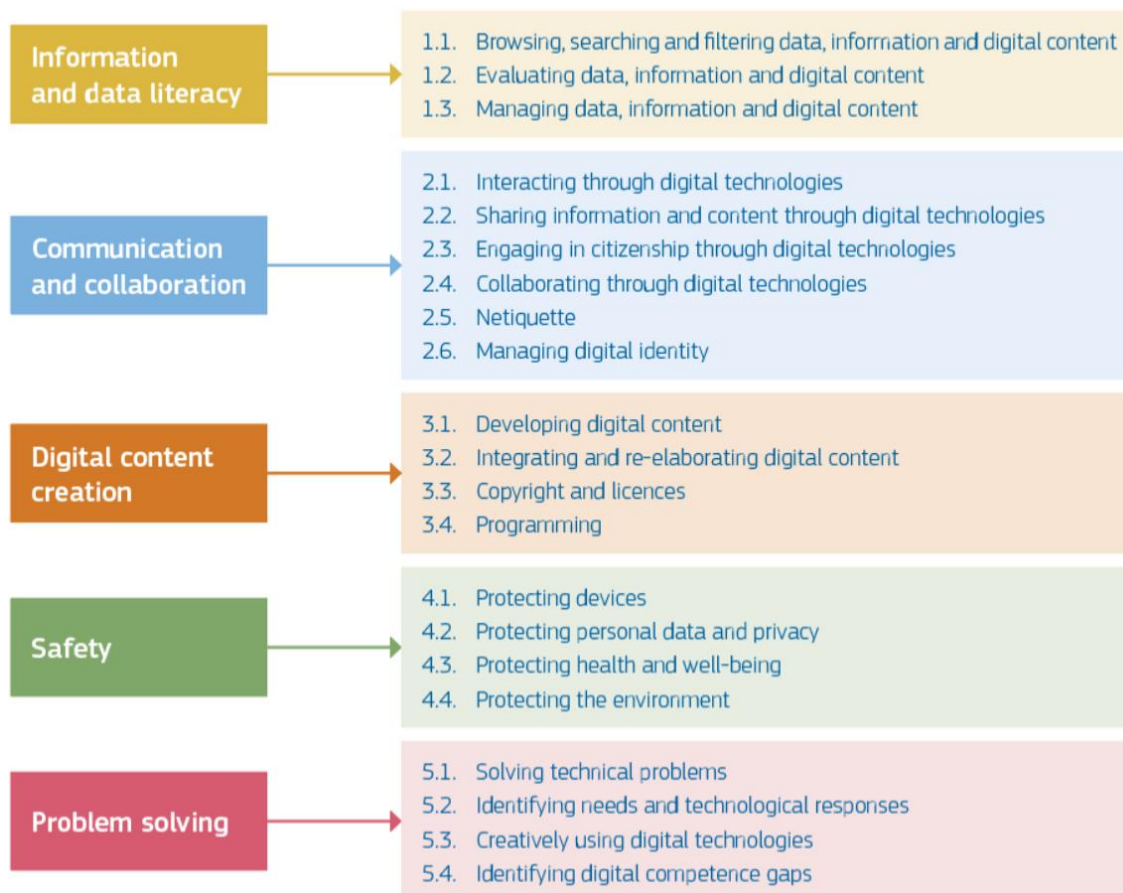
Social constructivism envisages learning as a social process of knowledge construction in which learners take an active role and teachers become facilitators rather than knowledge transmitters. The growing presence of the digital component in educational environments has brought new changes in classroom dynamics and the roles of teachers (Koehler et al., 2014; Llanes, 2019). Technology may serve as a mere tool for presenting information or content, a means to facilitate pre-service teachers' active exploration of knowledge, or a tool to enhance connectivity (Mercader, 2018). Consequently, educators must cultivate not only digital literacy but also pedagogical expertise. This view is encapsulated in the concept of Digital Teaching Competence (DTC), defined by Krumsvik (2011) as a set of knowledge, skills, attitudes, and creativity in the use of digital technology used by teachers.

