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Generational classification and digital competencies in professional communication: an analysis from the technological approach

Clasificación generacional y competencias digitales en la comunicación profesional: un análisis desde el enfoque tecnológico

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Abstract
Digital competence, understood as the ability to use information and communication technologies (ICT) for effective interaction, is essential in the contemporary professional context. This study examines the relationship between age and digital competencies across different generations, emphasizing key areas such as communication, collaboration, and digital content creation. Based on the Common Framework of the National Institute of Educational Technology and Teacher Training (INTEF), the research was conducted in an Ecuadorian setting and adopted a quantitative approach. Data were collected and analyzed from 193 professionals, highlighting the generational influence on the adoption of technological tools for effective communication. The results indicate that although age is not a determining factor in general digital skills, significant generational differences exist in content creation and digital interaction. This study underscores the importance of continuous training in technological skills, particularly in areas related to communication and professional collaboration.

Keywords
Digital competence, taxonomy, generations, training, technology, level of knowledge, Ecuador, education.

Resumen
La competencia digital, entendida como la capacidad de utilizar tecnologías de información y comunicación (TIC) para la interacción efectiva, es esencial en el contexto profesional contemporáneo. Este estudio examina la relación entre la edad y las competencias digitales de diferentes generaciones, con énfasis en áreas clave como comunicación, colaboración y creación de contenido digital. Basado en el Marco Común del Instituto Nacional de Tecnología Educativa y Formación del Profesorado (INTEF), la investigación se llevó a cabo en un entorno ecuatoriano y adopta un enfoque cuantitativo. Se recolectaron y analizaron datos de 193 profesionales, que destaca la influencia generacional en la adopción de herramientas tecnológicas para la comunicación efectiva. Los resultados indican que, si bien la edad no es un factor determinante en las habilidades digitales generales, existen diferencias generacionales significativas en la creación de contenido y la interacción digital. Este estudio subraya la importancia de la formación continua en habilidades tecnológicas, especialmente en áreas relacionadas con la comunicación y colaboración profesional.

Palabras clave
Competencia digital, taxonomía, generaciones, formación, tecnología, nivel de conocimientos, Ecuador, educación.

Introduction

Digital competence has become a skill for both students and teachers, who must acquire digital knowledge to adapt to the demands of society and provide quality education (Orakova *et al.,* 2024). Alvarez-Flores *et al.* (2017) affirm that ICT helps traditional models to be more flexible and participatory.

This means knowing how to use digital tools and integrate them in teaching and in virtual environments that promote collaborative learning. The study focuses on examining the relationship between age, in terms of generations and the level of digital competence in five areas established by INTEF. A questionnaire was applied to 193 high school teachers in various Loja educational institutions in Ecuador. The aim is to understand how the age of teachers can influence their ability to develop digital skills in an increasingly digitized educational environment.

Importance of digital competence in education

The integration of Digital Competence (DC) in teacher training is essential to adapt to professional roles in the digital age (Tejada-Fernández and Pozos-Pérez, 2018). Digital Teaching Competence (DLC) is crucial both in the professional field and in everyday life. Throughout this study, we will use 'DC' to refer to Digital Competence, and 'DC' for Teaching Digital Competence. Alvarez-Flores *et al.* (2017) mention the e-Skills initiative, which seeks to raise awareness about the safe use of technology, promoting interest in technological disciplines and offering ICT training opportunities for the reinsertion of unemployed people into the labor market.

Padilla *et al.* (2019) underline their importance in the education system and the need for effective integration of ICT in the classroom. It refers to the Common Framework of Teaching Digital Competence (CDCF) and highlights that there is a low level of DC among the teachers evaluated. It identifies an interest in teachers in receiving training to improve their skills in the use of ICT. The MCCDD establishes three levels in each DC: basic, intermediate and advanced (INTEF, 2022), which provides a framework for the training and evaluation of teachers in this field.

Garzón Artacho *et al.* (2020) emphasize that DTC is fundamental in continuous learning and emphasize that addressing the teacher deficit in various digital dimensions is a current educational challenge. Their study reveals a direct correlation between previous ICT training and the dimensions of communication, collaboration and content creation, indicating that teachers with a more solid ICT training tend to show superior skills in these areas. They noted that a gap in digital content creation persists, underscoring the need to strengthen digital content training and address gaps in various digital di-

mensions. It highlights the urgency of improving the digital DC of teachers through training and effective training in the use of ICT.

