applied system innovation

MDPI

Article

Exploring the Impact of Digital Platforms on Teaching Practices: Insights into Competence Development and Openness to Active Methodologies

Víctor Díaz-Suárez [1,*], Miriam Martín-Paciente [2] and Carlos M. Travieso-González [1,3]

[1] Instituto para el Desarrollo Tecnológico y la Innovación en Comunicaciones (IDeTIC), 35001 Las Palmas de Gran Canaria, Spain; carlos.travieso@ulpgc.es
[2] Faculty of Law, University of Las Palmas de Gran Canaria, 35001 Las Palmas de Gran Canaria, Spain; miriam.paciente@ulpgc.es
[3] Signals and Communications Department, University of Las Palmas de Gran Canaria, 35001 Las Palmas de Gran Canaria, Spain
* Correspondence: victor.diaz102@alu.ulpgc.es

Abstract: This research examines the impact of digital transformation on teaching practices and evaluates educators' training requirements within the European Framework for the Digital Competence of Educators (DigCompEdu), focusing specifically on its implementation in the Canary Islands' educational system. Through a quantitative study involving 546 teachers from primary and secondary institutions during the 2023/2024 academic year (confidence level: 95%, margin of error: 4.15%), we analyzed the relationship between digital competence development and educational innovation. Results indicate significant gaps in four key areas: digital content creation, innovative teaching methodologies, assessment strategies, and feedback mechanisms. The findings reveal a direct correlation between insufficient educational funding and limited professional development opportunities in digital competencies. This study identifies critical areas requiring immediate attention, including increased budgetary allocation for technological infrastructure, systematic professional development programs aligned with DigCompEdu standards, and the restructuring of current innovation approaches in educational institutions. This research contributes to the understanding of how educational systems can effectively adapt to digital transformation while highlighting the crucial role of both financial investment and structured training programs in fostering successful educational innovation, ultimately emphasizing that adapting education systems to digital realities is essential for ensuring future success in an increasingly digitalized educational landscape.

Keywords: educational innovation; digital competences; questionnaire; teacher training; digital platform

Academic Editor: Teen-Hang Meen

Received: 3 April 2025
Revised: 27 April 2025
Accepted: 30 April 2025
Published: 7 May 2025

Citation: Díaz-Suárez, V.; Martín-Paciente, M.; Travieso-González, C.M. Exploring the Impact of Digital Platforms on Teaching Practices: Insights into Competence Development and Openness to Active Methodologies. *Appl. Syst. Innov.* **2025**, *8*, 64. https://doi.org/10.3390/asi8030064

1. Introduction

In recent decades, digital transformation has fundamentally reshaped educational landscapes, compelling teachers to expand their pedagogical skills and adapt to rapidly evolving technological innovations. The integration of information and communication technologies (ICTs) in academic environments has become not merely advantageous but essential [1], requiring a thorough understanding of both historical pedagogical approaches [2] and contemporary digital methodologies [3]. This technological modernization has rendered digital tools indispensable in daily operations, leading to a comprehensive digital transformation across educational institutions.

Research initiatives, such as the European Union's Emedus study (2014), have empirically demonstrated the necessity of ICT integration in classroom environments, emphasizing the importance of contextual factors including cultural, social, and educational dimensions [4]. However, the effective implementation of technology in educational settings demands enhanced professional development opportunities for educators to acquire and maintain digital competencies [5,6]. This necessity is particularly evident in the context of the Fourth Industrial Revolution, where continuous updating of digital skills has become crucial for effective classroom instruction.

Recent studies have advanced the evaluation of teaching competencies within digital frameworks, notably DigCompEdu, providing validated tools to assess digital competence in educational contexts. Several works emphasize the importance of structured frameworks for competence evaluations [7]; the need for specific competences in communication, collaboration, and innovation [8]; and the relevance of self-perceived digital safety skills for teachers in training [9]. Furthermore, collaborative problem-solving has been identified as a tangible indicator of digital skill acquisition in educational settings [10].

The European Framework for the Digital Competence of Educators (DigCompEdu) has emerged as a scientifically validated reference point for educational policy development and implementation [7]. This framework addresses six crucial areas of educators' professional activities, with a particular emphasis on digital content, pedagogy and learning, and evaluation and feedback mechanisms [8]. Initial implementation efforts, such as those in Andalusia's schools [9], have provided valuable insights into the framework's practical application.

The significance of digital literacy extends beyond institutional boundaries, encompassing family involvement in the educational process. Research indicates that home-based digital education plays a crucial role in students' technological development, with parental modeling significantly influencing young learners' digital behaviors [8,9]. Moreover, the recent COVID-19 pandemic has served as an unprecedented catalyst for rapid digital methodology implementation in education [10], highlighting both the potential and challenges of accelerated digital transformation.

