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Enhancing teachers' digital competence for combating disinformation and fake news through the use of social media in classroom

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Abstract

Enhancing the digital competences of teachers remains a critical and pressing issue, despite that fact almost two decades have passed since their inclusion in education legislation. The emergence of concerning and challenging scenarios, such as the widespread use of social media among minors and the rapid proliferation of disinformation, underscores the necessity for ongoing vigilance and adaptation in this domain. The present study is particularly significant as it examines the support provided to secondary education teachers in addressing the issue of disinformation and fake news in social media. This study has two primary objectives: first, to explore and describe the differences and similarities between teachers and students in terms of their digital competences, use of social media, and the management of disinformation; second, to design training materials for use in the classroom based on the findings. To achieve the first objective, a quantitative methodology was applied to a convenience sample comprising 1,186 students aged 12 to 18 and 166 secondary education teachers. Given the sample distribution, non-parametric statistical analyses were conducted, using the Mann–Whitney U test to compare independent groups. The results provide a basis for an educational approach that aims to improve three distinct areas of digital competence for teachers, as identified in the DigCompEdu framework: facilitating learners´ digital competence, supporting teaching and learning, and empowering learners. Findings from the second stage present a detailed guide for secondary education teachers, including innovative training materials and methodological support for effectively developing and integrating digital competences in the classroom.

Keywords: Digital competences, Teacher training, Disinformation, Social media, Secondary education, Media literacy

1 Introduction

In today's educational context, teacher training in digital competences is increasingly essential in order to effectively prepare students for the challenges of contemporary and future society (Cabero-Almenara et al., 2023; Guillén-Gámez et al., 2021). The European Framework for the Digital Competence of Educators, or DigCompEdu (Redecker & Punie, 2017), introduced by the European Union and adopted by all Member States, including Spain, serves as the foundational reference for adapting digital competences in

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response to the ongoing changes and transformations in an increasingly digitalized society. Two key phenomena frame the issue addressed in this study: First, the widespread use of social networks across the population, driven by the penetration of smartphones among children, adolescents and adults, as a mass-use device (Lena-Acebo et al., 2023; Pérez-Escoda et al., 2024; We are Social, 2025). Second, the global phenomenon of disinformation and fake news, described by the World Health Organization as an "infodemic" (WHO, 2020), which directly threatens democracies and civil liberties, with minors being an especially vulnerable population (Pérez-Escoda et al., 2023; Seijas, 2020). Thus, enhancing teachers´ pedagogical training to equip them with the necessary competences to navigate the multifaceted challenges posed by rapid digital transformation in education represents a social responsibility requiring unwavering commitment and continuous effort (Mas-García et al., 2024; Mercader, 2019). Designing effective teacher training plans involves two fundamental aspects: firstly, tailoring resources to meet social demands; and secondly, ensuring that teachers feel supported, thereby fostering confidence and security. Finally, minimizing the digital divide is essential to enable the implementation of didactic practices in the classroom that promote digital competences.

The research presented here forms part of a European Union-funded project designed to support secondary education teachers in enhancing their digital competences. Specifically, the project focuses on helping teachers use social media effectively in educational contexts, enabling both teachers and students to address disinformation and fake news within the environments where these issues are most prevalent: social networks.

This work therefore pursues two primary objectives: 1) to explore and describe the differences and similarities between teachers and their students regarding digital competences related to the issues outlined; and 2) to design training materials, based on these findings, that will enable teachers to develop didactic practices aimed at fostering these competences in their students.

1.1 Teachers' digital competence

> *The promotion of digital competence in education has been a top priority since the European Union published the Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning. This foundational document identifies digital literacy as one of the eight key competences that every adult should acquire to be competent member of society in the 21st century. The initial definition, which remains valid today, is as follows: Digital competence involves the confident and critical use of Information Society Technologies (IST) for work, leisure and communication. It is underpinned by basic ICT skills: the use of computers to retrieve, evaluate, store, produce, present and exchange information, and to communicate and participate in collaborative networks over the Internet (DOUE, 2006).*

Following this, the European Union conducted a series of in-depth studies through the Joint Research Centre. The most specific framework for educators´ digital competence is DigCompEdu (Redecker & Punie, 2017), which has been adopted by all EU member states. In Spain, DigCompEdu has been adapted into the Framework for Reference for Digital Teaching Competence (INTEF, 2022). This framework defines the professional

and pedagogical digital competences that enable teachers to foster their students´ digital competences in a cross-cutting manner, positioning the teacher as both a reference model and a facilitator of learning. The framework identifies six domains for developing these competences: 1) Professional engagement, 2) Digital resources; 3) Teaching and learning; 4) Assessment; 5) Empowering learners and 6) Facilitating learners' digital competence, further divided into 22 specific sub-competences. These domains provide teachers with comprehensive guidance for effectively developing digital competences (Cabero-Almenara et al., 2023; Fernández-Batanero et al., 2020); García-Ruiz & Pérez-Escoda, 2021). Since its establishment, this framework has enabled educators to implement efficient, innovative and inclusive teaching and learning strategies using digital tools.

Within this comprehensive framework, responsibility for the development of students' digital competences lies explicitly with teachers in the sixth domain 'Facilitating learners' digital competence'. The aim is to develop students' digital skills across five distinct areas: 1) media literacy in the processing of information and data; 2) understanding the mechanisms of communication, collaboration and digital citizenship; 3) learning to create digital content; 4) making responsible use of technology for digital well-being; and 5) learning to solve problems efficiently. The importance of these competences has become increasingly evident in recent years (Castañeda et al., 2021; UNESCO, 2024), driven by to two main factors. First, the widespread adoption of social networks among the population (We are social, 2025), which has significantly broadened the scope of the original 2006 framework, then primarily focused on ICT (Esteve-Mon, et al., 2020). Second, the unprecedent proliferation of misinformation on social networks (Fasching & Schubatzky, 2022; Shu et al., 2020), a phenomenon described as an information pandemic or *infodemic* (WHO, 2020).

Over the past decade, teaching practice has increasingly been shaped by the need to develop these digital competences with a dual purpose: first, to narrow the digital divide, as highlighted by numerous studies (Cabero-Almenara et al., 2022; Moreno-Morilla et al., 2021; Pérez-Escoda et al., 2020) particularly since the onset of the COVID-19 pandemic (Rodríguez-Alayo & Cabell-Rosales, 2021). Second, and of particular significance, to prepare students with the competences required for their future workplaces and to equip them to be competent citizens, in line with the 2006 Recommendation of the European Parliament.