The study by Marín-Suelves *et al.* (2019) focuses on working the DC of postgraduate professors in a transversal way during an academic year. An increase in the perception of the participants was observed. This highlights the relevance of integrating DC in teacher training, since digital skills training has a positive impact on their professional development. The approach of Domingo-Coscolla *et al.* (2020) highlights the need to prioritize its development and recognizes that digital technologies are becoming increasingly relevant in educational practice. Garcia-Ruiz *et al.* (2023) affirm that the Digital Teaching Competence (DTC) is key among teachers and guarantees success in teaching quality.

Socio-demographic factors and digital competence

These factors play a crucial role in determining DC as it encompasses a wide range of skills, such as competencies in Information and Communication Technologies (ICT), pedagogical competencies for ICT integration, curriculum knowledge and evaluation, ICT in education policy and leadership, professional development, digital citizenship, lifelong learning (UNESCO, 2019). Factors such as age, sex, years of experience, academic training, access to technology, among others, can influence people's DC achievement. Asang Mañay (2018) found in his study an inverse relationship between age and DC among professors, indicating that older professors tend to have lower levels of digital competence. Another study reveals that "older professors have not received specific training in digital technologies (DT) in their initial training" (Garcia i Grau *et al.,* 2022, p. 48). Academic training plays an important role, as teachers who have received an education that emphasizes the use of digital technologies in teaching are more likely to possess a more advanced DC. Padilla-Escobedo and Ayala Jiménez (2021) mention that a high percentage of professors, supported by their solid professional training, consider this competence as very important in the development of their subjects. González-Sanmamed *et al.* (2020) refer to the fact that the field of study to which a university professor belongs has a significant impact on his use of technological tools for professional development in the framework of the Learning Ecologies.

More experienced professors may have more opportunities to integrate digital technologies into their teaching practice and gain skills over time (UNESCO, 2020). Access to technological resources can facilitate the de-

velopment of the DTC, as it gives them the opportunity to explore, practice and experiment with different digital tools and resources. Martín Fernández *et al.* (2022) affirm that Web 2.0 tools have simplified access to high-quality educational resources in the educational environment, allowing the selection, organization, integration and connections of those that best fit the teaching practice, thus promoting the creation of knowledge in a collaborative way. It is important to promote policies that increase access to the Internet and multimedia in educational institutions (Flores Cueto *et al.,* 2020).

Teachers who have access to digital technologies and can use them regularly are more likely to develop the skills and knowledge needed to integrate them effectively into their teaching practice. Teachers who lack access to digital technologies may struggle to develop digital competence. But Padilla-Escobedo and Ayala Jiménez (2021) highlight that the mere use of ICT in the teaching-learning process is insufficient to promote changes in formal education. The digital gender gap in the initial training of future teachers in the educational context also marks significant differences in the areas of communication and collaboration, digital content creation and problem solving, in which men scored higher than women (Fernández-Sánchez and Silva-Quiroz, 2022). This digital gap is linked to the difficulties of using and accessing technology, which affect both individuals and institutions. Berrío Zapata *et al.* (2017) indicate that Internet access has become more common, differences in access to and use of the Internet still persist due to socio-economic and cultural conditions, posing additional challenges in the fight against digital exclusion.

Influence of generational taxonomy on teachers' digital competence

DC is known as a key factor for implementing innovative teaching and learning processes through the use of information and communication technologies at all levels, ages and educational settings (Mariscal-Vega *et al.,* 2021). Different factors can influence their use, one of them is the age of teachers. Amaro-Agudo *et al.* (2020) remind us that competences were born in the world of work and are related to the skills of a worker in his daily work.

In order to better understand how age affects the digital competence of teachers, attitudes towards technology of each generation were analyzed. The concept of generation is used to describe groups of people with similar

characteristics and behaviors. As the characteristics of life change, so does behavior. This can create a generational gap, where ideas do not always coincide with current reality (García-Ayala, 2017).

Table 1 shows a comparison between the characteristics of the four generations regarding their technological development (Ricaurte and Ortega, 2013). The limit years may vary, depending on the different authors (Cataldi and Dominighini, 2015).