This study addresses critical gaps in current research by examining the impact of digital platforms on teaching practices and analyzing essential training needs within the DigCompEdu framework. This study places particular emphasis on the challenges and opportunities presented by educational innovation, including resource allocation, infrastructure development, and professional training requirements. The investigation focuses on several key aspects: teacher training in digital platforms and innovative pedagogical techniques, the integration of digital tools in educational institutions, the adaptation of teaching resources to new technologies, and the economic implications of implementing comprehensive digital education programs.

By identifying current implementation challenges and training needs, this research aims to contribute to the ongoing discourse on educational digital transformation while providing practical insights for policy development and resource allocation in educational institutions. The findings will serve as a foundation for future initiatives supporting the sustainable integration of digital technologies in education. This study is guided by the following research questions: (1) What is the current level of digital competence among teachers in the Canary Islands as defined by the DigCompEdu framework? (2) How is this competence associated with the implementation of active learning methodologies? (3) What are the primary training needs as perceived by the teaching staff?

2. Materials and Methods

This study employed a quantitative research design by utilizing an online questionnaire to evaluate the influence of digital platforms in educational environments within the framework of digital transformation and educational innovation. While previous studies have examined ICT usage by teachers in countries such as Spain, Mexico, Colombia, Peru, and Argentina at a national level [11], our research specifically focuses on the regional context of the Canary Islands' educational system, providing a unique perspective on local digital transformation initiatives.

The research instrument, titled "Questionnaire about Digital Transformation in the Classroom", was developed based on the DigCompEdu framework and validated through the Common Framework of Digital Competence of Teachers [12]. The questionnaire was validated through expert judgment and a preliminary pilot test to ensure clarity, reliability, and alignment with the DigCompEdu framework. The final version incorporated revisions based on this initial testing phase.

Furthermore, the sample size (n = 546) was calculated using a standard formula for finite populations, based on a total population of 24,667 teachers, with a 95% confidence level and a 4.15% margin of error. This ensures strong representativeness and statistical reliability. This alignment with established frameworks ensures the instrument's validity in assessing digital competencies and innovation implementation.

To ensure the research instrument's validity, its design was based on the DigCompEdu framework, and it was validated through the Common Framework of Digital Competence of Teachers. The questionnaire was structured to capture comprehensive data about digital transformation in education. Each question was carefully formulated to gather specific information about digital competencies and implementation practices, allowing for both quantitative analysis and qualitative insights into current educational technology usage patterns.

The multiple-choice format for the digital competency assessment enabled participants to indicate various skill levels across different technological domains, providing a nuanced understanding of teacher capabilities and training needs. Specifically, the questionnaire sections were designed to align with DigCompEdu's six areas of educators' professional activities. For example, questions related to digital content creation, knowledge of educational digital platforms, and digital information management directly correspond to DigCompEdu's 'Digital Content' and 'Information and Data Literacy' areas.

Similarly, the section on the implementation of communication tools for didactic purposes and interest in ICT-based active learning methodologies aligns with DigCompEdu's 'Communication and Collaboration' and 'Teaching and Learning' areas. Furthermore, questions about digital identity management and security measures relate to DigCompEdu's 'Digital Safety' area, while the section on problem-solving using digital media and creative technology use corresponds to the 'Problem Solving' area. This alignment ensures that the questionnaire effectively assesses teachers' digital competencies as defined by the DigCompEdu framework, providing a robust foundation for analyzing training needs and innovation barriers.

Previous research has indicated that teachers primarily use ICT for personal matters and entertainment rather than didactic purposes, making it essential to specifically examine educational applications.

The questionnaire was designed to assess both the technical implementation of educational innovations and teachers' digital competencies through six comprehensive questions:

1. Teaching location identification.
2. Educational level specification.
3. Availability and usage of digital platforms or online spaces for student interaction.

4. Assessment of acquired digital competencies, including
    - Digital content creation using available tools (blogs, websites, and YouTube channels).
    - Knowledge of educational digital platforms.
    - Implementation of communication tools for didactic purposes.
    - Digital identity management.
    - Internet navigation and content-related information filtering.
    - Security measures (personal protection, data protection, and digital identity).
    - Problem-solving using digital media and creative technology use.
    - Digital information management (identification, retrieval, and organization).
    - Social media and virtual community resource sharing.
5. Institutional digital transformation tool inventory.
6. Interest in implementing ICT-based active learning methodologies.