In this context, lifelong learning has had a significant positive impact on teachers, with research showing improvements in their ability to create digital resources and in their professional engagement (Mas-García et al., 2024; Sánchez-Castellanos et al., 2024). Moreover, there has been an increased use of social networks for educational purposes (Lena-Acebo et al., 2023; Pérez-Escoda & Carabias-Herrero, 2025) and increased application of technology to support diversity (Cabero-Almenara et al., 2022). Nevertheless, challenges remain in developing students' digital competence and in assessment and feedback processes, which require further reinforcement and more specific didactic designs.

1.2 Digital divide between teachers and students

The digital transformation of education has intensified the focus on acquiring digital skills among both teachers and students. This shift has revealed a significant gap between the two groups, evident not only in access but also in the pedagogical, critical and reflective use of digital technologies. The so-called generational digital divide is reflected in differences in skills, attitudes and patterns of technology use between teachers and students, posing a challenge for delivering meaningful education adapted to the requirements of the twenty-first century (Cabero-Almenara, et al., 2023).

Recent studies show that secondary school students display greater fluency in informal digital environments, particularly on social networks, messaging platforms and audiovisual services (Pérez-Escoda & Carabias-Herrero, 2025). Conversely, although teachers have improved their digital competences, significant deficiencies persist in key areas such as content creation, digital safety, and the pedagogical integration of ICT (Fernández-Batanero et al., 2020). This divide creates tensions within the educational process, limiting teacher´s ability to engage with students' genuine digital practices and leverage them as educational resources.

This challenge is further exacerbated by the widespread presence of disinformation and the urgent need for media literacy. Students are constantly exposed to digital content of varying quality and reliability, yet educators often lack the necessary skills to teach students how to assess, compare, and critically analyze such information (García-Quismondo et al., 2024; Shu et al., 2020). As a result, the digital environment becomes a risky space: one in which students navigate with ease but without sufficient pedagogical support to develop their critical competences.

Attitudinal factors also play a role. While students tend to be enthusiastic and receptive towards technology, many teachers continue to view digital tools as a constraint or imposition rather than an opportunity (Mercader, 2019; Moreno-Morilla et al., 2021). This perception affects teachers' willingness to pursue professional development or experiment with new digital formats, thus sustaining the generational and methodological gap. Studies such as those by Sánchez-Castellanos and others (2024) emphasize that many training programs still focus primarily on instrumental and technical skills, neglecting key areas such as security, content creation and critical engagement in digital networks.

Consequently, the digital divide between teachers and students is not merely a matter of literacy, but represents a structural challenge that requires rethinking initial and ongoing teacher education, a revision of school curricula, and the implementation of strategies that promote connected, contextualized and meaningful learning. Addressing this issue is essential to ensure that educational systems integrate technology in a pedagogical, ethical and critical way.

1.3 Disinformation, fake news and media-digital literacy in the secondary school curriculum

The widespread use of digital technologies and the ubiquity of social networks have created a complex information environment where disinformation, fake news and manipulative discourse pose a real threat not only to the quality of democracy (Pérez-Escoda et al., 2024) but also to the educational development of younger generations. Within this

context, fostering media and digital literacy has become a crucial competence in education and while the Spanish legal framework acknowledges this necessity, the consistent and effective integration of these competences in secondary education classrooms remains a significant challenge (Herrero-Curiel & La-Rosa, 2022).

In Spain, as in other EU member states, recent educational reforms have prioritized digital literacy and critical thinking. Royal Decree 217/2022 of 29 March establishes the minimum educational requirements for compulsory secondary education and explicitly states that students must be able to identify disinformation, assess the reliability of sources, and use digital media in a critical and ethical manner – reflecting broader European policy trends toward media literacy education. As the most recent Spanish educational statute governing the organization and minimum teaching standards for compulsory secondary education, this law marks a substantial shift toward inclusivity and the integration of key competences that respond to contemporary challenges, including disinformation. In line with broader reforms under Organic Law 3/2020 (LOMLOE), it prioritizes the development of critical thinking, digital literacy, and social responsibility, equipping students with the skills necessary to recognize and counter disinformation. This emphasis is reflected in the fundamental competences and core subjects such as Geography and History, Spanish Language and Literature, Education in Civic and Ethical Values, and the elective Digitalization. For example, the CCL3 competence requires students to identify risks of manipulation and misinformation, and to transform information into knowledge with a critical approach, while respecting intellectual property (Royal Decree 217/2022, p. 27). The law also aims to foster responsible digital citizenship, preparing students to navigate environments characterized by *infoxication* or information overload.

Despite the existence of a robust legal framework, numerous studies have demonstrated a disconnect between the curriculum´s intentions and its implementation in practice. Effective teaching of media and digital literacy demands a critical and interdisciplinary approach, empowering students to interpret, analyze, and produce content in diverse formats (Berbel & Andrelo, 2024; Rusakov et al., 2022). However, this critical dimension is not always realized in classrooms, in part due to insufficient teacher training (Fernández-Otoya, et al., 2024; Pérez-Tornero & Varis, 2010; Sánchez-Cruzado, et al., 2021; Villar, et al., 2022). Moreno-Morilla and others (2021) highlight that media literacy in the Spanish education system remains underdeveloped, often fragmented, and reliant on individual initiatives rather than systematic or institutional policies.

Furthermore, recent analyses such as those by Weninger (2023) and Nash (2024) indicate that while these competences are incorporated into curricula, their implementation is often piecemeal and primarily focused on technical skills while neglecting essential areas such as communication ethics, information verification, and reflective media consumption. This limited perspective reduces the ability of schools to educate informed and active citizens in digital environments and increases students' vulnerability to phenomena like viral disinformation or hate speech.

This paper is framed within a European project designed to equip secondary school teachers with the necessary skills to address disinformation and fake news

by leveraging social networks in educational settings. The specific objectives of this research are twofold:

1) To explore and describe the differences and similarities between teachers and their students in digital competences associated with these challenges, including the management of information/disinformation, communication, content creation, responsible use of information and problem-solving.
2) To develop training materials based on these findings, aimed at supporting teachers in designing classroom practices that address these topics and, ultimately, foster the corresponding digital competences in students.