Table 1

Generations and their technological evolution

Generation	Baby Boomers (1946–64)	X (1965–1980)	Y (1981–1995)	Z (1996 -->)
TECHNOLOGICAL DEVELOPMENT	Disk Phone, Radio, Cinema, Acetate disks, Polaroid camera, Early computers.	TV, Cable TV, VCR, PC, Atari, Cellphone, Walkman, TFT, ARPAnet, Advanced Research Projects Agency Network, Ethernet (LAN) Technology Development	Keyphone, Beeper, Nintendo, PlayStation DC, DVD, Laptop, MTV, Nickelodeon, Discman, Mp3, WWW, Yahoo!, Hotmail, Internet, Windows, Email, Chat, Web Cam, USB	Digital cameras, 3D TV, Google, Wikipedia, YouTube, Cellphones, GPS, Web 2.0 and 3.0, Videochats, Social networks, PSP, Wii, IPod, iPhone, SMS, Tablets, Gmail, Bluetooth, Wireless, Wireless routers

Note. A synthesis of the technological evolution that outlines the differentiation between the four generations is presented. Adapted from *Practices of Digital Generation in Mexico* (p. 17), by Ricaurte, 2013, Tecnológico de Monterrey. https://bit.ly/3RRVYv8

In Table 1 it is observed that experiences and exposures to technology vary according to the generation: The "Baby Boomers", born between 1946 and 1964 (Angeles, 2016), have experienced a gradual transition to digital technology; in terms of education "they are attached to the tradition and it is difficult for them to break the paradigms that they acquired many years ago, therefore the use and management of ICT is difficult for them and the young people of the new generations do not achieve technological empathy with them" (García-Flores *et al.,* 2016, p. 136). While the "Generation X", born between 1965 and 1980, has witnessed the expansion of digital technologies in its adult life. Harari *et al.* (2022) mention that, despite being more conservative in education, they show a willingness to work from home. In the educational field, this generation normally use ICT, although a small part also uses printed information (García-Flores *et al.,* 2016, p.138).

According to Delgado-Velesaca *et al.* (2020), the educational systems have teachers of diverse generations, the majority of them belonging to the Baby Boomers and Generation X. These groups were characterized by their early exposure to rudimentary technologies at a time when the world was experimenting with basic technology that led to future advances. Regarding the educational characteristics of "Millennials" or "generation Y", born between 1981 and 1996, Cadena Miranda *et al.* (2020), mention that they have grown up immersed in technology and are considered digital natives. Garcia-Flores *et al*. (2016) highlight that this generation is highly connected to ICT and can quickly access educational information locally and globally. Their ability to search for information on a subject taught by a teacher of the Baby Boomer generation is so quick that the teacher may fall behind in the search for information. "Generation Z", those born between 1995-2012, have been exposed to ICT for longer than any previous generation (Fernández Pérez, 2021), according to Jiménez-Macías *et al.* (2020) This generation uses technology since they were born, and they apply it in their daily lives.

By contrasting the studies mentioned at the beginning with the generations and their characteristics, the behavior of each group in the digital context could be better understood. However, it is important to consider these results from a critical approach since digital teaching competence is a complex construct that encompasses multiple dimensions and skills. Not only do digital technologies offer many new opportunities and present certain challenges, but they are also becoming essential to be able to form a relevant part of the knowledge society and economy in the 21st century (INTEF, 2022). It should be noted that age analysis may be insufficient to fully understand the influence of socio-demographic factors on the level of digital competence.

Materials and method

The research presented uses a quantitative approach, not experimental, with a transactional design (Hernández-Sampieri and Mendoza Torres, 2018). Its main objective is to examine the relationship between age and the level of digital competence in teachers who teach in public and private educational institutions in the city of Loja, and knowledge is assessed in the five competence areas defined by the common framework of teaching digital competence (INTEF, 2022). Different technological resources were applied to facilitate and

contribute to the documentary research process (Gregorio Rojas, 2023). Field research was developed, whose purpose was to collect and analyze numerical data, since the process of localization, selection and evaluation of an instrument is crucial to ensure the quality of the data collected and the validity of the study results (Creswell, 2012). An online survey was used to collect data and a descriptive statistical analysis was performed. Correlational research was carried out that included a regression analysis to examine the relationship between digital teaching competence (basic, intermediate or advanced) and sociodemographic variables (sex, age, academic background, years of experience, among others). Sociodemographic variables were considered as independent variables and digital competence was evaluated as a dependent variable.

