Between Digital and Analogical: Familial Perspectives on Teaching to Develop 21st-Century Competences

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Abstract

In recent decades, education has transformed due to new demands, requiring constant updates to teaching methods. Training in 21st-century competences is essential for preparing students for a changing future. Education 4.0, driven by Information and Communication Technologies (ICT), plays a key role in this process. However, some argue that a blend of traditional methods and technology enhances learning. This study examines the perceptions of families of students aged 3-18 on adapting teaching with ICT versus traditional methods to promote the development of 21st-century skills. It also explores how family relatives' education levels influence their views on the best methodologies for teaching these competences. Data from 720 family relatives were collected through an online questionnaire. The analysis showed that families see a clear connection between the competences studied. However, there were significant differences in their perceptions of teaching methods with and without ICT for developing certain skills. The study also found that family relatives' education levels affected their views. Overall, the research concludes that a balanced approach, integrating ICT with traditional teaching methods, is essential for enriching education and preparing students for the future.

Keywords: 21st-century competences, family relatives, ICT, analogical resources

Between Digital and Analogical: Familial Perspectives on Teaching to Develop 21st-Century Competences

Over recent decades, education has undergone a transformation owing to the rapid social progress, demands and challenges that people must face (González-Pérez & Ramírez-Montoya, 2022). Nowadays, society's expectations (e.g., emphasizing digital literacy and collaborative problem-solving) demand skills and competences that extend beyond conventional educational approaches (i.e., lecture-based teaching and standardized testing) (Ghavifekr & Wong, 2022). Therefore, this context highlights the need to adopt pedagogical methods aligned with these emerging demands, thus encouraging education systems to focus on preparing students integrally so that they acquire the necessary competences to face a complex and rapidly changing future (Ghavifekr & Wong, 2022; Karakoyun & Lindberg, 2020; Kornytska et al., 2023; Koul & Nayar, 2020).

The recent social and educational transformation brought about by integrating Information and Communication Technologies (ICT) (Schlomann et al., 2020) has led to different phases of Internet evolution known as Web 1.0, Web 2.0, Web 3.0 and Web 4.0 (Huk, 2021; Maria et al., 2018). These phases are closely linked with the changes in education known as Education 1.0, 2.0, 3.0, and 4.0, reflecting the growing influence of technology on teaching and learning. Education 1.0 refers to a teacher-centred model focused on knowledge transmission and memorization. Education 2.0 emerged with early internet use, allowing limited interactivity and some learner engagement. Education 3.0 introduced more participatory and collaborative approaches, promoting active learning and digital content creation. Education 4.0, the current phase, emphasizes personalized learning, real-time feedback, integration of AI and big data, and the development of competences aligned with the OECD Learning Compass and ATC21S frameworks (Ghavifekr & Wong, 2022; González-Pérez & Ramírez-Montoya, 2022; Griffin et al., 2012; Himmetoglu et al., 2020; Huk, 2021; Maria et al., 2018; OECD, 2019).

Education 4.0 goes beyond the mere presence of technology, requiring profound transformations in educational approaches to respond to contemporary and future demands. Strongly supported by digital technologies, this phase promotes the integration of ICT as pedagogical tools to create flexible curricular systems aligned with current needs and guided by frameworks such as DigComp and DigCompEdu, which provide structured guidelines for developing digital competences in both students and teachers (González-Pérez & Ramírez-Montoya, 2022; Prasojo et al., 2019; Redecker, 2017; Vuorikari et al., 2022). Effectively incorporating these tools into teaching and learning processes is therefore essential to strengthen education and foster the development of 21st-century competences (Agaoglu & Demir, 2020; Ghavifekr & Wong, 2022; Huk, 2021; Karakoyun & Lindberg, 2020).

It is important to acknowledge that many competences now considered essential for the 21st-century have been cultivated within traditional educational approaches long before the widespread integration of ICT (González-Salamanca et al., 2020; Willis et al., 2018). However, the inclusion of ICT enriches these competences by introducing new dimensions, such as digital literacy and citizenship, which are vital for effective participation in modern society. While ICT may not be indispensable for all competences, they are powerful tools for enhancing learning efficiency, motivation, accessibility, and personalisation. Therefore, several authors advocate approaches that combine digital and analogue resources to optimise the educational process and meet diverse learning needs (Agaoglu & Demir, 2020; Lytvyn et al., 2020; Willis et al., 2018).

These competences correspond to skills considered necessary to face future challenges and participate effectively in society (Ghavifekr & Wong, 2022; González-Salamanca et al.,

2020; Kornytska et al., 2023). Interrelated and complementary 21st-century competences jointly contribute to holistic development, as highlighted in frameworks such as the OECD Learning Compass and ATC21S (González-Pérez & Ramírez-Montoya, 2022). Developing such competences is essential to manage today's challenges and to promote significant personal and professional progress in a complex and interconnected world (González-Pérez & Ramírez-Montoya, 2022; Karakoyun & Lindberg, 2020).

Although ICT offer benefits for future training (Carrión-Martínez et al., 2020; Das, 2019; Lawrence & Tar, 2018; Prasojo et al., 2019), some researchers emphasize the importance of integrating conventional and digital tools (Agaoglu & Demir, 2020; Lytvyn et al., 2020; Willis et al., 2018). Such integration enriches the education experience by providing teachers and students with a diverse series of tools to provide more effective learning (Lytvyn et al., 2020). It is also important to distinguish between education and training, which, although related, are distinct processes: education encompasses holistic development across multiple domains, whereas training focuses on developing specific practical skills. ICT play a valuable role in both areas by enhancing theoretical understanding and practical skill acquisition.