DTC is described in *El Marco Común de Competencia Digital Docente* (Instituto Nacional de Tecnologías Educativas y Formación del Profesorado [INTEF], 2022; A Common Framework of Digital Competence for Teachers), which is the Spanish adaptation of The European Framework for the Digital Competence of Educators-DigCompEdu (Punie & Redecker, 2017). Both texts describe 22 competences organized in 6 areas: (1) Professional Engagement; (2) Digital Resources, (3) Teaching and Learning, (4) Assessment, (5) Empowering Learners and (6) Facilitating Learners' Digital Competence. The first one encompasses educators' professional competences; areas two, three, four and five relate to educators' pedagogy competences and the last area corresponds to the competences teachers need to help students to acquire. Professional engagement is not mentioned in all DTC descriptions. For example, Generalitat de Catalunya (2017) describes DTC as the combination of instrumental and methodological knowledge and abilities. In this article we subscribe this definition.

Both *El Marco Común de Competencia Digital Docente* (INTEF, 2022; A Common Framework of Digital Competence for Teachers), and The European Framework for the Digital Competence of Educators-DigCompEdu (Punie & Redecker, 2017) depart from two other documents European: DigComp: A Framework for Developing and Understanding Digital Competence in Europe (Ferrari, 2013) and The European Framework for Digitally Competent Educational Organisations-DigCompOrg (Kampylis et al., 2015). DigComp (Ferrari, 2013) describes the digital competences all citizens must achieve. To do so, it establishes 5 competence areas: (1) information and data literacy, (2) communication and collaboration, (3) digital content creation, (4) safety and (5) problem solving. These same 5

competence areas are used to describe DigCompEdu Area 6 as it makes sense that for teachers to facilitate learners' digital competence, they must first possess instrumental digital competences as digital users and producers. In turn these five areas encompass a total of 21 competencies, as illustrated in Figure 1.

Figure 1. The DigComp conceptual reference model (Vuorikari et al. 2022, p. 4)



Different works have analyzed the development levels of these 5 competence areas. For example, Esteve-Mon et al. (2020) and Rolf et al. (2019) identify the areas of Information and Information Literacy, Communication and Collaboration as the most developed. Conversely, Pozo et al. (2020) argue that Information and Information Literacy, Communication and Collaboration exhibit the lowest levels. In contrast, Batanero & Martín (2017) and Romero et al. (2017), suggest that the area of Digital Content Creation exhibits the greatest deficiencies, while for Villarreal-Villa et al. (2019) the area Security is the most challenging. Yet, several other investigations related to the development of DTC reveal that the self-perception of future teachers is higher than their true competence (see Moreno et al, 2018).

The Sectoral Conference of Education in Spain recently endorsed an agreement (BOE, 2022) emphasizing the critical need to enhance teachers' digital teaching competence (DTC) and to implement the DigCompEdu framework (Punie & Redecker, 2017). This agreement focuses on certifying and accrediting DTC and outlines the processes for accrediting various competence areas detailed in the *El Marco Común de Competencia Digital Docente* (INTEF, 2017; *Reference Framework of Teaching Digital Competence*). This agreement's publication is a noteworthy milestone in the realm of education in Spain, highlighting the urgency of equipping future teachers with essential digital teaching skills and promoting enhanced digital literacy among educators and pre-service teachers.

To ensure the development of DTC teacher training programs must recognize that although pre-service teachers may use ICT in their personal and social lives, they still require assistance in the development of their competences in the context of pedagogical ICT implementation (Liu et al., 2020). To address this issue, our study aims to explore the perspectives of a cohort of pre-service teachers enrolled in the Primary Education, English minor program at Universitat Autònoma de Barcelona (UAB) from 2014 to 2018, regarding whether their training program, including their internships, have enabled them to develop their Digital Teaching Competence. To achieve this goal, we seek to answer the following research questions:

1. Do pre-service teachers feel that during their four-year training program they developed competences in the five competence areas described in the DigComp conceptual reference model?
2. Do pre-service teachers' self-perception on the development of their digital methodological and instrumental competences coincide with the views of their university practicum tutor?