Population and sample

The study sample is non-probabilistic or directed (Hernández-Sampieri and Mendoza Torres, 2018). This study was based on a population of 382 teachers who are part of 40 educational institutions belonging to 17 areas of the urban and rural sector of the province of Loja. Male and female teachers of different ages who teach subjects at the levels of elementary and high school from public and private schools in urban and rural areas in the city of Loja were selected. The sample consisted of 193 teachers, of which 111 are women and 82 men; the age ranges that prevail are from 35 to 64 years. It was ensured that the sample was representative with a confidence level of 95%. Table 2 details the characteristics of the participants.

Table 2. *Socio-demographic profile of teachers*

Sex	**N**	**%**
Male	82	42.5 %
Female	111	57.5 %
Generational taxonomy	**N**	**%**
Millennial	39	20.2 %
Generation X	91	47.2 %
Baby Boomers	63	32.6 %

Note. Own elaboration based on the results of the socio-demographic profile of the participants.

Instrument and procedure for data collection

The validation of content and expert judgment was based on the summary of statistics for data analysis proposed by Escobar-Pérez and Cuervo-Martínez (2008). For collecting the data, an online survey was used as the main technique, using a questionnaire developed with the tool ArcGis-Survey123 of the SmartLand platform of the Universidad Técnica Particular de Loja (https://bit.ly/4fAojPO). The survey was sent via email; it was applied from September 14 and extended until October 10, 2022 where the total count was observed. This indicates an approximate duration of two months for collecting the information.

The online survey was distributed using a questionnaire designed specifically to measure digital competences in teachers, based on the Common Framework of the National Institute of Educational Technology and Teacher Training (INTEF) (Tourón *et al.,* 2018). This questionnaire was implemented through an online tool, allowing remote participation of respondents. The adaptation focused on adjusting the questions to the socio-demographic characteristics of the participants, adapting items such as the name, sector and support of the educational institution, among others, to the Ecuadorian context.

The validation process of the questionnaire was carried out with the contribution of six university professors, who are participating in university-level research programs and projects and have broad academic trajectory. The aim was to evaluate the items built and determine the appropriate criteria to know the level of digital competence of high school teachers. This process was carried out using a previously established rubric that evaluated ten criteria, which included coherence, clarity, method, suitability, experience, chance, order, convenience or whether the questionnaire is current.

The scale used for the valuation was 1 to 4, where 1 means "completely disagree", 2 "disagree", 3 "agree" and 4 "completely agree". The minimum scores the questionnaire could obtain was 10 points, while the maximum score was 40 points. According to Supo (2013), it is important that expert professionals have a training in multiple disciplines or be related to the fields of knowledge of interest in order to avoid bias or subjective judgments on the subject of research. After adjusting for judgements and assessments, the questionnaire was structured into two sections. The first section included 12 questions to collect personal and professional identification data from participants. The second section consisted of questions designed to assess tea-

chers' knowledge in the five competency areas established by INTEF (2022). Thirty-five questions were selected that addressed the most relevant aspects related to digital technology in teaching.

To determine the level of digital competence, a five-alternative Likert scale was used, ranging from "I don't know" to "I totally know it". A key process for validating the instrument was to assess the clarity and understanding of the questions through expert judgment, leading to adjustments to improve their quality. A pilot test involving 13 randomly selected teachers was conducted; reliability was measured with Cronbach's Alpha coefficient.

The questionnaire management was carried out via email to an initial population of 382 teachers, following previously agreed guidelines. As a result of this phase, a representative sample of 193 high school teachers was obtained. Ethical protocols were considered to guarantee the privacy and confidentiality of participants, thus ensuring responsible treatment of the information collected.

Results

Validity of the content and reliability of the instrument

The results indicated that 80% of the experts evaluated the questionnaire criteria as completely in agreement, indicating high validity of the content. For this process, the Kendall W index was applied as a statistical analysis, obtaining a value of 0.544, with a Chi-square of 21.75 and an asymptotic significance value of 0.000. This suggests that there is moderate to substantial agreement between the expert assessments, thus reinforcing the validity of the assessment made. The results yielded a high Cronbach Alpha coefficient of 0.98, indicating a solid internal consistency.

Socio-demographic profile

As shown in Table 2, 42.49% of the participating sample is male and 57.51% female. This result is in line with other research at the global, national and local levels that have found a predominant presence of women working in education. Regarding the age range, most teachers belong to Generation

X with 47.15%, followed by Baby Boomers with 32.1%, while Millennials represent 20.21%. The importance of these data lies in the need to consider generational diversity in the planning of educational policies and in the implementation of appropriate pedagogical strategies for each age group. It is evident that 30.6% of teachers have more than 20 years of experience in the profession, while only 0.5% have less than one year in this educational practice. The majority of teachers, 58% work in public educational institutions, 33.2% in public offices and 8.8% in private institutions. The main area of knowledge is Mathematics (23.3%) and less represented Cultural and artistic education with only 3.1%.