Moreover, family perception plays a critical role in the educational process, which is not shaped solely within the school environment. Students' development and engagement with both conventional and ICT-based learning are strongly influenced by the family, understood as the primary context for early learning and socialization. As the first setting for human development, the family plays a decisive role in children's growth and learning across multiple areas of life (Bolaños & Rivero, 2019; Meza Rueda & Páez Martínez, 2016). This central role of the family can be understood through Bronfenbrenner's (1979) bioecological model, which posits that individual development is shaped by the interaction between various immediate environments. Within this framework, the family functions as the primary microsystem, and its alignment with the school environment constitutes a critical mesosystem. Furthermore, according to the Hoover-Dempsey and Sandler (1995) model, parental involvement is fundamentally driven by their 'role construction' and their perceptions of their own skills to support learning. Consequently, familial perceptions regarding 21st-century competences are not merely isolated opinions; rather, they are fundamental factors that determine the efficacy of Education 4.0 implementation within the domestic sphere.

In the Spanish Autonomous Community of Aragón, the integration of ICT into education is supported by national and regional policies, such as the LOMLOE curriculum (BOE, 2020) and the Digital Education Action Plan of Aragón (Gobierno de Aragón, 2021). These policies provide the infrastructure, teacher training, and curricular guidance necessary to develop students' 21st-century competences. By linking these policies explicitly to the research objectives, this study analyzes how family relatives perceive the effectiveness of ICT-based versus conventional teaching methods.

Despite the central role of families, relatively few studies have explored how they perceive education delivered through ICT compared to conventional methodologies, particularly regarding the development of 21st-century competences. This constitutes a relevant gap in current research, especially within the Spanish context. In the Autonomous Community of Aragón, ICT integration in education is supported by both national and regional policies, including the LOMLOE curriculum and the Digital Education Action Plan. Schools in the region generally have access to digital devices and internet connectivity, and ongoing teacher training initiatives—aligned with the European DigCompEdu framework—reinforce a commitment to digital competence and technological innovation.

Considering these aspects, the present study aims to analyze perceptions of family members of students aged 3-18 years in Aragón regarding the suitability of education delivered

through ICT compared to conventional teaching methods for developing 21st-century competences. The relevance of this study lies in focusing on families' viewpoints—a perspective that remains underrepresented in the literature—and in exploring a topic of growing importance: how different educational methodologies are perceived in relation to the development of competences regarded as fundamental for students' present and future.

Objective of This Study

In general terms, and by considering the aforementioned theoretical background, the objective of this study was to analyze the perceptions of the family relatives of students aged 3-18 years from Aragón regarding the suitability of ICT-based and conventional teaching methodologies for fostering 21st-century competences. To fulfil this overall objective, the following specific objectives were set out:

1. Evaluate family relatives' perceptions of the suitability of ICT-based teaching methodologies for fostering 21st-century competences
2. Examine family relatives' perceptions of the suitability of conventional teaching methodologies for fostering 21st-century competences
3. Examine whether family members consider analog teaching more or less suitable than ICT-based teaching for developing specific 21st-century skills.
4. To analyze the differences in the perception of family members regarding the suitability of analog and ICT-based teaching methodologies for promoting 21st-century skills according to the educational level of the family members.

Method

Participants

The sample in this work consisted of the family relatives of students aged 3-18 years from Aragón (Spain). For the purpose of this research, the term "family relatives" encompasses parents, guardians, and other close family members who play an active and significant role in the educational and developmental processes of the students. The only eligibility requirement for participation was having at least one child currently enrolled in school within the 3-18-year age range. Families were invited to participate through the Parents' Associations of the different schools in the region, as well as directly via the schools, which helped disseminate the information among families. The study's objective was communicated by email, providing participants with the option to participate voluntarily and assuring that all data would remain confidential. The invitation also included a web link giving direct access to the questionnaire. The instrument was designed and developed using Qualtrics software. After reviewing the valid questionnaires for our research, there were 720 participants, whose characteristics are reflected in Table 1. In addition to the variable concerning the relative's educational level, which is directly related to one of the main objectives of the research, information on other variables was collected to characterize the sample and facilitate the interpretation of the generalisability of the findings. The final sample size was considered appropriate for the descriptive and comparative analyses planned, in line with the exploratory scope of the study and the diversity of the target population.

Table 1

The Sample's Socio-Demographic Characteristics (N=720).

Variables	N	% of the sample
Gender		
Female	574	79.7
Male	146	20.3
Age (M=45.88; SD=5.53)		
Between 18-32 years old	7	0.97
Between 33-42 years old	169	23.47
Between 43-52 years old	470	65.28
Between 53-62 years old	74	10.28
Province		
Huesca	121	16.8
Zaragoza	557	77.4
Teruel	42	5.8
Highest level of education attained		
Primary/Secondary	84	11.6
Baccalaureate	81	11.3
Vocational training	194	26.9
University	361	50.1
Type of school your children attend		
Public school	75	10.4
State school	645	89.6
Children's school environment		
Municipality with less than 2,000 inhabitants	77	10.7
Municipality between 2,000 - 10,000 inhabitants	201	27.9
Municipality with more than 10,000 inhabitants	441	61.3
Total	720	100

Definition of Variables

The variables that the present study took as an analysis object were the so-called 21st-century competences. The literature offers no unanimous definition of this term (Loução & Pedro, 2023; Tight, 2020). However, 21st-century competences are understood as a set of essential skills to face future challenges and requirements. Although the employed terms may change, the basic idea is that these competences are crucial for making people capable and enabling them to actively participate in society (Ghavifekr & Wong, 2022; González-Salamanca et al., 2020; Kornytska et al., 2023).