2 Method

To achieve the research objectives, a two-stage study was conducted, each corresponding to one of the two objectives. The study adopted an action-research framework, widely recognized as suitable for educational transformation processes. This methodology combines exploratory and descriptive research techniques with subsequent actions aimed at promoting change (Kemmis, 2009). In the initial phase (Step 1), a quantitative, descriptive and exploratory study was carried out, enabling the observation and description of the initial context and the analysis of the perceptions and practices in both target groups, teachers and students. A comparative, cross-sectional design was implemented, with Group 1 consisting of students (N = 1,186) and Group 2 consisting of their teachers (N = 166). The methodological approach was crucial in revealing not only the perceptions, practices, and uses within each group, but also in identifying the differences and similarities between them. Step 2 built on these findings to support teachers by advancing their training in digital competences and thereby enabling them to teach these competences effectively to students.

An ad hoc questionnaire was developed as the primary tool for data collection, considered the most appropriate for this research (Hernández-Sampieri et al., 2014). Given that data collection occurred across six countries –Spain, Austria, Greece, the Czech Republic, Bulgaria and Denmark– participants from each nation were invited to validate and approve the instrument. A panel of experts representing each country was recruited to refine the questionnaire, consisting of two university professors specializing in digital literacy, two experts in digital learning and educational design, two educational consultants from non-governmental organizations (the European Center of Entrepreneurship Competence & Excellence and Odpovědá společnost, z.s.) and two secondary school teachers. A rigorous procedure was followed for the design of the questionnaire. An initial draft version was prepared, informed by the project´s objectives and prior validated instruments (Lena-Acebo et al., 2023; Pérez-Escoda et al., 2024) and aligned with the study´s core keywords. The items were crafted to maximize clarity and precision, thereby ensuring the integrity of the data. The questionnaire was first written in English and subsequently translated into the six official languages of the participating countries. Experts then assessed each item, providing commentary where necessary via a shared Google Drive document, resulting in revision, rewriting, deletion or addition of items as appropriate. For a comprehensive variable analysis, all students completed the same questionnaire. The research protocol was approved by the Ethics Committee

of Nebrija University (registration code UNNE-2024–0007), to ensure compliance with standards established by the 1964 Helsinki Declaration and its subsequent amendments.

Each participating country contacted secondary schools willing to participate, resulting in a convenience sample aimed at recruiting committed educational communities rather than achieving representativeness. Given the differing personal data protection laws, data collection was limited to two socio-demographic variables would be collected: age and gender. Age was recorded as a numerical variable, while gender was registered as a nominal qualitative variable with three categories (1 = Female; 2 = Male; 3 = Other). This standardized approach ensures data consistency across all countries. The participant sample was described as follows: Group 1 consisted of students (N = 1,186), and Group 2 consisted of teachers (N = 166). In Group 1 (students) the gender distribution was 51.7% female, 45% male and 3.3% other; Mean = 1.52 and SD = .562. Age distribution was: 12 years (9.4%), 13 years (10.9%), 14 years (20.1%); 15 years (20%), 16 years (22.4%), 17 years (15.2%), and 18 years (2%); Min. 12 and Max. 18, Mean = 14.89 and SD = 1.579. For Group 2 (teachers): 63.6% female, 35.2% male and 1.2% 'other'; Mean = 1.38 and SD = .510. Aged ranged from Minimum = 21 to Maximum = 70, with Mean = 45.06, Median = 46 and Range = 51.

2.1 Instrument

For both the questionnaire and the quantitative research (Step 1), as well as the creation of materials (Step 2), the study adopted the digital competences outlined in the European reference framework DigiCompEdu (Redecker, 2017). This framework, widely adopted across Europe offers a robust and unified basis for the development of digital competences. Table 1 illustrates the digital competences relevant to each phase of the research process (Steps 1 and 2).

Table 1 The development areas and digital competences involved in each step of the process

Process	Development area	Digital competences involved
Step 1: Exploratory, descriptive, and comparative study	Area 6: Facilitating digital competence	6.1: Information and media literacy
		6.2: Communication
		6.3: Content creation
		6.4: Responsible use
		6.5: Problem solving
Step 2: Material design: Handbook for teachers and interactive online platform	Area 3: Teaching and learning	3.1.: Teaching: To plan and implement digital devices and resources in teaching process, so as to enhance the effectiveness of teaching interventions
		3.2: Guidance: To use digital technologies and services to enhance the interaction with learners, individually and collectively
		3.3.: Collaborative learning: To use digital technologies to foster and enhance learner collaboration
		3.4. Self-regulated learning: To use digital technologies to support learner´s self-regulated learning
	Area 5: Empowering learners	5.1 Accessibility and inclusion
		5.3. Actively engaging learners

The questionnaire was structured into four blocks to facilitate the analysis of the phenomenon of social networks and disinformation, drawing on previous research (Lena-Acebo et al., 2023; ,Pérez-Escoda et al., 2024). Block 1 encompassed sociodemographic variables (3 variables); Block 2 addressed use of social networks (15 variables and 88 items); Block 3 focused on the management of information on social networks (6 variables and 31 items); and Block 4 referred to the management of disinformation (11 variables and 41 items). Thus, the instrument consisted of a total of 35 variables and 150 items. The following study variables (Table 2) were selected, associated with the digital competences from areas 3, 5 and 6 of the DigComEdu framework (Table 1) relating specifically to blocks 3 and 4 of the questionnaire. To assess the internal consistency of the instrument and the reliability of the 50 items analyzed in this study, Cronbach's alpha was computed, yielding a total value of.847. This is above the commonly accepted threshold of.70, indicating a high level of reliability and consistency for the instrument. Moreover, Table 2 shows specifically the Cronbach's alpha for each area used in this analysis.

The statistical analysis, used to support the creation of digital resources for teachers in Step 2, compared two independent samples: Group 1 = students and Group 2 = teachers. To determine the most suitable statistical technique, a distribution analysis was first performed using the Kolmogorov–Smirnov test (recommended for samples larger than 50) which indicated non-normal distribution ($p < 0.05$). Given that the normality assumption was violated, non-parametric statistical methods were chosen. For the comparison of independent samples, the Mann–Whitney U test was deemed most appropriate (Hernández-Sampieri et al., 2014). The results are presented a significance level of $p < 0.05$ with a of 95% confidence interval.