Table 1 shows the relationship between the different sections of the questionnaire and the areas and competencies of DigCompEdu:

Table 1. Relationship between questionnaire sections and DigCompEdu areas and competencies.

Survey Section	DigCompEdu Area	Competencies Evaluated
Teaching location identification	Professional Engagement	Use of digital resources for communication and networking
Educational level specification	Professional Engagement	Understanding the context for digital application
Availability and usage of digital platforms	Digital Resources	Selecting, creating, and sharing digital resources
Digital content creation	Digital Resources	Designing and modifying educational materials
Knowledge of educational platforms	Teaching and Learning	Utilizing digital tools for pedagogical strategies
Implementation of communication tools	Teaching and Learning	Facilitating student interaction through technology
Digital identity management	Empowering Learners	Managing online presence and personal data security
Security measures	Facilitating Learners' Digital Competence	Ensuring safe and responsible digital use
Problem-solving with digital media	Assessment and Feedback	Developing creative and critical digital solutions
Digital information management	Professional Engagement	Organizing and managing digital content effectively
Social media and virtual community sharing	Teaching and Learning	Encouraging collaboration through digital tools
Interest in ICT-based active learning	Pedagogical Competencies	Willingness to integrate digital methodologies

This study employed a quantitative research design by utilizing an online questionnaire to evaluate the influence of digital platforms. Each question was carefully formulated to gather specific information about digital competencies and implementation practices, allowing for both quantitative analysis and qualitative insights. The questionnaire was developed based on the DigCompEdu framework and validated through the Common Framework of Digital Competence of Teachers. This alignment with established frameworks ensures the instrument's validity in assessing digital competencies and innovation

implementation. While the questionnaire included open-ended questions to gather qualitative data, the reported findings primarily reflect the quantitative data obtained through the multiple-choice format. The selection of quantitative analysis was motivated by the objective to provide a broad, statistically significant overview of digital competence levels among teachers in the Canary Islands, directly related to the DigCompEdu framework's defined competencies.

Data were collected through a voluntary online survey disseminated to teachers across all educational levels in the Canary Islands via email and mobile communication applications. The questionnaire was designed to be accessible on various digital devices (computers, mobile phones, and tablets) with internet connectivity, ensuring maximum participation opportunity. To maintain data quality and prevent response bias, participants completed the questionnaire individually without time constraints, eliminating potential duplicate responses or peer influence on answers.

The study adhered strictly to data protection regulations, including the Organic Act for Personal Data Protection, the Guarantee of Digital Rights 3/2018, and the General Data Protection Regulation (GDPR), which came into effect on 25 May 2018. Participants were informed of the anonymous nature of the survey and its intended use for educational innovation research at the outset, ensuring informed consent and compliance with privacy requirements.

The research achieved a substantial sample size of 546 active teachers from schools and high schools under the Ministry of Education, Universities, Culture, and Sports of the Canary Islands' Government. This sample, drawn from a total population of 24,667 active teachers, provides robust statistical significance with a 95% confidence level and a 4.15% margin of error (alternatively, a 99% confidence level with a 5.46% margin of error) [13], calculated using standard statistical sampling formulae for known populations.

The geographical distribution of respondents closely mirrors the Canary Islands' population distribution according to the 2024 Canary Statistics Institute (ISTAC) data. Specifically, 42.7% of participants were from Gran Canaria, 39.6% from Tenerife, and 17.7% from other islands in the Canary Autonomous Community. This distribution aligns well with the overall population statistics, where Tenerife (958,834 residents) and Gran Canaria (866,972 residents) account for 81.85% of the total 2,236,013 inhabitants, with the remaining 18.35% distributed across Fuerteventura, Lanzarote, La Palma, La Gomera, El Hierro, and La Graciosa.

The questionnaire was designed to capture comprehensive data about digital transformation in education while maintaining efficiency and respondent engagement. Each question was carefully formulated to gather specific information about digital competencies and implementation practices, allowing for both quantitative analysis and qualitative insights into current educational technology usage patterns. The multiple-choice format for the digital competency assessment enabled participants to indicate various skill levels across different technological domains, providing a nuanced understanding of teacher capabilities and training needs.

The methodology employed in this study ensures both scientific rigor and practical relevance by combining careful sample selection, comprehensive data collection, and adherence to ethical and privacy standards. The alignment between participant distribution and population demographics, coupled with the statistically significant sample size, provides a solid foundation for drawing meaningful conclusions about digital transformation in the Canary Islands' educational system.