METHODOLOGY

Our study uses a mixed approach and a process of multiple triangulations to collect data from fourth year pre-service teachers of Primary Education, cohort 2014-2018, English minor, from the Universitat Autònoma de Barcelona (UAB). Thurmond (2001) states, triangulation is a method that confers credibility on the study, as it allows a more complete view of the phenomenon from various perspectives. The multiple triangulations process proposed in this study involves a) Data source triangulation (Patton, 1999) as data come from pre-service teachers, their internship tutors and internship mentors; b) Method triangulation (Patton, 1999), since

various data collection tools (interviews and questionnaires) were used and c) Analytical triangulation (Kimchi et al., 1991), as we used different quantitative and qualitative data analysis techniques.

To gather quantitative data, we designed an online questionnaire and sent it to 23 pre-service teachers. The questionnaire was validated before its distribution and was answered voluntarily by 20 pre-service teachers (86.9%). Our questionnaire consists of one general information section and five content-related sections, one per each of the DigComp (Ferrari, 2013) instrumental competence areas: Information and Information Literacy, Communication and Collaboration, Creating Digital Content, Security, and Problem-solving. The questions we posed were developed considering the descriptors of each five areas as illustrated in figure 1 and its levels of attainment as described in *El Marco Común de Competencia Digital Docente* (INTEF, 2017; Reference Framework of Teaching Digital Competence) for area 6.

In addition to the quantitative data, we collected qualitative data through semi-structured interviews addressed to five of the pre-service teachers who had answered the questionnaire. Each interview lasted approximately 25-30 minutes, during which we asked between 22-30 questions to explore their perceptions of the development of their methodological and instrumental digital competences during their undergraduate studies at the UAB. Interviews were recorded and we produced non-verbatim transcriptions. Participants were interviewed one by one, but excerpts 3 and 4 present the responses of the two participants to the same question one after the other. For sake of brevity, the corpus of this study is made up of the online questionnaire administered to the whole cohort, and the interviews conducted with 2 randomly selected pre-service teachers (Anna and Matilde) out of those 5 who were interviewed and their university practicum tutor (Elena).

The analysis of the data was conducted in two stages. In the first stage, a thematic analysis was applied to the qualitative data collected from the interviews to identify the main topics related to the development of DTC according to the perceptions of the pre-service teachers, university tutors, and school mentors. This was done through a categorization process involving classical content analysis and constant comparative analysis, where units of analysis were identified, given codes, and grouped into families that were associated with one another in networks.

The second stage involved a quantitative analysis of the data collected through the questionnaire. This analysis aimed to identify the primary differences and similarities in the development of various aspects of digital teaching

competence. The quantitative data were analyzed using percentages and the “T test”. This stage provided a clear understanding of the patterns and trends in the data, enabling us to draw informed conclusions about the development of DTC.

RESULTS

This section presents the results obtained in our research study. The first subsection addresses the first research question, examining the perceptions of the whole group of pre-service teachers regarding their instrumental digital competences and whether they feel their 4-year university training program helped them develop their DTC. The second subsection aims at comparing the views the two selected pre-service teachers, their internships tutors and mentors have regarding the application of the DTC during their internships.

The voices of the whole cohort of pre-service teachers

Having a global picture of the pre-service teachers' perceptions on the development of their instrumental digital competence is the first step we decided to take to understand student- teachers' views on their digital teaching competence. To explore this field, an online questionnaire was administered to the whole group of pre-service teachers. As previously mentioned, the questionnaire consisted of 5 content sections, aligning with the five instrumental competence areas outlined in DigComp (Ferrari, 2013), which encompasses a total of 21 competences, as illustrated in figure 1. Each section included one item to explore the context in which pre-service teachers considered they had acquired or developed the competence. Below we present the results obtained:

Information and Information Literacy

Our results indicate that the pre-service teachers perceive themselves as highly competent in this area. Specifically, 100% of the pre-service teachers reported feeling competent in navigation, search, and filtering, and in in the storage and retrieval of information while 95% reported feeling competent in the evaluation of information, data, and digital content. These findings were supported by the “T test”, with a mean of 13.0 and a standard deviation of 2.39 confirming the accuracy of the presented information. As a result, the null hypothesis was accepted based on these values.