3 Results

3.1 Results for quantitative study (Step 1)

The comparison of independent samples determines the decision to retain the null hypothesis (H_0 = There are no differences between groups) or reject it in favor of the alternative hypothesis (H_1 = There are differences between groups). This is critical for

Table 2 Study variables and digital competences

Digital competences associated	Variables of study	Cronbach's Alpha value
Information and media literacy	V_1 = Finding information (8 items) V_2 = Trust consideration for information found (13 items) V_3 = Fake news recognition (1 item) V_4 = Recognition of concepts associated with disinformation (10 items)	.797
Communication and Digital collaboration	V_5 = Fake news sharing V_6 = Fake news distribution (13 items)	.874
Digital content creation	V_7 = Fake news creation (6 items)	.701
Responsible use	V_8 = Information judgement (7 items) V_9 = Information verification (1 item)	.773
Digital problem solving	V_{10} = Fact-checking practice (1 item) V_{11} = Strategies used to confirm information (1 item)	.698

the design of the training modules, ensuring that teachers receive appropriate training before instructing their students.

The results are presented according to the associated digital skills outlined in Table 2. The first set of results corresponds to variables related to "Information and media skills", which include four variables (V_1, V_2, V_3 y V_4). Table 3 shows the initial outcomes following the application of the Mann–Whitney U test.

The results for variable one (V_1) show significant differences across all eight items ($p < 0.05$). As expected, these differences reflect the generation gap between the two groups, which have markedly different information consumption habits. Despite this generational divide, it is noteworthy that both groups report obtaining the majority of their information via the Internet and social networks.

The Mann–Whitney U test for independent samples was used to compare perceptions between students and teachers for variable two (V_2) which addresses the question: "To what extent do you consider the content trustworthy on the: Facebook, Instagram, TikTok, X, WhatsApp, YouTube, etc.". Significant differences between groups were found for Facebook ($z = -11.353$; $p = <.001$); Instagram ($z = 9.445$; $p = <.001$); TikTok ($z = 12.246$; $p = <.001$); X ($z = 2.315$; $p = <.005$); WhatsApp ($z = 5.647$; $p = <.001$); YouTube ($z = 5.844$; $p = <.005$); Be Real ($z = 8.647$; $p = <.001$); Discord ($z = 6.441$; $p = <.001$); Pinterest ($z = 6.271$; $p = <.001$); Snapchat ($z = 7.381$; $p = <.001$). Figure 1 illustrates the frequency distribution, highlighting the differences between the groups. Participants responded using a 6-item Likert scale from 0, indicating "I do not use this social media", and rising from 1 to 5 showing increasing levels of trust.

The results for variable $V_{3,}$ which measures "How often can you recognize fake news and/or disinformation?" show statistically significant differences when Mann–Whitney U Test was performed ($z = -2.836$; $p = .005$). As expected, teachers showed

Table 3 Frequencies in percentages and Mann–Whitney U Test for independent samples for the variable one (V_1)

How do you normally get informed?								
		Never	**Rarely**	**Sometimes**	**Often**	**Always**	***z***	***p****
Internet	G1	7.3%	15.6%	28.9%	30.9%	17.4%	−5.302	<.001
	G2	2.4%	4.2%	23.5%	45.8%	24.1%		
Social networks	G1	8.6%	14.8%	27.2%	33.5%	15.9%	3.394	<.001
	G2	13.9%	14.5%	34.3%	31.9%	5.4%		
TV	G1	16.3%	25.5%	30.3%	19.2%	8.7%	−3.719	<.001
	G2	11.4%	15.7%	31.9%	30.1%	10.8%		
Radio	G1	48.7%	26.8%	16.4%	5.5%	2.6%	−10.370	<.001
	G2	15.7%	22.9%	28.9%	23.5%	9.0%		
Newspapers	G1	66.1%	22.5%	7.3%	2.2%	1.9%	−10.644	<.001
	G2	29.5%	25.9%	22.3%	16.9%	5.4%		
My friends	G1	6.1%	13.9%	34.9%	32.0%	13.1%	4.011	<.001
	G2	4.8%	12.7%	60.2%	19.3%	3.0%		
My family	G1	4.0%	11.8%	32.6%	35.7%	15.9%	7.947	<.001
	G2	11.4%	23.5%	42.2%	19.9%	3.0%		
Classmates	G1	9.4%	21.9%	33.1%	23.3%	12.3%	4.184	<.001
	G2	15.7%	23.5%	41.6%	18.1%	1.2%		

* *p* value < 0.05. G1 = students and G2 = teachers

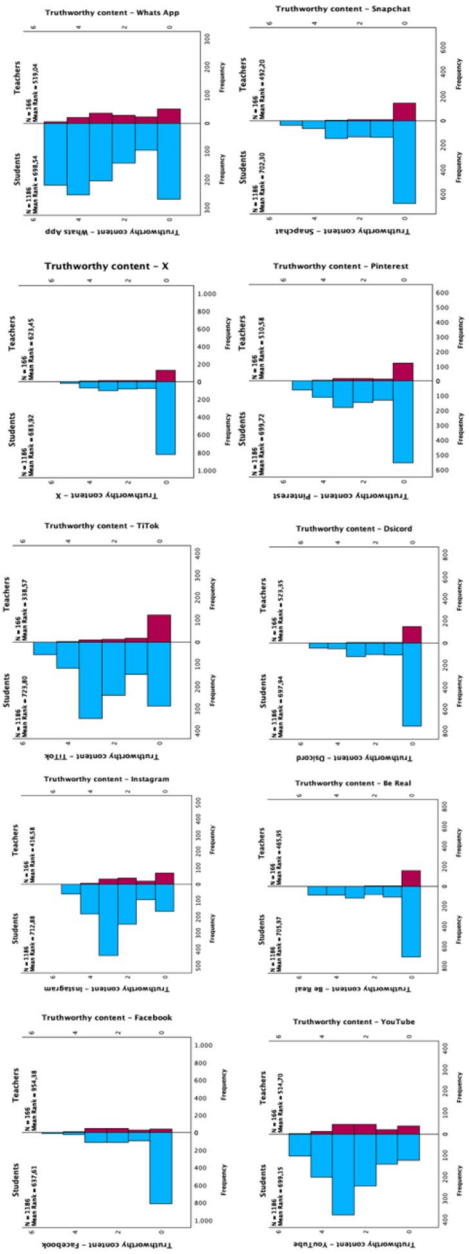

Fig. 1 Frequencies and descriptives of trustworthiness for social media between both groups: students and teachers

greater confidence in their ability to recognize fake news and/or disinformation, with six out of ten teachers reporting they "often or always" recognize such content compared to only four out of ten students.