Generational Taxonomy and Digital Competence

To determine if age ranges influence the level of DTC of the five areas under analysis, the Chi-square test is applied, its p-value and the frequencies that show the results with respect to the variables of interest. The null hypothesis (H0) in this case is that age does not influence the level of teaching digital competence, while the alternative hypothesis (H1) the opposite, that age does influence the level of teaching digital competence.

Table 3

Age ranges and levels obtained in Area 1: Information and information literacy, Chi-square and Cramer V tests

Generational taxonomy	Levels obtained					Total	Pearson's Chi-square			Cramer V	
	A2	B1	B2	C1	C2		Value	LG	p	Value	p
Millennial		7.7%	25.6 %	38.5 %	28.2%	100 %					
Generation X	2.2%	3,3 %	33.0 %	25.3 %	36.3 %	100 %	20,851a	12	0.05	0.190	0.05
Baby Boomer		11.3%	46.8%	29.0 %	12.9%	100 %					

Table 3 presents the levels obtained in Area 1: "Information and information literacy", divided into four age ranges. This Area 1 focuses on developing competencies to search, evaluate, and use information effectively. The levels of progress are: Basic (A): Awareness of the existence of online resources, elementary evaluation based on the author and the origin of the information: Intermediate (B): Knowledge of licenses for reuse and disse-

mination of resources, considering legal and ethical aspects. Advanced (C): Critical source assessment, alignment with curriculum, and discernment in online relationships and communities.

The results of the statistical tests are observed to evaluate the association between the age of the teachers and the competence levels (A2: Basic); (B1 and B2: Intermediate); (C1 and C2: Advanced). The Pearson Chi-square value is 20.851 with 12 degrees of freedom, and the associated p-value is 0.05. Since the p-value (0.05) is slightly higher than the commonly used threshold of 0.05, we would not reject the null hypothesis, suggesting that age does not significantly influence levels of teaching digital competence in this particular area.

The value of Cramer V, which measures the strength of the relationship, is 0.190, indicating a moderate relationship between the variables. This suggests that although there is a link between age and levels of digital competence, it is not strong enough to be considered significant in most cases. When looking at the frequencies by age group, it is noted that the levels of digital competence in Information and information literacy vary in all groups. Millennials show a diversity of levels, with a significant presence at the C1 level. Generation X presents a diversified competition, with an important presence at levels B2 and C2. Baby Boomers also exhibit a variety of levels, albeit with a significant proportion at lower levels. Generation Z, for the most part, has competition levels at the bottom. From these data, it is concluded that age does not play a significant role in determining the levels of digital teaching competence in the field of information and information literacy.

Table 4

Age ranges and levels obtained in Area 2: Communication and collaboration, Chi-square and Cramer V tests

Generational taxonomy	Levels obtained					Total	Pearson's Chi-square			Cramer V	
	A2	B1	B2	C1	C2		Value	LG	p	Value	p
Millennial		5.1%	33.3 %	33.3 %	28.2%	100 %	13,384[a]	12	0.342	0.152	0.342
Generation X	1.1%	9.9%	34.1 %	25.3 %	29.7%	100 %					
Baby Boomers	3.2 %	17.7 %	40.3 %	24.2 %	14.5 %	100 %					

Table 4 presents the percentage distribution of the different levels (A: Basic, B; Intermediate and C: Advanced) obtained in Area 2: "Communica-

tion and collaboration" in contrast to the different ranges of generational taxonomy observed. This Area 2 includes digital skills to interact and collaborate effectively in educational settings. Understanding "Digital Interaction": The efficient use of digital platforms and the media. "Sharing information": Disseminate contextualized educational resources to facilitate understanding. "Citizen participation online": Responsible use of digital platforms for debates and collaborative learning. And "Online Collaboration": Creating communities and collaborative projects that transcend physical barriers.

The Chi-square test compares the observed frequency in each cell with the expected frequency under the assumption that there is no relationship between the variables (age and level of digital teaching proficiency). If the resulting p-value is greater than 0.05, we would not reject the null hypothesis and conclude that age does not significantly influence the level of teaching digital competence.