These competences include creativity, critical thinking, problem solving, decision making, communication capacity, teamwork, seeking and organising information, digital citizenship, ICT competences, adapting to changes, initiative-taking capacity, productivity, leadership capacity skills and the capacity to be enterprising (Agaoglu & Demir, 2020; González-Pérez & Ramírez-Montoya, 2022; González-Salamanca et al., 2020; Koehorst et al., 2021).

For this study, educational approaches were classified as ICT-based or analogue. ICT-based education integrates digital technologies, such as online platforms, educational apps, or interactive whiteboards, whereas analogue education relies on traditional, non-digital methods like printed books, notebooks, and face-to-face instruction.

Instrument

The instrument employed to collect data was designed *ad hoc* by taking the available literature about the study theme as a basis. Having written the first version of the instrument, it was judged by a panel of experts to determine the suitability, match and wording of items. During this process, 10 professionals with experience in the academic university domain came from different disciplines (inclusive education, use of technologies in the education context and methods of research). The instrument was also delivered to 10 mothers and fathers of students aged 3-18 years to collect their opinions about its formulation and understanding. The aim was to check if the vocabulary and instructions in the instrument were easy for family relatives to understand. For this stage, family relatives with different incomes, levels of education and socio-cultural levels were intentionally selected. In this research, the term "suitability" was understood as the judgments made by family relatives regarding the appropriateness of both ICT-based and conventional teaching methodologies in supporting the development of 21st-century competences in their children, which was a central focus of the instrument's evaluation. These judgements were considered as expressions of perception, understood here as subjective evaluations shaped by beliefs and attitudes towards the effectiveness of different teaching approaches.

Based on this analysis, and bearing in mind the contributions provided, the next stage involved restructuring the instrument to obtain its definitive version. With this final version, the instrument was divided into two sections: the first part centred on collecting data about the participants' socio-demographic characteristics; the second part included the indicators that family relatives had to score. This second part contained 14 items that, on two Likert-type scales from 0 to 10 points, had to be valued by the participants according to how they perceived the adaptation of teaching with ICT and by analogical teaching (i.e., without ICT) for students to develop and acquire 21st-century competences. The full wording of the questions, the scale points, and the grouping of items into subscales are provided in Appendix A.

Data Analysis

The data collected with the instrument were coded and analysed using version 22.0 of the SPSS statistical package. According to the research objectives, descriptive statistics were applied (in terms of means and standard deviations), as was the inferential type. Differences in means (Student's t) were applied for paired samples, given that the same participants evaluated both analogical and ICT-based teaching methodologies. To analyze differences according to the educational level of family relatives, one-way analyses of variance (ANOVA) were performed. When the ANOVA results were statistically significant, *post hoc* multiple comparisons using Tukey's HSD test were conducted to identify which groups differed significantly from each other. Pearson's correlation coefficient was employed to establish linear relations among the 21st-century competences set out in the questionnaire.

Results

Table 2 (Appendix B) provides the data obtained from the descriptive statistics in terms of means (M) and standard deviations (SD). It also includes results on the perceived suitability of analogical and ICT-based teaching for developing 21st-century competences.

Regarding perceptions of the suitability of analogical teaching, the competences that received the highest scores were teamwork (M = 7.62; SD = 1.92) and communication capacity (M = 7.53; SD = 1.93). Conversely, family relatives more negatively evaluated the adaptability of teaching without digital resources for developing digital citizenship (M = 5.18; SD = 2.58) and ICT competences (M = 4.9; SD = 2.55). Notably, these competences also showed the highest SDs, reflecting greater variation in how participants perceived the suitability of analogical teaching to support 21st-century competences.

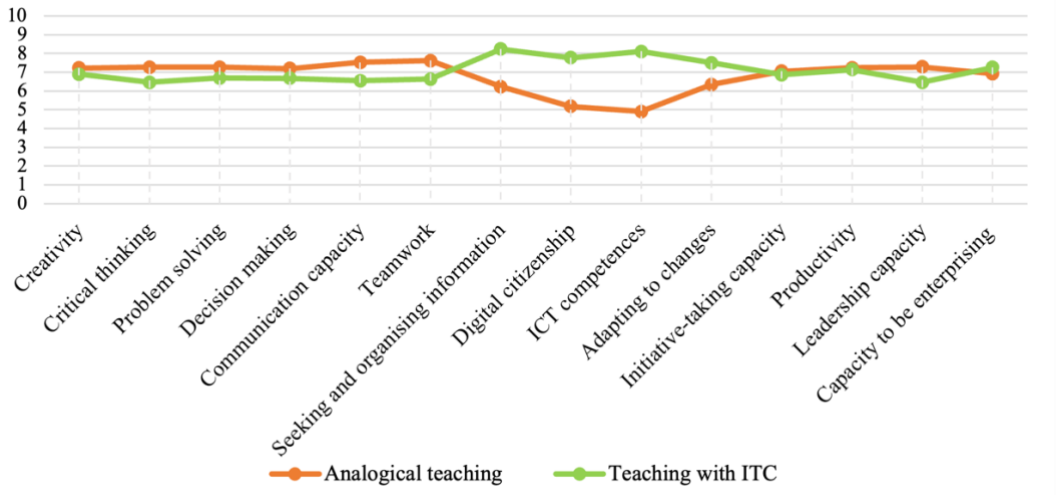
Regarding the results obtained about adapting ICT-mediated teaching to work on 21st-century competences, the highest scores were for seeking and organizing information (M = 8.24; SD = 1.87) and ICT competences (M = 8.11; SD = 1.8). These scores presented comparatively lower SDs, indicating greater consistency in participants' perceptions of ICT-mediated teaching. Conversely, the more negatively valued competences were critical thinking (M = 6.46; SD = 2.06) and leadership capacity (M = 6.46; SD = 2.19).