As shown in Table 4, the null hypothesis was retained for variable V_4 across a total of 10 items following the Mann–Whitney U test. However, where differences were detected, statistical significance was observed.

The results for variables V_1 to V_4, offered important insights for the design of training modules focused on the concepts of disinformation and fake news, particularly in relation to social media and information consumption. The findings for these variables facilitated the identification of consumption patterns within both samples, enabling an analysis of how information is accessed, the perceived trustworthiness of information, the ability to recognize fake news, and the understanding of concepts associated with disinformation. These findings formed the foundation for Modules 1 and 2 (see Section 3.2, step 2).

Further analysis was conducted of the variables associated with "Communication and Digital collaboration" digital skills area. The first variable referred to consciously sharing fake news. The Mann–Whitney U test identified statistically significant differences between students and teachers ($z = -3.323$; $p = <.001$).

As illustrated in Fig. 2 showing the results for both groups for variable five (V_5), differences between groups are apparent. Specifically, 52.3% of students reported never having shared fake news, compared to 64.5% of teachers. Notably students were more prone to sharing fake news unknowingly, 32.3% compared to 20% of teachers. Additionally,

Table 4 Frequencies in percentages and Mann–Whitney U Test for independent samples for variable four (V_4)

		N	Yes	No	*Z*	*p**
Disinformation	G1	1,186	92.6%	7.4%	2.400	.016
	G2	166	97.6%	2.4%		
Clickbaiting	G1	1,186	58.3%	41.7%	–.988	.323
	G2	166	54.2%	45.8%		
Hoax	G1	1,186	73.1%	26.9%	2.601	.009
	G2	166	82.5%	17.5%		
Infoxication	G1	1,186	45.4%	54.6%	3.429	<.001
	G2	166	59.6%	40.4%		
Post-truth	G1	1,186	41.6%	58.4%	4.685	<.001
	G2	166	60.8%	39.2%		
Bot	G1	1,186	84.4%	15.6%	–8.366	<.001
	G2	166	57.2%	42.8%		
Infodemic	G1	1,186	21.1%	78.9%	3.986	<.001
	G2	166	34.9%	65.1%		
Polarization	G1	1,186	36.3%	63.7%	10.855	<.001
	G2	166	80.7%	19.3%		
Fact-checkers	G1	1,186	51.4%	48.6%	2.419	.016
	G2	166	61.4%	38.6%		
Deep Fake	G1	1,186	58.5%	41.5%	3.394	<.001
	G2	166	72.3%	27.7%		

* *p* value < 0.05. G1 = students and G2 = teachers

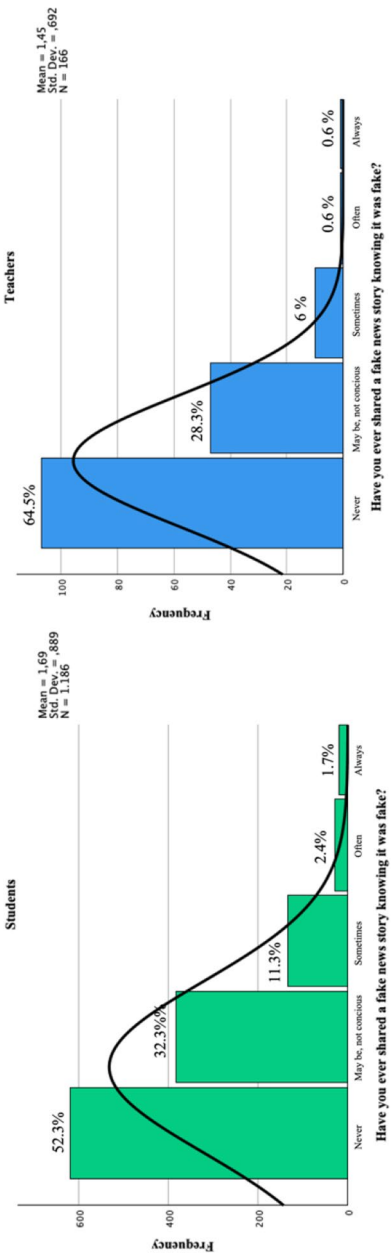

Fig. 2 Histograms for variable five (V_5) from students and teachers

15.4% of students reported having shared fake news at some point, compared to 7.2% of teachers.

The Mann–Whitney U test for independent samples comparing perceptions between students and teachers for variable six (V_6): "To what extent do you think fake news and/or disinformation is distributed through: Media (TV, radio, press), Facebook, Instagram, TikTok, X, WhatsApp, YouTube, etc." revealed significant differences between groups for several platforms: Media (TV, radio, press) ($z = -5.157$; $p = <.001$); Facebook ($z = -9.491$; $p = <.001$); Instagram ($z = 1.969$; $p = .049$); TikTok ($z = 8.047$; $p = <.001$); WhatsApp ($z = -4.936$; $p = <.001$); Twitch ($z = 3.755$; $p = <.001$); Discord ($z = 4.423$; $p = <.001$); Pinterest ($z = 2.502$; $p = .012$); Snapchat ($z = 4.457$; $p = <.001$). However, no significant statistically differences were found between groups in the case of: X ($z = .277$; $p = .782$) and YouTube ($z = -.977$; $p = .328$).

Figure 3 presents the frequency distributions and descriptive statistics showing differences between groups. Responses were recorded on a 6-item Likert scale from 0, indicating "I do not use this social media", and rising from 1 to 5 showing increasing degrees of trust. As can be seen in Fig. 3, student responses were broadly distributed along the scale, reflecting their more active engagement with various media platforms.

Although only a small percentage of participants from both groups reported sporadic sharing of fake news (V_5), the researchers considered it advisable to create teaching materials aimed at helping students and teachers identify and understand the cognitive biases that influence their perception of information on social media, and to recognize common manipulative techniques for disseminating fake news. Additionally, intriguing findings emerged from V_6: paradoxically, although students predominantly obtain information from social media platforms such as Instagram and TikTok, they perceive these platforms as major distributors of fake news. This prompted researchers to design materials that assist students in understanding how their usage habits influence their social media activity, and to foster both self-awareness and social awareness for responsible engagement with online content. Subsequently, the results from V_5 and V_6 provided researchers valuable insights reaffirming the need for a dedicated training module focused on psychological and emotional responses to disinformation (Module 3, see Section 3.2).

The following variable (V_7) refers to fake news creation, in this case related to the digital competence area linked to "Digital content creation". Comparative results between students and teachers show an interesting variety in the significance of data obtained (Table 5).