The Chi-square Pearson value is 13.384 and the p-value is 0.342. Since the p-value (0.342) is greater than 0.05, there is insufficient evidence to reject the null hypothesis. Based on these data, we can conclude that age does not significantly influence the level of teaching digital competence of the area under study, since there is no statistically significant difference in levels of digital competence between different age groups. The values of the Cramer V obtained in this analysis are relatively low, indicating a null association that is also statistically not significant ($p > 0.05$). With these results, it cannot be affirmed that there is a significant relationship between age and the level of teaching digital competence in this context.

Table 5

Age ranges and levels obtained in Area 3: Creation of digital content, Chi-square and Cramer V tests

Generational taxonomy	Levels obtained					Total	Pearson's Chi-square			Cramer's V	
	A2	B1	B2	C1	C2		Value	LG	p	Value	p
Millennial	2.6%	12.8%	53.8%	20.%	10.3%	100.0 %	22.642[a]	12	0.031	0.198	0.031
Generation X	5.%	25.3%	26.4%	24.2%	18.7%	100.0 %					
Baby Boomers	9.7%	30.6%	37.1%	19.4%	3.2%	100.0 %					

Note. Values of p that are less than the commonly used threshold of 0.05 are highlighted in gray.

The analysis in Table 5 reveals Pearson's Chi-square test, which compares the observed frequencies with those expected under the assumption that there is no relationship between age and level of teaching digital competence in Area 3: "Digital Content Creation". Area 3 refers to skills for producing, adapting and improving educational content. They are the "Digital Tools": Use of software for editing videos, multimedia presentations, and interactive creation. The "Pedagogical Design": Integrate digital tools with specific pedagogical objectives. And "Copyright": Respect for intellectual property and use of appropriate licenses for the creation and distribution of content.

Table 5 yielded a Chi-square value of 22.642 with 12 degrees of freedom and a p-value of 0.031. Since this p-value is less than the commonly used threshold of 0.05, we reject the null hypothesis.

The results reveal a moderate relationship (Cramer's V = 0.198) between age and teaching digital competence. Millennials (21-34 years) show high digital competence, with the majority at B2 level (53.8%). Generation X (35-49 years) has a more uniform distribution of proficiency levels, with B1 (25.3%) being the most common. Baby Boomers (50-64 years) tend to have lower levels of competition, with the majority in B2 (37.1%) and B1 (30.6%). These findings underscore the influence of age on teaching digital competence and the generational differences in this aspect.

Table 6

Age ranges and levels obtained in Area 4: Safety, Chi-square and Cramer's V tests

Generational taxonomy	Levels obtained					Total	Pearson's Chi-square			Cramer's V	
	A2	B1	B2	C1	C2		Value	LG	p	Value	p
Millennial	2.6%	12.8%	43.6 %	23.1 %	17.9%	100 %					
Generation X	8.8%	22.0 %	33.0 %	20.9 %	15.4%	100 %	13,733[a]	12	0.318	0.154	0.318
Baby Boomers	8.1%	27.4 %	41.9%	17.7 %	4.8%	100 %					

Table 6, which examines the relationship between age and the level of teaching digital competence in Area 4: "Security", reveals interesting results. Area 4 is focused on safe and ethical navigation in digital environments. It includes "Data Protection": Password management, privacy settings and prevention of threats such as malware. "Cybersecurity": Identifying misleading

content and protecting against digital harassment; and "Responsible Use": Managing time online, balancing digital and non-digital activities, and measures to reduce environmental impact.

Pearson's Chi-square value, which compares observed to expected frequencies, yielded a result of 13.733 with 12 degrees of freedom, and the associated p-value was 0.318. Since this p-value is greater than the commonly used significance level of 0.05, we would not reject the null hypothesis, suggesting that age does not significantly influence levels of teaching digital competence in this area of safety. The Cramer's V value, which measures the strength of the ratio, is 0.154, indicating a weak relationship between the variables.

When looking at the frequencies by age group, it is noted that, , levels of digital competence in Security varyin all groups, with a diverse presence at each level. Millennials show competition at medium and high levels, Generation X has diversified competition, Baby Boomers exhibit reasonable competition in digital security. From these data, it is concluded that age does not play a significant role in determining the levels of teaching digital competence in the field of Security, which shows us that this competence can be independent of the generation and more related to other factors or specific training.