A paired-sample t-test revealed statistically significant differences in how family relatives perceived the suitability of analogical teaching and ICT-mediated teaching methods. Table 2 presents these results, and Figure 1 graphically represents them. Regarding competences where analogical teaching was perceived as more suitable than ICT-mediated teaching, family relatives rated creativity ($t = 2.99$; $p < .01$), critical thinking ($t = 8.06$; $p < .001$), problem solving ($t = 5.80$; $p < .001$), decision making ($t = 5.41$; $p < .001$), communication capacity ($t = 8.03$; $p < .001$), teamwork ($t = 9.21$; $p < .001$), and leadership capacity ($t = 8.25$; $p < .001$) as significantly more suitable.

Conversely, for competences where ICT-mediated teaching was perceived as more suitable than analogical teaching, the highest ratings were observed for seeking and organising information ($t = -17.87$; $p < .001$), digital citizenship ($t = -21.02$; $p < .001$), ICT competences ($t = -26.63$; $p < .001$), adapting to changes ($t = -10.74$; $p < .001$), and being enterprising ($t = -3.44$; $p < .001$).

Figure 1

Comparing the Means between Analogical Teaching and Teaching with ICT



Pearson's correlation analysis was used to examine the relationships among the 21st-century competences studied. As Table 3 shows (Appendix C), the obtained results evidenced strong positive correlations, which consistently appeared among this set of variables. Nevertheless, it is worth pointing out that some relations stood out for their marked significance. The strongest positive correlation emerged between critical thinking (CAN 2) and ICT competences (CAN 9) ($r = 0.838$; $p < .01$). Strong positive relations were also found between digital citizenship skills (CAN 8) and ICT competences (CAN 9) ($r = 0.785$; $p < .01$); leadership capacity (CAN 13) and capacity to be enterprising (CAN 14) ($r = 0.774$; $p < .01$); and problem-solving capacity (CAN 3) and decision-making skill (CAN 4) ($r = 0.749$; $p < .01$).

Although all correlations were positive and statistically significant, some were weaker in magnitude, including communication capacity (CAN 5) with ICT competences (CAN 9) ($r = 0.275$; $p < .01$); communication capacity (CAN 5) with digital citizenship (CAN 8) ($r = 0.282$; $p < .01$); problem solving (CAN 3) with ICT competences (CAN 9) ($r = 0.331$; $p < .01$); and teamwork (CAN 6) with ICT competences (CAN 9) ($r = 0.342$; $p < .01$). Despite being comparatively lower, these correlations also indicate meaningful relationships among competences.

Next, an inferential analysis was performed by applying the ANOVA test and considering the independent variables referring to the surveyed family relatives' highest level of education (Table 4, Appendix D). *Post hoc* comparisons using Tukey's HSD test were conducted to determine which education-level groups differed significantly from each other. The results generally revealed more pronounced differences across education levels in perceptions of analogical teaching than ICT-based teaching.

Significant differences were observed in perceptions of the suitability of analogical teaching for developing creativity ($F = 4.809$; $p < .01$), problem solving ($F = 2.934$; $p < .05$), seeking and organising information ($F = 4.305$; $p < .01$), and productivity ($F = 2.662$; $p < .05$), with contrasts emerging mainly between participants with Primary/Secondary education and those with university studies. For digital citizenship ($F = 7.234$; $p < .001$) and ICT competences ($F = 11.023$; $p < .001$), significant differences also appeared between Primary/Secondary and university education groups and between Vocational Training and university groups.

For suitability linked to adapting to changes ($F = 4.304$; $p < .01$), significant differences were found between participants with Primary/Secondary and university studies, and between Primary/Secondary and Vocational Training studies. Finally, perceptions related to being enterprising ($F = 4.583$; $p < .01$) showed significant differences between Primary/Secondary and Higher Secondary Education groups, and between Vocational Training and university groups.

For ICT-based teaching, significant differences were found only for communication capacity ($F = 3.460$; $p < .05$) and ICT competences ($F = 3.496$; $p < .05$), both appearing among relatives with Vocational Training and university studies. These results suggest that education level influenced perceptions more clearly in relation to analogical teaching than ICT-based teaching.