Teachers and students show similar perceptions regarding the creation of fake news or disinformation out of boredom ($z = 1.658$: $p = .076$) or for fun ($z = 1.772$; $p = .097$). with no statistically significant differences between the groups. However, teachers are significantly more likely to attribute the creation of fake news and disinformation to malicious intent ($z = -3.935$; $p = .<.001$), political interest ($z = -5.918$; $p = .<.001$) and economic gain ($z = -6.224$; $p = .<.001$). The divergence in perceptions on political and economic motivations aligns with the noted lack of ideological competence among adolescents, as previously documented by Scolari (2018) in the European Transliteracy project.

Regarding the "Responsible use", two variables were analyzed: V_8 "Information judgement" encompassing seven items, and V_9: "Information verification" consisting of one

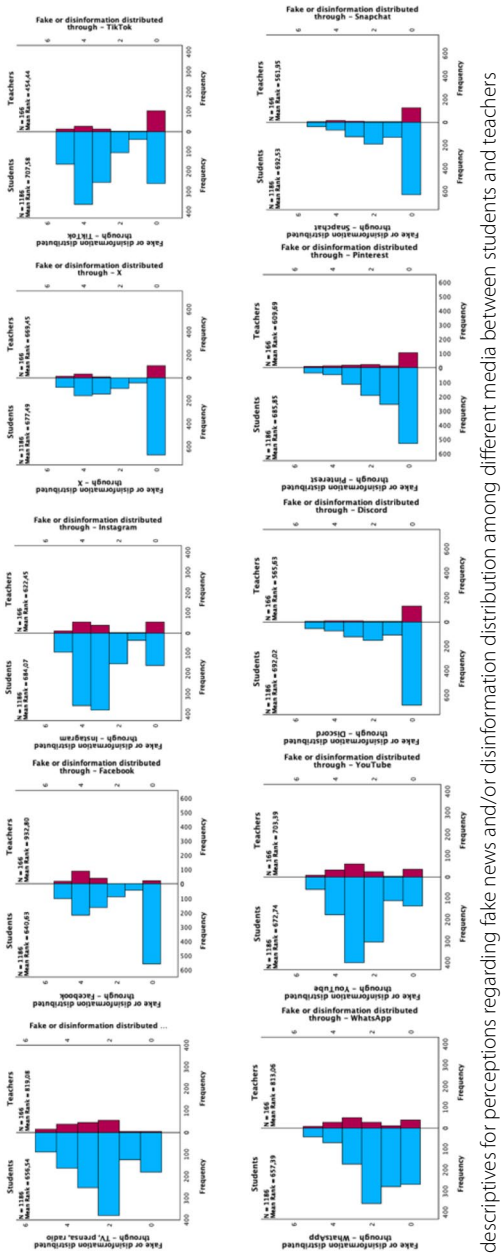

Fig. 3 Frequencies and descriptives for perceptions regarding fake news and/or disinformation distribution among different media between students and teachers

Table 5 Frequencies in percentages and Mann–Whitney U Test for independent samples for variable seven (V_7)

Why do you think fake news or disinformation is created?								
		Never	**Rarely**	**Sometimes**	**Often**	**Always**	***z***	***p****
By mistake	G1	34,1%	39,9%	19,1%	5,3%	1,7%	−2.245	.025
	G2	27,1%	38,6%	26,5%	7,2%	0,6%		
By malicious intent	G1	4,6%	10,6%	27,5%	42,0%	15,3%	−3.935	<.001
	G2	0,0%	4,8%	24,1%	49,4%	21,7%		
Out of boredom	G1	9,6%	17,5%	31,5%	32,0%	9,4%	1.772	.076
	G2	12,0%	16,9%	36,7%	30,1%	4,2%		
For fun	G1	7,6%	13,7%	32,5%	34,7%	11,6%	1.658	.097
	G2	4,8%	13,3%	43,4%	36,7%	1,8%		
For political interests	G1	6,4%	12,1%	25,4%	37,1%	19,0%	−5.918	<.001
	G2	0,6%	2,4%	17,5%	50,6%	28,9%		
For economic interests	G1	5,8%	13,7%	29,1%	33,2%	18,1%	−6.224	<.001
	G2	1,2%	1,8%	19,9%	50,0%	27,1%		

* *p* value < 0.05. G1 = students and G2 = teachers

item. The Mann–Whitney U test comparing student and teacher perceptions related to V_8 focused on the question: "Based on what do you judge the content on social media?" reveal statistically significant differences in three of the seven items. Students were more likely than teachers to judge content on social media based on the number of likes (z = 6.523; p = <.001), clearly illustrated in the frequencies shown in Fig. 4. Conversely, teachers were more inclined to assess the credibility on content based on the source, as evidenced by the statistically significant difference favoring teachers in this regard (z = −4.031; p = <.001), also apparent in the frequencies for Fig. 4.

Contrary to previous findings, students were more likely than teachers to judge content based on it being shared by an influencer with statistically significant differences observed (z = −4.031; p = <.001). Interesting results were found for the items not showing statistically significant differences (p = > 0.05) within V_8 variable: "Affinity with my ideas" (z = 1.624; p = .104); "Comments from others" (z = .942; p = .346); "Because a friend sent it to me privately" (z = 1.657; p = <.098); "Because it was shared by a media outlet (z = −1.415; p = .157).

For the second variable in this area, V_9: "Verify information from multiple sources before believing or sharing it across", statistically significant differences were also found (z = −7.845; p = <.001). As expected, teachers were more likely to verify information "often (22.3%) or always (28.3%)" compared to students who verified "often (14.4%) or always (7.3%)". Nonetheless, it is notable that students tend to verify information when it is especially important (38.3%), as observed in Fig. 4.

All data collected from V_7 to V_9 enabled the researchers to develop an ethical and responsible approach within the sample, paving the way for the creation of Module 4 (see Section 3.1, Step 2). The insights were especially valuable for creating content related to the promotion of respectful and informed online behaviour, the necessity of fostering responsible digital citizenship, and the importance of cultivating a more analytical and critical approach to processing information in the digital sphere.