Table 7
Age ranges and levels obtained in Area 5: problem solving, Chi-square and Cramer's V tests

Generational taxonomy	Levels obtained					Total	Pearson's Chi-square			Cramer's V	
	A2	B1	B2	C1	C2		Value	LG	p	Value	p
Millennial	2.6%	10.3 %	35.9 %	28.2%	23.1 %	100 %	17,719[a]	12	0.124	0.175	0.124
Generation X	7.7%	16.5 %	33.0 %	22.0 %	20.9 %	100 %					
Baby Boomers	8.1%	27.4 %	40.3 %	19.4%	4.8%	100 %					

Table 7 assesses the relationship between age and the level of teaching digital competence in Area 5: "Problem solving". It addresses the ability to identify, analyze and solve digital challenges. Area 5 presents the "Identification and analysis": Decomposition of problems into manageable components and evaluation of solutions. The "Use of tools": Selection of relevant digital applications: and the "Implementation and evaluation": Design effective strategies and adjust according to the results obtained.

Table 7 shows that the Chi-square value is 17.719 with 12 degrees of freedom, and the associated p-value is 0.124. As this p-value is higher than the commonly used significance level of 0.05, the null hypothesis would not be rejected, suggesting that age does not significantly influence levels of teaching digital competence in this area of problem solving. The Cramer's V value, which measures the strength of the ratio, is 0.175, indicating a moderate strength ratio between the variables.

When looking at frequencies by age group, it is highlighted that the levels of digital competence in Problem solving vary in all groups, showing a diversity in each level. Millennials exhibit competition at medium and high levels, Generation X presents diversified competition, and Baby Boomers show reasonable competition in solving digital problems. Based on these results, it can be said that age does not play a significant role in determining the levels of digital teaching competence in the field of problem solving. This suggests that competence in this area may depend more on other factors or a specific training than on the generation of belonging.

Discussion and conclusions

The results of this research confirm a high concordance in the validation of the instrument used, which supports its use to measure the teaching digital competence in educational technology. In relation to the main hypothesis, it is concluded that age is not a determining factor in the level of teaching digital competence in most of the areas evaluated by the Common Framework of Teaching Digital Competence (INTEF, 2022). However, significant differences were identified in the area of Digital Content Creation, where younger teachers excelled in advanced competences (C1 and C2). This finding is consistent with previous studies that point to a positive correlation between technological familiarity and early exposure to digital tools in younger generations (Garzón Artacho *et al.,* 2020; López-Belmonte *et al.,* 2020).

In the areas of Information and Information Literacy, Communication and Collaboration, Security and Problem Solving, data suggest that digital skills are homogeneous across generations. This result reinforces the idea that continuous training and access to technology can mitigate generational gaps, allowing teachers of all ages to reach similar competency levels (Rubio-Gragera *et al.,* 2023; Pozo-Sánchez *et al.,* 2020).

The divergence observed in the area of Digital Content Creation could be explained by factors such as the lack of specific ICT training in older generations, a gap that has been widely documented in previous studies (Asang Mañay, 2018; García i Grau *et al.,* 2022). andounger teachers considered "digital natives" have naturally integrated these skills into their professional development, while older groups require additional efforts to adapt to these technological environments.

The area of safety, although it showed no significant differences, presented an interesting trend: teachers between 40 and 49 years reached the highest levels of competence, probably due to a combination of professional experience and focused training (López-Belmonte *et al.,* 2020). This underlines the importance of including specific digital security modules in teacher training programs.

Finally, the data confirm the need for differentiated training approaches that address the areas with the greatest gaps, such as content creation and empowerment in digital tools. Future studies should explore additional variables, such as academic specialization or educational setting, to better understand the interactions between sociodemographic factors and digital competences (Orozco-Cazco *et al.,* 2020).

In conclusion, age should not be perceived as an obstacle for the development of digital teaching skills. The key lies in promoting educational policies that prioritize transversal technological training adapted to the needs of each generation. In this way, it will be possible to close existing gaps and promote quality education in an increasingly digitized environment.

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Declaration of Authorship - Taxonomy CRediT	
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Mónica Herrera Solorzano	Conceptualization, data curation, formal analysis, validation, visualization, writing – original draft and acquisition of funding.
Ángel Hernando Gómez	Research, validation, methodology and conceptualization.
Isidro Marín Gutiérrez	Project management, resources, software and monitoring, writing – review and editing.