Discussion and Conclusions

Using appropriate statistical techniques, this study described how students' family members perceive the suitability of conventional teaching methods compared to ICT-mediated methods for fostering 21st-century competences throughout the educational process. These findings directly address the study's aims, particularly those related to comparing both teaching approaches and analyzing how they support competence development. This study goes beyond

descriptive parental surveys by directly comparing analogue and ICT-mediated methodologies across competence domains in a large regional sample spanning ages 3–18.

The research works by authors like González-Salamanca et al. (2020) and Willis et al. (2018) point out that some 21st-century competences were already present even before technology emerged in our lives and in different education stages. These authors highlight competences such as critical thinking, problem solving, decision making, communication skills, and teamwork. They argue that these skills were effectively developed even before ICT was integrated into education. Consequently, researchers ensure that technologies are not essential for dealing with these competences but can be very useful tools for improving the process of acquiring and developing them. This improvement would take place in terms of efficiency, motivation and personalization of learning.

In relation to this, family relatives perceived that conventional teaching methodologies might be more suitable for promoting and developing the competences mentioned in this section compared to ICT-guided teaching. This perception appears to align with the perspectives discussed by González-Salamanca et al. (2020) and Willis et al. (2018), who note that these competences have historically been developed without relying on technology. These patterns are consistent with cognitive development theories, suggesting that families may prefer analogical methods for competences like creativity, communication, and teamwork due to their alignment with children's developmental trajectories and prior parental experiences. From a socio-cultural perspective, such preferences may also reflect families' beliefs about learning as a socially mediated and relational process, in which face-to-face interaction, dialogue, and shared experiences play a central role. This supports Objective 2 of the study, as relatives attributed greater suitability to conventional teaching for fostering competences linked to learning processes. Apart from critical thinking, problem solving and decision making, communication capacity and teamwork, family relatives added creativity and leadership capacity to this list.

It is also relevant to consider insights from cognitive development and neuroscience, which suggest that human cognition and brain function are closely linked to analogical processes, particularly in early childhood. Children's neurological networks mature progressively, and as such, certain cognitive abilities develop over time. This developmental trajectory implies that ICT-based methods may not be as beneficial or appropriate during very early educational stages, where hands-on, analogy experiences could better align with children's evolving cognitive capacities. Families' preferences for analogue approaches may therefore be informed not only by tradition, but also by intuitive judgments about age-appropriateness and developmental readiness, addressing the study's focus on perceptions across the 3–18 educational range.

It is important to highlight that the literature categorizes 21st-century competences based on their focus or area of application. The competences that refer to critical thinking, problem solving, decision making, communication capacity and teamwork have been grouped by several authors (Agaoglu & Demir, 2020; González-Pérez & Ramírez Montoya, 2022; González-Salamanca et al., 2020) under the heading of "skills or capacities for learning". These competences are those that the participating family relatives point out as those that can be developed without relying on ICT; that is, they could potentially be worked on from a more conventional educational approach. This thematic alignment strengthens the interpretation of Objective 2 and clarifies why analogical methodologies were rated as suitable for these competences.

Another broadly recognized category includes 'digital literacy skills,' which cover ICT competences as well as abilities related to searching for and organizing information (Agaoglu

& Demir, 2020; González-Pérez & Ramírez Montoya, 2022). Indeed, according to the perceptions of the family relatives who participated in this study, ICT seem to be perceived as indispensable as tools for developing these competences. Apart from them, family relatives added other closely linked competences, such as digital citizenship, to the list of competences that might require ICT in the classroom. This distinction suggests that families differentiate between competences grounded in experiential or interpersonal learning and those inherently linked to technological environments, directly responding to Objective 1 by demonstrating that participants viewed ICT-guided methodologies as more suitable for developing digital-related skills. From the perspective of the TPACK framework (Mishra & Koehler, 2006), these findings suggest that while families recognize the technological component, they may not yet perceive the effective integration of pedagogy and content through digital means for complex "soft skills". This indicates a tendency to view ICT as a tool for information access rather than a medium for high-level cognitive and creative development.

Regarding students' use of ICT for holistic competence development, numerous authors highlight the benefits technology offers in delivering education geared towards future needs (Carrión-Martínez et al., 2020; Das, 2019; Lawrence & Tar, 2018; Prasojo et al., 2019). Some authors (Hafifah, 2020; Schlomann et al., 2020) have recently reported that for today's society and that of the future, acquiring skills in ICT could be considered an unavoidable need. Emphasis has also been placed on the skill to browse with and efficiently apply digital tools because they are not only useful in the professional area but are also essential to fully participate in day-to-day living. Those with technological skills not only have advantages in the present but will be better prepared to face the challenges and to make the best of the opportunities that the digitized future will present (Hafifah, 2020).

The literature supports the idea that integrating ICT into teaching practices and curricula is likely to be essential for developing certain 21st-century competences (Ghavifekr & Wong, 2022; Huk, 2021). Consequently, ICT-guided methodologies will not only empower education quality but will also contribute to reinforcing essential skills for students in the present and the future; that is, to develop 21st-century competences (Agaoglu & Demir, 2020; Ghavifekr & Wong, 2022; González-Pérez & Ramírez-Montoya, 2022; Huk, 2021; Karakoyun & Lindberg, 2020). Taken together, these findings reinforce relatives' perception that ICT plays a critical role in fostering future-oriented competences, echoing the framework guiding this study.