Communication and collaboration

Our results indicate that the average group of pre-service teachers consider they have developed DTC skills in this area. Pre-service teachers reported high levels of competence in areas such as Interaction through digital technologies (100%), sharing information and content through digital technologies (100%), and collaboration through digital channels (100%). However, the field of citizen participation (65%) and digital identity (60%) were viewed as areas that needed improvement, while netiquette was considered deficient by 70% of the respondents. The results of the "T test" supported the reliability of the presented information, with a mean value of 19.2 and a standard deviation of 4.18. Furthermore, the null hypothesis was accepted based on these values.

Digital Content Creation

Our results indicate that pre-service teachers have not developed DTC skills in all the competences in this area. Specifically, digital content development (100%) and integration and reworking of digital content (95%) are viewed as strong fields. However, programming (65%) is perceived as an area that requires improvement. Additionally, pre-service teachers identified weaknesses in aspects such as copyright (45%) and licensing (50%). The veracity of this information is reinforced by the results of the "T test," with a mean of 15.6 and a standard deviation of 2.76. Consequently, the null hypothesis was accepted based on these values.

Safety

Our results indicate that pre-service teachers perceive themselves as quite competent in the areas of protection of devices and digital content (85%), the environmental protection (70%) and physical and psychological well-being (Physical aspect 100%, psychological aspect 80%). However, they did not very feel competent in the protection of personal data, digital identity/ privacy (55%). The reliability of this information is reinforced by the results of the "T test," with a mean of 15.5 and a standard deviation of 4.17. Consequently, the null hypothesis was affirmed based on these values.

Problem solving

Our results indicate that the surveyed pre-service teachers perceive that they have developed their DTC skills in Problem Solving. Specifically, they reported high levels of competence in solving technical problems (90%), in identifying problems and technological solutions (95%), and in identifying gaps in digital competence

(95%). Yet, they give a lower value to their abilities to innovate and make creative use of digital technology (75%). The accuracy of this information is supported by the results of the “T test”, with a mean of 13.0 and a standard deviation of 2.63. Thus, the null hypothesis was accepted based on these values.

Context of acquisition

Identifying the context in which pre-service teachers feel they have developed the instrumental digital competences as described in DigComp (Ferrari, 2013) is important to gain valuable insights into the acquisition of one part of their DTC. This section focusses on the analysis of this aspect.

a) Information and Information literacy. 25% of our informants mentioned that they acquired these competences through interactions with friends, family, or colleagues. Another 25% stated that they developed this competence both at the university and with friends, family, colleagues. Just 10% attributed their development of this competence solely to the education received at the university and the remaining 40% reported they did so through self-directed learning.

b) Communication and collaboration. 45% of informants attributed the development of their competence to a combination of factors, including input from friends, family, colleagues, and their formal university education. Conversely, 35% of respondents reported self-directed improvement in this area. Only 15% credited their university education as the sole source of competence development, with the remaining 5% acknowledging interactions with friends, family, or colleagues.

c) Creating digital content. 35% of respondents identified collaborative efforts involving friends, family, colleagues, and their university education as the primary means of competence development. Conversely, 30% emphasized the significant role of formal university education in this aspect. Another 25% cited self-directed learning as their path to competence, while 5% credited interactions with friends, family, or colleagues. It's worth noting that 5% of participants acknowledged their lack of competence in this domain.