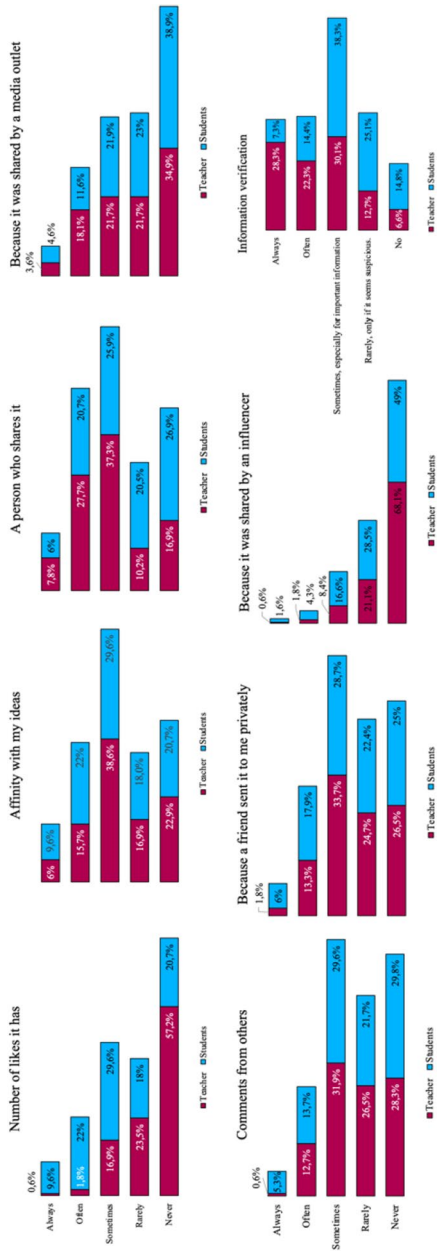

Fig. 4 Frequencies for perceptions regarding variable eight (V_8) "Information judgement by…" and variable nine (V_9) "Information verification"

Table 6 Frequencies in percentages and Mann-Whitney U Test for independent samples for the variable ten (V_{10}) and variable eleven (V_{11})

V_{10}: Do you tend to fact-check information shared on social media?							
	Never	Rarely	Sometimes	Often	Always	*z*	*p**
G1	18.1%	32.4%	30.9%	14.4%	3.5%	-7.481	<.001
G2	4.8%	17.5%	39.8%	31.9%	6%		
V_{11}: Use of strategies or tools to confirm what comes to you							
	Yes	No				*z*	*p**
G1	43,7%	56,3%				2.993	.003
G2	56,0%	44,0%					

* *p* value <0.05. G1= students and G2= teachers

Finally, two variables related to the "Problem solving" competence area were analyzed: V_{10}: "Do you tend to fact-check information shared by friends or family on social media? and, V_{11}: "Do you use any strategies or tools to confirm what comes to you? As shown in Table 6, statistically significant differences were found for both variables.

Notably, although statistically significant differences were found for both variables: V_{10}: Do you tend to fact-check information shared on social media? (z = –7.481; p = <.001) and V11: Use of strategies or tools to confirm what comes to you, (z = 2.993; p = <.005), fact-checking is not widely practiced. Approximately 18% of students report fact-checking information "often or always", whereas this figure rises to almost 38% for teachers. Regarding the use of strategies or tools to verify information from social media, some four out of six students reported using such methods, compared to nearly six out of ten teachers.

3.2 Results of the design of an educational approach (Step 2)

The results provide a general overview of the digital competence of teachers and students, enabling an assessment of the current situation. The data allowed the research team to identify specific weaknesses in digital literacy for the development of a targeted pedagogical approach aimed at addressing these gaps. The design of training modules was established in a multi-stage process. Firstly, each nation was tasked with the creation of a report that emphasized the primary issues. Secondly, an internal report encompassing all results obtained was to be compiled as one of the project's work packages. Thirdly, in accordance with the findings of the project, the coordinator identified the primary domains constituting the various modules, which were subsequently endorsed and recognized by the partners. Subsequently, prior to numerous online meeting sessions with all partners and a face-to-face meeting, partners established the learning objectives for each module, as illustrated in Table 6.

Table 7 shows the learning modules created and the learning objectives for each module:

All the materials have been incorporated into a digital platform, and a comprehensive teacher's handbook was created for teachers (the link to the material is not included in order to maintain the anonymity of the paper). Importantly, feedback from meetings

Table 7 Learning modules designed and learning objectives for each module

Learning modules designed	Learning objectives of the module
Module 1: Introduction to disinformation and fake news	Define information disorders Identify the sources and motivations behind the spread of disinformation Recognize common tactics used to spread disinformation Evaluate the credibility of information Apply critical thinking skills to analyze information Practice responsible sharing of information online
Module 2: Social media and information consumption	Distinguish the different social media platforms and their main functions Recognize bias and manipulation techniques Analyze content critically rather than accepting it at face value Act responsibly by verifying sources and questioning the intent behind content Build a personalized set of trusted resources and tools that empower lifelong learning Learn how to use social media constructively while mitigating its negative impacts
Module 3: Psychological and emotional reactions to disinformation	Identify and understand cognitive biases influencing perception of information we encounter on social media Recognize commonly used manipulative techniques used to spread fake news Understand how habits influence our activities on social media Develop self and social awareness skills to deal responsibly with social media content
Module 4: Ethical considerations and responsible information sharing	Promote respectful and informed online behavior Foster responsible digital citizenship Promote a more analytical and critical approach to one's processing in the digital sphere
Module 5: Detecting fake news and disinformation	Recognize commonly used manipulative techniques used to spread fake news Develop critical thinking and media literacy skills to evaluate online content effectively Use online verification tools to fact-check information Practice responsible online behavior

with teachers revealed a common challenge: many found it difficult to deploy the materials in a pedagogical manner and as part of the formal curriculum. To address this need, an additional module –Module 6: "Apply this knowledge to your area"– was created. This methodological module was designed to help teachers adapt the content from previous modules to their individual subject areas using didactic and pedagogical approaches. This was performed simultaneously, but not based on the results obtained in Step 1. The learning objectives of Module 6 were designed to facilitate the implementation of the training materials related to disinformation and fake news. These objectives were: to implement social media in the classroom from an appropriate perspective; to use social media safely and effectively in teaching; to introduce social media as a tool to counter disinformation across all disciplines; and to create a classroom Personal Learning Environment (PLE) that supports the teaching of all module content. These consist of innovative materials accompanied by interactive activities specifically designed for students to apply what they have learnt in practice.