Although family relatives in this study believe conventional analogy methods better promote some competences, and ICT-based methods are highly effective for others, some authors stress the importance of leveraging the benefits of both approaches in education. Agaoglu and Demir (2020), Lytvyn et al. (2020), and Willis et al. (2018) acknowledge that the complementarity between analogical and digital methods might significantly empower the educational process. This integrating approach seeks to make the best of both worlds by favouring an enriched pedagogical environment that attends to learners' diversity through a wide range of tools and strategies. This perspective helps explain why families' preferences are not necessarily contradictory, but context-dependent, aligning with the comparative objectives of the study while avoiding overgeneralized conclusions.

Similarly, the results of this study show that students' family members perceive a strong interconnection among different competences. According to González-Pérez and Ramírez-Montoya (2022), 21st-century competences are not isolated aspects, but interdependent components that converge to shape global development. This integrating approach of competences promotes an educational paradigm that goes beyond merely acquiring knowledge, a perspective that some researchers consider should be ruled out (González-Pérez & Ramírez-Montoya, 2022; Kornytska et al., 2023; Koul & Nayar, 2020) to encourage significant learning

that falls in line with today's demands. This interpretation responds to Objective 3 by demonstrating that relatives recognized significant relationships among competences, consistent with the correlational findings.

The results regarding the differences in perceptions based on educational level also merit discussion and conclusion. Bolaños and Rivero (2019) point out that the family is the first socialization context in which the bases for children's academic and personal development are set. Ludeke et al. (2021) emphasize the influence that the family setting has, particularly mothers' and fathers' level of education, because it plays a key role in their children's educational process. The present research work verifies differences in the perceptions regarding the suitability of analogical teaching compared to ICT-mediated teaching to deal with 21st-century competences, which could interfere with students' education according to the aforementioned authors. This finding directly addresses Objective 4 by demonstrating that relatives' educational level influenced perceptions of teaching suitability. These differences may also reflect unequal access to digital resources, varying levels of confidence in supporting ICT-based learning, and distinct forms of engagement with schools. This variation aligns with the 'second-level digital divide' (Hargittai et al., 2019; Scherder et al., 2017), suggesting that higher educational levels correlate with greater digital capital and a more positive perception of ICT's pedagogical value.

These differences are evident when comparing family members with Primary/Secondary education, who tend to favour conventional methods, with those holding Vocational Training or University degrees, who generally prefer technological approaches. Authors like Shafie et al. (2019) stress the importance of teaching training in competences from earlier education stages. Nonetheless, many studies (Abelha et al., 2020; Sá & Serpa, 2018; Sousa & Wilks, 2018) attach importance to dealing more specifically with 21st-century competences in the education stages that prepare students for the labour market; that is, Vocational Training and University. This may help explain why relatives with higher education levels show greater alignment with ICT-mediated approaches, as these have been more prominent in their own academic and professional trajectories.

At this point, it is necessary to revisit the idea of González-Salamanca et al. (2020) and Willis et al. (2018), which was previously considered. They suggest that some competences presently identified as being typical 21st-century ones have existed for years and do not need to rely on ICT. Based on this premise, this finding suggests that family relatives with Primary/Secondary studies tend to prefer conventional methods based on the personal experience that they acquired when they were students, which allowed them to develop such competences without technology. Some other previously mentioned authors (Abelha et al., 2020; Sá & Serpa, 2018; Sousa & Wilks, 2018) indicate that people with Vocational Training and University studies highlight the value and importance of 21st-century competences, and also emphasize the growing presence of technology in education today (Carrascal et al., 2021; Carrión-Martínez et al., 2020; Das, 2019; Khattri, 2021; Lawrence & Tar, 2018; Prasojo et al., 2019; Willis et al., 2018). These ideas contextualize why relatives with higher levels of education may view ICT-based methodologies more positively, deepening understanding of Objective 4.

Considering all these factors, this study suggests that while the literature supports ICT integration to prepare individuals for a digital future, family members hold differing preferences. For example, the family relatives with Primary/Secondary education favour what is traditional, while those with higher education studies are more inclined to prefer ICT. What these differences suggest is that family relatives' level of education is related to how they perceive different methodologies. From a school–home partnership perspective, these findings

underline the need for differentiated communication and support strategies that acknowledge families' diverse backgrounds and experiences with technology. This reinforces the importance of acknowledging diverse perspectives when designing teaching approaches that aim to foster 21st-century competences. Nevertheless, the literature suggests that 21st-century competences can be developed by both conventional and ICT-based methods, but depending on the specific goals and learning context. Thus, we stress that an integrating approach might be needed that takes the best of both worlds to enrich the educational process and to prepare students for their personal and professional future.

This study highlights the crucial role of families in children's development, but also reveals a gap in actively involving family relatives in educational interventions. These findings suggest the importance of exploring ways to effectively engage family relatives, especially in supporting ICT-based learning. Providing guidance, training opportunities, and accessible resources may help reduce perceived barriers and strengthen families' capacity to support competence development at home. Future research could examine how family training and resources might strengthen relatives' capacity to contribute to competence development, particularly in digital contexts. It should be noted, however, that the sample for this study was drawn exclusively from the autonomous community of Aragón, which may limit the generalizability of the findings to other regions or contexts.