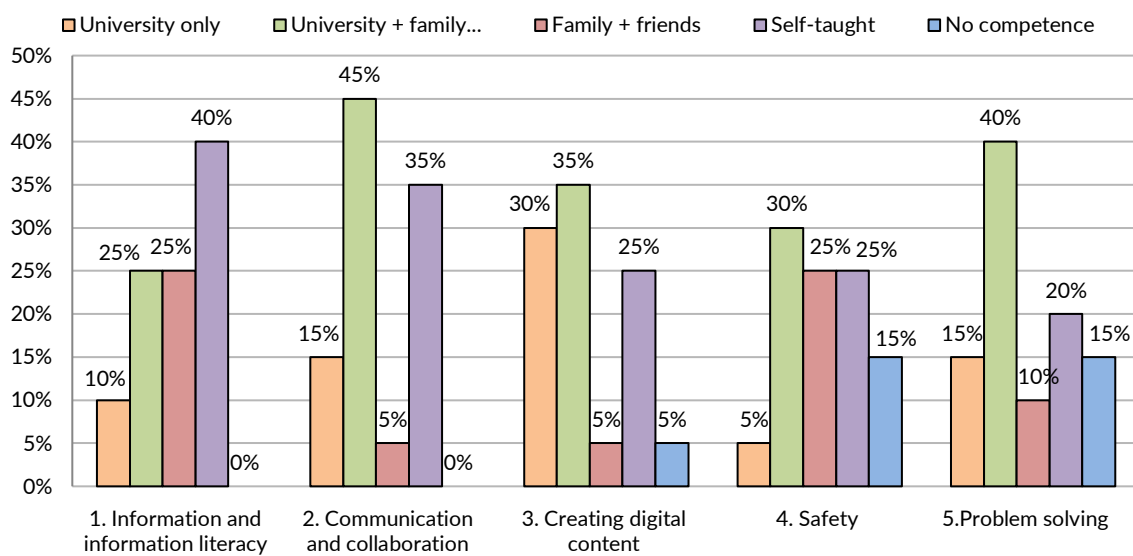
d) Safety. 30% of the respondents attributed their development of this competence to a combination of interactions with friends, family, colleagues, and formal university education. Another 25% reported that their competencies were primarily developed through interactions with friends, family,

or colleagues. Additionally, 25% emphasized self-directed learning as the main approach for acquiring safety competencies. Conversely, 15% acknowledged their lack of competence in this area, while the remaining 5% attributed their competence solely to university education.

e) Problem solving. 40% of our informants asserted that their competences were developed through a combination of interactions with friends, family, colleagues, and formal university education. Conversely, 20% of participants attributed their competence to self-directed learning. An additional 15% exclusively credited their university education for their competence. However, 15% acknowledged a lack of competence in this area. Finally, the remaining 10% attributed their problem-solving competencies to interactions with friends, family, or colleagues.

Figure 2 summarizes our results.

Figure 2. Context of development of pre-service teachers' instrumental digital competences



Narrowing perspectives on the pre-service teachers' development of their digital teaching competence

Addressing the second research question, we will examine the views and coincidences between two pre-service teachers and their internship tutor regarding their university training program and the application of DTC during the internships.

Developing DTC at the university

During the interviews, the two pre-service teachers only described practices related to two areas of the DigComp (Ferrari, 2013) framework, namely Creating Digital Content and safety. Let's observe what they say about the creation of digital content.

Excerpt 1. Creating Digital Content

Researcher: A nivel de tecnología, ¿cuáles crees que son las necesidades más apremiantes de la universidad? ¿qué haría falta implementar en la universidad? ¿qué te parece que no hay? O, ¿qué se puede mejorar?

At university, what would you say are the most pressing needs, at the technology level? What should be implemented in this university? What do you think it is missing or could be improved?

Anna: Es que yo creo que lo dan como que muy por hecho, como que nosotros ya sabemos mucho de tecnología creo porque, por ejemplo, ahora en el prácticum han dicho que vamos a hacer una web y nadie nos ha explicado cómo se hace una web, ni nada. Han dado como por hecho que todo el mundo, debe saber hacerlo.

I think they take it for granted, like if we already know a lot about technology, I think because. for example, now in the Practicum they have told us that we are going to make a website, and nobody has explained to us how to create a website or anything. They have taken for granted that everybody should know how to do it.

Researcher: ¿Tu hablabas de la página web que tienen que entregar ahora como trabajo final ahora en cuarto ¿no?

You talk about the website that you have to deliver now as final work in year 4, right?

Anna: Sí. En Prácticum V.

Yes. In Practicum V.

Researcher: ¿Has tenido que hacer alguna otra página web en algún otro momento?

Did you had to create any other website at some other time?