4 Discussion and conclusion

The importance of digital competences in teacher training has been thoroughly investigated for nearly two decades, since their integration into the education legislation of European countries (Cabero-Almenara et al., 2022; Cabero-Almenara et al., 2023; Mas-García et al., 2024; Pérez-Escoda et al., 2020; Palacios-Rodríguez et al., 2023; Sánchez-Castellanos et al., 2024; Sánchez-Cruzado et al., 2021; Villar et al., 2022). Additionally, extensive training programs have been launched on a national level. In Spain, for instance, the INTEF has been instrumental in providing teachers with recognized certifications and credentials attesting to their digital proficiency levels while similar initiatives have also been established throughout Europe.

Nevertheless, the rapid evolution of the social and technological landscape, exemplified by the widespread adoption of social media among minors and the increasing prevalence of disinformation and fake news, calls for new approaches in the development of digital competences (Gisbert-Cervera & Caena, 2022); Martínez-Otón, 2022). Sustained research and development of digital competences is essential, requiring constant and intense efforts from the academic community, including continuous training for teachers in their challenging task of preparing students for the dynamic demands of the digital era. This study highlights the importance of regularly updating digital skills, particularly to address issues such as disinformation. The main conclusions of this research are summarized below:

Both students and teachers habitually access information using the internet and social networks, reflecting an increasingly prevalent trend. Previous studies indicated that this behavior was more characteristic of younger users than adults (Guillén-Gámez et al., 2021; Mercader, 2019). This trend, identified in this project, is crucial for developing effective training approaches, particularly as teachers are becoming more familiar with digital environments. Nonetheless, clear differences are evident in their trust of media sources; specifically, students are more likely to trust the platforms they use most: Instagram, TikTok and WhatsApp. This finding marks a departure from prior studies, which found that students tended to be skeptical of the very platforms they most frequently accessed (Pérez-Escoda et al., 2024; Mendiguren et al., 2020). Such insights must inform future training programs. The conclusion is indisputable: there is an urgent need to develop a robust degree of digital competence, particularly in response to misinformation, and to support the cultivation of genuine critical thinking ability among young people. This latter ability is clearly lacking in students' educational development, as demonstrated by the dissonance revealed when young people say they mostly get their information from social media, despite being aware that social media is a major distributor of fake news. To address this paradox, Module 3 includes training materials and specific activities designed to: identify and understand the cognitive biases that influence our perception of the information we encounter on social media; recognize the commonly used manipulative techniques that are employed to spread fake news; understand how our habits influence our activities on social media; develop self- and social awareness skills in order to engage with social media content responsibly.

In the area of 'Responsible Use', the conclusions suggest that both groups (students and teachers) judge online information in line with Social Influence Theory (Kelman, 1974). Participants are especially influenced by the source of information, and by

messages received from friends, privately. This highlights the importance of the social environment in shaping one's beliefs through online social influence (Kurt Lewin) and certainly exacerbates the filter bubble phenomenon (Pariser, 2012). Subsequently, the divergence in perceptions regarding political and economic motivations aligns with the observed lack of ideological competence among adolescents. These results informed Modules 1 and 4. The first module aimed to provide students with a framework for understanding complex phenomena such as disinformation and information disorders, and for identifying the sources and motivations behind the spread of disinformation. It also aimed to help students recognize common tactics used to spread disinformation and evaluate the credibility of information. As for Module 4, the results highlighted the need to promote respectful and informed online behavior, firstly by fostering responsible digital citizenship and, secondly, by encouraging a more analytical and critical approach to processing information in the digital sphere. It is worth mentioning that each module was completed with several interactive activities to help students develop the expected skills.

The following conclusion can clearly be drawn from these findings: there is a notable lack of knowledge regarding disinformation in the 'problem solving' area. Although fact-checking has been described as "one of the most popular innovations designed to address the prevalence of disinformation" (Walter et al., 2019, p.2), the evidence from this study suggests that it is not practiced as extensively as expected, consistent with the findings of Wineburg and McGrew (2016). These results are echoed in Scolari's report *Adolescents, Media, and Collaborative Cultures*: "The results demonstrate the discrepancy between institutions (media, fact-checkers, etc.) and academia, which attributes added value to the way young people participate in a converging media landscape" (Scolari, 2018, p. 61). While in theory, fact-checkers are a powerful tool for combatting disinformation and can effectively reduce false beliefs across diverse populations, in practice, their use among citizens remains limited.

It is important mentioning that this study has several limitations, so the findings may not be generalized beyond the participating countries or to different educational systems and curricula. Firstly, although the instrument demonstrated adequate internal consistency ($\alpha = .847$), factor analysis was not conducted to confirm the dimensional structure of the 150-item questionnaire. Future research should validate the instrument's construct validity across different populations. Secondly, the convenience sampling approach and cross-sectional design restrict the ability to make causal inferences. Longitudinal studies with randomized samples would strengthen claims about the effectiveness of the designed training modules. It is also important to note that the training modules have not yet been implemented, so their effectiveness has not had a chance to be tested. Nevertheless, it does represent a meaningful step forward in addressing the widespread social changes brought on by new technologies. It is necessary to continue developing and implementing initiatives that complement institutional actions and legal guidelines. A review of previous research reveals two primary innovations of this study within the field of digital competences. Firstly, it addresses a contemporary challenge in education: the pervasive use of social media by minors and the spread of disinformation

–topics that, while formally included in curricula, are often ineffectively implemented in the classroom. Second, the materials developed adopt a methodological approach that supports teachers in effectively integrating these resources across a variety of subjects. Finally, it should be noted that this research project will be soon supplemented by the introduction of an interactive bot designed to support both teachers and students in advancing digital competence –an innovative strategy that distinguishes this work from previous initiatives. In the near future, this study could be enriched by new studies that could delve deeper into cross-country differences and the effectiveness of module implementation.

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Authors' contributions
All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by APE. Conceptualization, EOF and LMO. Writing-original draft, APE, EOF, and LMO. The first draft of the manuscript was written by APE, EOF, and LMO. The translation was done by APE. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability
The data collected for this study can be consulted upon request by the SAFE project's principal investigator, who is the custodian of the data.

Declarations

Ethics approval and consent to participate
The study was approved by the institutional review board of Ethics Committee of the University of Nebrija with registration number UNNE-2024-0007, and informed consent was obtained from all individual participants included in the study. All procedures performed in studies involving human participants were in accordance with the Helsinki declaration as revised in 2013 and its later amendments.

Consent for publication
All authors consent to the publication of the manuscript.

Competing interests
The authors declare that they have no competing interests.

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