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Appendix A—Instrument

Socio-Demographic Data

1. **Gender:**
   - Female
   - Male
   - Other
   - Prefer not to answer
2. **Year of birth (indicate with a four-digit number): _____**
3. **Current province of residence:**
   - Huesca
   - Zaragoza
   - Teruel
4. **Select your highest completed level of education (or equivalent):**
   - Primary
   - Secondary
   - High School
   - Vocational Training
   - University
5. **Type of school attended by your child(ren):**
   - Private
   - Private-Subsidized
   - Public
6. **Location of your child(ren)'s school:**
   - Municipality with fewer than 2,000 inhabitants
   - Municipality with 2,000–10,000 inhabitants
   - Municipality with more than 10,000 inhabitants

21st-Century Competences

We want to compare traditional education without technology and education with technology. The so-called "21st-century competences" refer to the most important skills for children's personal and professional future. Indicate to what extent you consider that each teaching context (traditional and ICT-based) is adapted to developing each of these competences, where 0 = "not adapted" and 10 = "fully adapted."

	Enseñanza tradicional											**Enseñanza con TIC**										
Creativity	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Critical Thinking (Analyze problems and make appropriate decisions)	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Problem Solving	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Decision Making	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Communication Skills	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Teamwork	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Information Searching and Organization	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Digital Citizenship (Active and responsible citizens in a digital world)	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
ICT Competences	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Adaptability to Change	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Initiative	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Productivity (Satisfactory achievement of learning outcomes)	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Leadership Skills	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Entrepreneurial Skills	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10

Appendix B—Table 2. Descriptive Statistics and Student's T-Test to Compare Means

21st-century competences	Analogical teaching (CAN)	Mean	SD	Teaching with ICT (CTI)	Mean	SD	T-Test	*Cohen's d*	IC 95%	
Creativity	**CAN1**	7.22	1.99	**CTI1**	6.9	2.02	2.99**	.11	(.110, .532)	CAN1 > CTI1
Critical thinking	**CAN2**	7.27	1.84	**CTI2**	6.46	2.06	8.06***	.30	(.612, 1.005)	CAN2 > CTI2
Problem solving	**CAN3**	7.26	1.72	**CTI3**	6.69	2.08	5.8***	.22	(.377, .762)	CAN3 > CTI3
Decision making	**CAN4**	7.19	1.83	**CTI4**	6.68	2.01	5.41***	.20	(.326, .696)	CAN4 > CTI4
Communication capacity	**CAN5**	7.53	1.93	**CTI5**	6.55	2.34	8.03***	.30	(.737, 1.213)	CAN5 > CTI5
Teamwork	**CAN6**	7.62	1.92	**CTI6**	6.64	2.37	9.21***	.34	(.848, 1.308)	CAN6 > CTI6
Seeking and organising information	**CAN7**	6.22	2.14	**CTI7**	8.24	1.87	-17.87***	-.67	(-2.246, -1.801)	CAN7 < CTI7
Digital citizenship	**CAN8**	5.18	2.58	**CTI8**	7.77	1.97	-21.02***	-.78	(-2.832, -2.384)	CAN8 < CTI8
ICT competences	**CAN9**	4.9	2.55	**CTI9**	8.11	1.8	-26.63***	-.99	(-3.443, -2.970)	CAN9 < CTI9
Adapting to changes	**CAN10**	6.34	2.16	**CTI10**	7.49	1.98	-10.74***	-.40	(-1.362, -.941)	CAN10 < CTI10
Initiative-taking capacity	**CAN11**	7.05	2.06	**CTI11**	6.86	2.08	1.87	.07	(-.010, .400)	CAN11 = CTI11
Productivity	**CAN12**	7.23	1.76	**CTI12**	7.14	1.96	0.88	.03	(-.098, .257)	CAN12 = CTI12
Leadership capacity	**CAN13**	7.28	1.96	**CTI13**	6.46	2.19	8.25***	.31	(.624, 1.014)	CAN13 > CTI13
Capacity to be enterprising	**CAN14**	6.92	2.06	**CTI14**	7.25	2.12	-3.44***	-.13	(-.519, -.142)	CAN14 < CTI14

On a scale from 0 to 10. According to Cohen's (1988) criteria, values of d around .20 indicate a small effect, around .50 a medium effect, and .80 or above a large effect.

*p < .05, **p < .01, ***p < .001

Appendix C—Table 3. Correlations among 21st-Century Competences

	CAN1	CAN2	CAN3	CAN4	CAN5	CAN6	CAN7	CAN8	CAN9	CAN10	CAN11	CAN12	CAN13	CAN14
CAN1	1													
CAN2	.639**	1												
CAN3	.589**	.692**	1											
CAN4	.615**	.714**	.749**	1										
CAN5	.506**	.578**	.601**	.650**	1									
CAN6	.531**	.573**	.561**	.629**	.704**	1								
CAN7	.441**	.469**	.490**	.494**	.414**	.465**	1							
CAN8	.383**	.386**	.346**	.341**	.282**	.345**	.505**	1						
CAN9	.388**	.838**	.331**	.354**	.275**	.342**	.501**	.785**	1					
CAN10	.535**	.537**	.511**	.531**	.477*	.513**	.557**	.563**	.575**	1				
CAN11	.606**	.652**	.623**	.684**	.579**	.619**	.510**	.446**	.433**	.649**	1			
CAN12	.531**	.602**	.590**	.603**	.536**	.589**	.507**	.394**	.411**	.516**	.665**	1		
CAN13	.547**	.581**	.589**	.629**	.597**	.645**	.427**	.363**	.363**	.507**	.687**	.644**	1	
CAN14	.575**	.592**	.604**	.643**	.599**	.640**	.524**	.459**	.457**	.587**	.713**	.656**	.774**	1