Anna: Sí, para tuvimos una asignatura en segundo, que era Learning and Development, entonces allí teníamos que hacer un portfolio y teníamos que entregarlo en el formato que nosotros quisiéramos. Podía ser en un Word o lo que fuera. Yo hice primero un blog y después descubrí la página web que era como, no sé, lo veía muy abstracto, y vi que realmente había plataformas en que tu sin tener que pagar podías crear una página web ¿no? Entonces lo hice allí y la verdad es que ese fue como mi inicio en el uso de plataformas.

Yes, for... we had a subject in second, which was Learning and Development, so there we had to make a portfolio and we had to deliver it in the format we wanted. It could be in a Word or whatever. I first made a blog and then I discovered the website that was like, I

don't know, I saw it very abstract, and I saw that there were really platforms where you could create a website without having to pay, right? So, I did it there and the truth is that that was like my start in the use of platforms.

In excerpt 1 Anna feels that none of the courses she has taken at the university focused on technology. It is interesting to observe, though, how Anna relates the concept of technology with the development of instrumental digital competences only. She complains because their teachers in year 4 expected them to use technology (e.g., to create a website) without having trained them on how to do so, but when she elaborates her answer, she also admits that in year two she had decided to create a website as the final product of another subject. 30% of the respondents to our questionnaire stated that they learnt to create contents thanks to the courses at the university and 25% through a self-learning process (see figure 2). Anna's answer seems to suggest that the border between these two categories may not be clearly cut and the university triggers pre-service teachers to explore by themselves their skills on creating contents.

Matilde, unlike Anna, does not seem to associate the concept of technology with the development of instrumental digital competences as we can observe in excerpt two.

Excerpt 2. Telecollaboration

Researcher: A nivel de tecnología, ¿cuáles crees que son las necesidades más apremiantes de la universidad? ¿qué haría falta implementar en la universidad? ¿qué te parece que no hay? O, ¿qué se puede mejorar?

At university, what would you say are the most pressing needs, at the technology level? What should be implemented in this university? What do you think it is missing or could be improved?

Matilde: Creo que, realmente, no hay ninguna asignatura aquí en la carrera en la que te enseñen tecnología ni que esté dedicada a la tecnología. Son asignaturas que tienen el foco en otro tema y utilizan la tecnología para excepto la de telecollaboration.

I think that there is really no course in our training program in which they teach you technology or devoted to technology. The subjects have the focus on another topic and use technology, except for the telecollaboration course.

Matilde, like Anna, states that university courses are not focused on technology. Yet, when she elaborates this first statement mentions one (telecollaboration) as an exception. Telecollaboration is a course in which they need to work online with students from another university to create and assess teaching sequences. So, in this case, Matilde's views on technology relates to her need to learn to use technology with a pedagogical end. When explicitly asked about courses

focused on the development of methodological digital competences, both pre-service teachers seem to agree.

Excerpt 3. Courses on the development of methodological digital competences

Researcher: Hay alguna asignatura en la que tú hayas aprendido. “pues mira, es que yo puedo utilizar, que sé yo, esto: para evaluar. O esto, con tal criterio” O sea, la herramienta tecnológica, pero con un criterio pedagógico.

Is there any subject in which you have learned... " Well, look, I can use, I don't know, this: to evaluate. Or that, with such criteria" That is, the technological tool, but with a pedagogical criterion.

Anna: Tecnología. La asignatura de este año de Telecolaboración. Quizás en el Prácticum. ha sido el momento. En los seminarios, cuando compartíamos con otras compañeras algún recurso que les iba bien a ellas, pues tú lo cogías de allí, pero no hay ninguna asignatura así de. Sí, por el intercambio. El intercambio de ideas.

Technology. This year's subject of Telecollaboration. Perhaps in the Practicum. It has been the time. In the seminars, when we shared with other colleagues some resource that were good for them. Then you took it from there. But there is no subject like that. Yes, for the exchange. The exchange of ideas.

Matilde: Sí, en, por ejemplo, la asignatura que tuvimos de “Telecollaboration”. Aprendimos a utilizar diferentes plataformas online para hacer esto, proyectos conjuntos. Bueno, también en una asignatura que tuvimos en tercero, de “Innovation” en la cual tuvimos que crear una plataforma para implementarla en nuestro proyecto.