Significance of the correlation: * $p < .05$, ** $p < .01$

Appendix D—Table 4. The ANOVA Test for Comparing Means

		Primary/ Secondary	Higher Secondary	Vocational Training	University				
Analogical teaching (CAN)		M (SD)	M (SD)	M (SD)	M (SD)	F	*p*	ηp²	*IC 95%*
Creativity	**CAN1**	7.79 (1.67)	7.43 (1.95)	7.36 (1.77)	6.97 (2.15)	4.809	**.003**	.020	(.196, 1.431)
Critical thinking	**CAN2**	7.56 (1.53)	7.40 (1.93)	7.29 (1.79)	7.16 (1.90)	1.254	.289		
Problem solving	**CAN3**	7.74 (1.67)	7.31 (1.55)	7.08 (1.77)	7.23 (1.73)	2.934	**.033**	.012	(.079, 1.323)
Decision making	**CAN4**	7.62 (1.73)	7.27 (1.67)	7.18 (1.82)	7.07 (1.88)	2.078	.102		
Communication capacity	**CAN5**	7.75 (1.82)	7.57 (1.98)	7.47 (2.01)	7.50 (1.90)	.468	.705		
Teamwork	**CAN6**	7.98 (1.64)	7.72 (1.94)	7.74 (1.93)	7.45 (1.96)	2.237	.083		
Seeking and organising information	**CAN7**	6.92 (2.22)	6.27 (2.21)	6.32 (2.13)	6.01 (2.08)	4.305	**.005**	.018	(.241, 1.565)
Digital citizenship	**CAN8**	5.86 (2.63)	5.34 (2.90)	5.64 (2.42)	4.77 (2.51)	7.234	**.001**	.029	(.291, 1.890)
ICT competences	**CAN9**	5.77 (2.37)	5.06 (2.89)	5.39 (2.47)	4.39 (2.44)	11.023	**.001**	.044	(.604, 2.162)
Adapting to changes	**CAN10**	7.07 (1.89)	6.48 (2.27)	6.30 (2.16)	6.16 (2.15)	4.304	**.005**	.018	(.249, 1.584)
Initiative-taking capacity	**CAN11**	7.55 (1.68)	6.94 (2.21)	7.08 (2.01)	6.94 (2.12)	2.056	.105		
Productivity	**CAN12**	7.73 (1.60)	7.17 (1.97)	7.21 (1.70)	7.13 (1.75)	2.662	**.047**	.011	(.047, 1.139)
Leadership capacity	**CAN13**	7.45 (1.62)	7.35 (2.10)	7.28 (1.97)	7.22 (1.99)	.362	.780		
Capacity to be enterprising	**CAN14**	7.68 (1.58)	6.68 (2.37)	6.88 (2.10)	6.81 (2.04)	4.583	**.003**	.019	(.299, 1.505)
Teaching with ICT (CTI)									
Creativity	**CTI1**	7.17 (1.77)	7.22 (2.06)	6.82 (2.08)	6.81 (2.02)	1.499	.214		
Critical thinking	**CTI2**	6.86 (2.00)	6.59 (2.13)	6.40 (2.03)	6.37 (2.07)	1.441	.230		
Problem solving	**CTI3**	6.80 (2.09)	6.73 (2.17)	6.94 (1.99)	6.52 (2.10)	1.833	.140		
Decision making	**CTI4**	6.73 (2.11)	6.91 (1.92)	6.75 (2.05)	6.57 (1.98)	.790	.500		
Communication capacity	**CTI5**	6.81 (2.15)	6.80 (2.06)	6.86 (2.29)	6.27 (2.45)	3.460	**.016**	.014	(.047, 1.116)
Teamwork	**CTI6**	6.73 (2.16)	6.79 (2.39)	6.63 (2.40)	6.39 (2.39)	1.029	.379		
Seeking and organising information	**CTI7**	7.80 (2.21)	8.35 (1.82)	8.22 (1.93)	8.34 (1.75)	1.980	.116		
Digital citizenship	**CTI8**	7.84 (1.78)	8.03 (1.54)	7.57 (2.06)	7.80 (2.03)	1.188	.314		
ICT competences	**CTI9**	7.82 (1.94)	8.21 (1.51)	7.85 (1.91)	8.30 (1.74)	3.496	**.015**	.014	(-.857, -.037)
Adapting to changes	**CTI10**	7.57 (2.02)	7.63 (1.65)	7.64 (1.96)	7.35 (2.05)	1.096	.350		
Initiative-taking capacity	**CTI11**	6.83 (2.13)	7.04 (2.07)	6.93 (2.07)	6.79 (2.08)	.432	.730		
Productivity	**CTI12**	7.36 (1.73)	7.20 (2.00)	7.19 (1.99)	7.06 (1.99)	.624	.600		
Leadership capacity	**CTI13**	6.73 (2.19)	6.58 (2.31)	6.60 (2.19)	6.29 (2.15)	1.486	.217		
Capacity to be enterprising	**CTI14**	7.35 (1.98)	7.43 (2.09)	7.34 (2.20)	7.13 (2.11)	.742	.527		

Effect sizes are reported as partial eta squared (ηp²). According to Cohen's (1988) guidelines, ηp² values of approximately .01 indicate a small effect, .06 a medium effect, and .14 a large effect.