Yes, in, for example, the subject we had of Telecollaboration. We learned to use different online platforms to do this, joint projects. Well, also in a subject we had in third, Innovation in which we had to create a platform to implement it in our project.

Both pre-service teachers mention the course of “telecollaboration” as a subject that allowed them to develop methodological digital competence and Matilde also mentions a course in “Innovation”. The fact that both pre-service teachers mention specific subjects in which they have developed their teaching digital competencies indicates that their course program attempts to preparing pre-service teachers in this area. Yet, their responses indicate that those courses were targeted at them as technology users (who had to learn to use different platforms) more than at technology producers. This situation seems to be different in the practicum seminars and during their internship, at least for Anna, who describes her experience during the “practicum seminars” as positive because she could discover language learning tools thanks to exchanging resources with their peers.

Developing DTC during the internships

We will focus on how the two pre-service teachers and their university practicum tutor describe the use of technology in the task of planning a teaching unit they would later implement during their internship.

Excerpt 4. Planning teaching sequences using technology

Researcher: ¿Cuándo planificaste esta unidad didáctica, incluiste de antemano actividades de tipo tecnológico?

When you planned this teaching unit, did you include beforehand technological type activities?

Anna: Hice un Proyecto de telecolaboración con otra estudiante de aquí, que está en San Cugat, y mis alumnos eran de tercero. Tenían que escribir como un cuento y luego la otra escuela votaba los mejores cuentos de aquí y nosotros los de ellos.

I did a project of Telecollaboration with another student from here, who is in Sant Cugat, and my pre-service teachers were third graders... They had to write like one story and then the other school voted for the best stories here and we theirs.

Matilde: Yo hice un proyecto llamado *Trip to London*, estaba básicamente enfocado a aprender la cultura de Londres, tanto el tiempo, como las costumbres, comida, sitios para visitar. El producto final que era crear una guía digital para futuros, bueno, viajeros a Londres. Entonces, ellos tenían, los niños tenían que utilizar la tecnología para crear este producto final.

I did a project called Trip to London; it was basically focused on learning the culture of London, both the weather and traditions, food, places to visit. The final product, which was to create a digital guide for future, well, travelers to London. So, they had, the kids had to use technology to create this final product.

In excerpt 4 we can see that having taken part in a telecollaboration project (see excerpt 3) allows pre-service teachers not only to develop instrumental digital competences in communication and collaboration but the experience itself constitutes a genuine example of the use of technology for methodological purposes. In the case of Matilde, she expects her primary students to become producers of digital contents (a digital guide), which also indicates that she constructs her proposal based as her experience as a learner (she had to create a platform for the course on Innovation, see excerpt 3). This transfer from a learning to a teaching experience is what makes the two learners feel they have developed their DTC. However, their university school tutor has a slightly different perception on that, as we can observe in excerpt 5.

Excerpt 5. Using ICT in the design of a classroom project

Researcher: Cuando tienen que preparar su unidad didáctica, su intervención en la escuela ¿tú les pides que también las utilicen con sus alumnos?

When they have to prepare their teaching unit, do you ask them to use them (technological tools) with their pupils?

Elena: En la medida de lo posible que utilicen alguna cosa, pero es algo que les cuesta muchísimo más. Yo creo que están acostumbradas a utilizarlo y creo que lo tienen tan interiorizado, saben cómo utilizar las herramientas, pero no saben cómo aplicar ese uso de las herramientas dentro del aula, con los niños.

As far as possible they should use some sort of tool, but it is something that they find extremely hard. I think they are used to using it and I think they have it so internalized, they know how to use the tools, but they do not know how to apply that use of the tools within the classroom, with the children.

As evident in excerpt 4 both pre-service teachers felt they had developed their DTC in year 4 when they were both challenged to create digital content (see excerpt 1) and to participate in a telecollaborative experience (see excerpts 2 and 3). Additionally, Anna linked her improvement with the possibility of exchanging digital resource with their peers in the practicum seminars (excerpt 3). In excerpt 5 we saw that they modelled their experience as learners to design a teaching unit using technology. Here we see that her university practicum tutor, acknowledges the instrumental digital competences of pre-service teachers (excerpt 6), and their familiarity as users with existing digital resources, but believes they find it difficult to put them at play in their teaching units. This somehow illustrates different perceptions on what being competent in the use of technology for education purposes means. For the pre-service teachers the development of their DTC relates to DigCompEdu (Punie & Redecker, 2017) competence area 2 (digital resources), that is, on their abilities to select, create, manage and share digital resources. Yet, her university practicum tutor DTC with DigCompEdu (Punie & Redecker, 2017) competence area 3 (teaching and learning), that is with the ability of teaching, guiding and the skills of promoting collaborative learning and self-regulated learning to facilitate learner's digital competence (competence area 6).

DISCUSSIONS AND CONCLUSIONS

This study reveals that the surveyed pre-service teachers exhibit a favorable self-perception of their competencies in information and information literacy, as well as in communication and collaboration. These findings are consistent with prior research conducted by Esteve-Mon et al. (2020) and Rolf et al. (2019), who similarly identified strengths in these areas among pre-service teachers in their

respective studies. Conversely, the collective responses to the online questionnaire highlighted a perceived weakness in safety, particularly in skills associated with the protection of personal data, and digital identity. This observation aligns with the findings of Villarreal-Villa et al. (2019). To address this identified weakness, various strategies may be implemented, including systematically incorporating digital safety topics into the curriculum, collaborating with subject matter experts, launching awareness campaigns, and facilitation of hands-on and project-based learning opportunities.

Research conducted by Romero et al. (2017) highlights deficiencies within the Digital Content Creation area. In contrast, our study suggests that, when evaluating the collective responses of pre-service teachers, there is an indication that they perceive the Digital Content Creation area as well-developed. However, upon a more detailed examination of each competence associated with this area, we observe that while strengths have been identified in digital content development and integration and reworking of digital content, other competencies such as copyright and licensing are perceived as weaknesses.

On a different ground, it is noteworthy that the context that encompasses university formal education, family, and friends has been identified as the most pertinent for the development of instrumental digital competences. This underscores the pivotal role played by the synergy between the academic milieu and social support structures, as they furnish complementary viewpoints and methodologies conducive to the enhancement of digital competencies. The university furnishes a robust theoretical and practical underpinning, whereas friends, family, and colleagues can impart distinct experiences and insights within authentic, real-world scenarios.

Regarding our second research question, it can be asserted that the two interviewed pre-service teachers, Anna and Matilde exhibit confidence in their development of DTC. This assertion is supported by their detailed descriptions of the development of both instrumental and methodological digital competences. With regards to the former, they cite different examples of content creation (e.g., web page designs as a product of a university course or as a platform to support the telecollaboration project that constitutes their teaching unit during the practicum). This observation aligns with the collective findings from the online questionnaire within the same area. With regards to the latter, they provide examples of how they incorporate technology in the planning of their teaching units. It is worth mentioning that both Anna and Matilde highlight the enlightening impact of their

practicum, especially within seminar settings, where extensive peer interaction and collaborative sharing of experiences significantly contributed to their collective learning.

Anna's and Matilde's perceptions contrast with those of their university practicum teacher. In alignment with the questionnaire results, Elena acknowledges their mastery of instrumental digital competences in Information and Information Literacy as well as in Communication and Collaboration. However, she asserts that one of their weaknesses related to their limited knowledge on how to use digital tools when teaching. This concern had been highlighted by the two pre-service teachers, as they pointed out that their training program lacked courses focused on technology integration within the educational context. Yet, the fact that Anna and Matilde feel they have acquired their DTC and are ready to enter the professional goal when her university practicum tutor outlines important weaknesses regarding their methodological digital competence aligns our results with those of Moreno et al. (2018), who discovered that the self-perception of future teachers regarding their DGT is higher than the actual findings.

To conclude, we would argue, in line with the proposal made by Gutiérrez Castillo & Cabero Almenara (2017), that actual teacher training programs offer pre-service teachers opportunities for developing their instrumental digital competences and for becoming familiar with existing teaching digital tools, it is necessary to focus training proposals in the fully development of their DTC, so more emphasis should be placed on the methodological integration of technology in the primary classrooms.

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