The study sample comprised teachers across all educational levels, ensuring a representative distribution to enhance the homogeneity and validity of the data analysis. The sample distribution among post-primary education levels consisted of 213 secondary

education teachers, 122 high school teachers, and 133 professional training instructors. Additionally, 31 Official Language School instructors participated, contributing to a more diverse dataset. Their inclusion is because these teachers are part of the formal educational system of the Government of the Canary Islands and depend on the Ministry of Education. Furthermore, their participation provides a broader perspective on the digital competence of teachers in different educational contexts.

While it may seem less relevant to ask about online platform use in early education (pre-school and primary), research suggests that digital exposure at these levels can play a foundational role in students' later digital competence. Additionally, the responses provide insights into how early-stage educators perceive and incorporate digital tools in their pedagogy.

Figure 1 illustrates the distribution of participants according to their teaching level and professional qualifications.

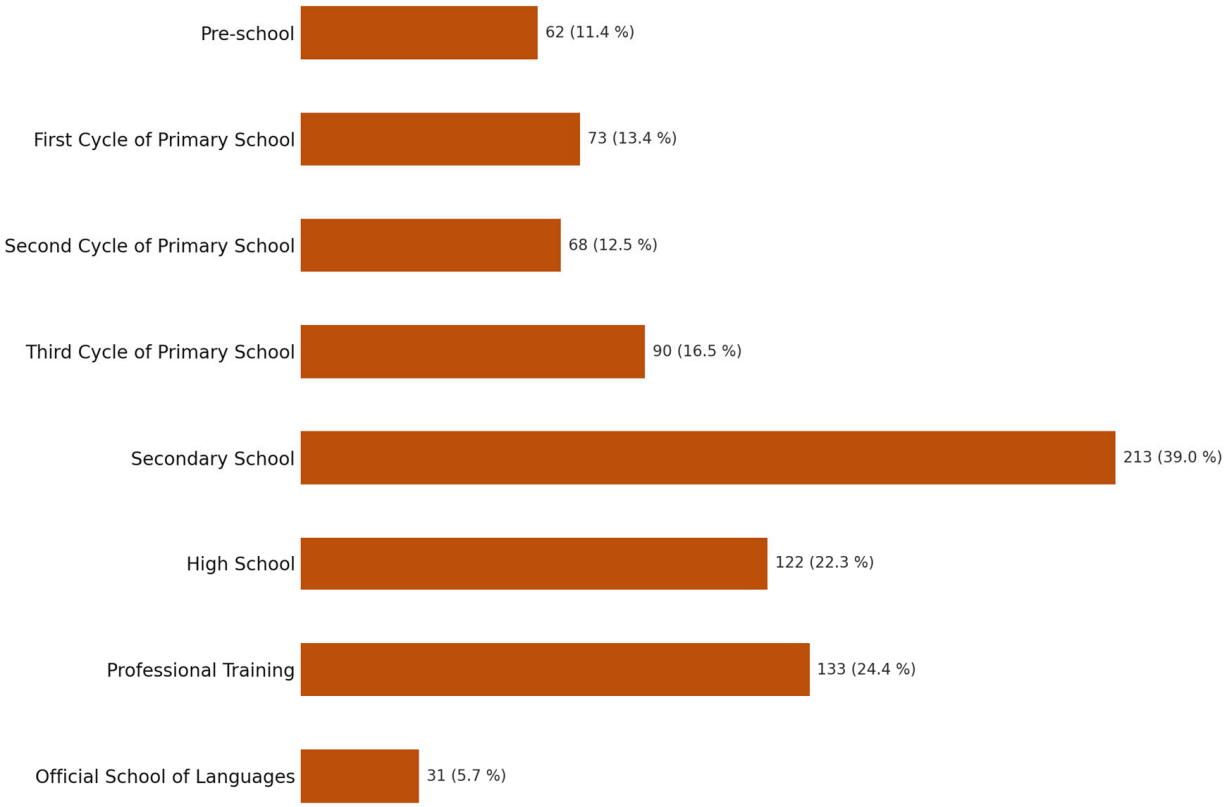

Figure 1. Levels of education of the teachers surveyed.

3. Results

The analysis of the results reveals that individual teachers frequently deliver instruction across multiple educational levels within the current academic framework. It is noteworthy that the study incorporated valuable input from 31 Official Language School instructors, whose participation significantly enriched the research findings and contributed to a more comprehensive understanding of the subject matter. Additionally, when examining the technological infrastructure available at educational institutions, the data indicate a substantial adoption of digital learning environments. Specifically, when participants were asked about the availability of online platforms or virtual spaces for student use at their institutions, an overwhelming majority (91%) reported affirmative responses. Figure 2 illustrates the percentage of educational institutions with digital platforms available for students, segmented by educational level.

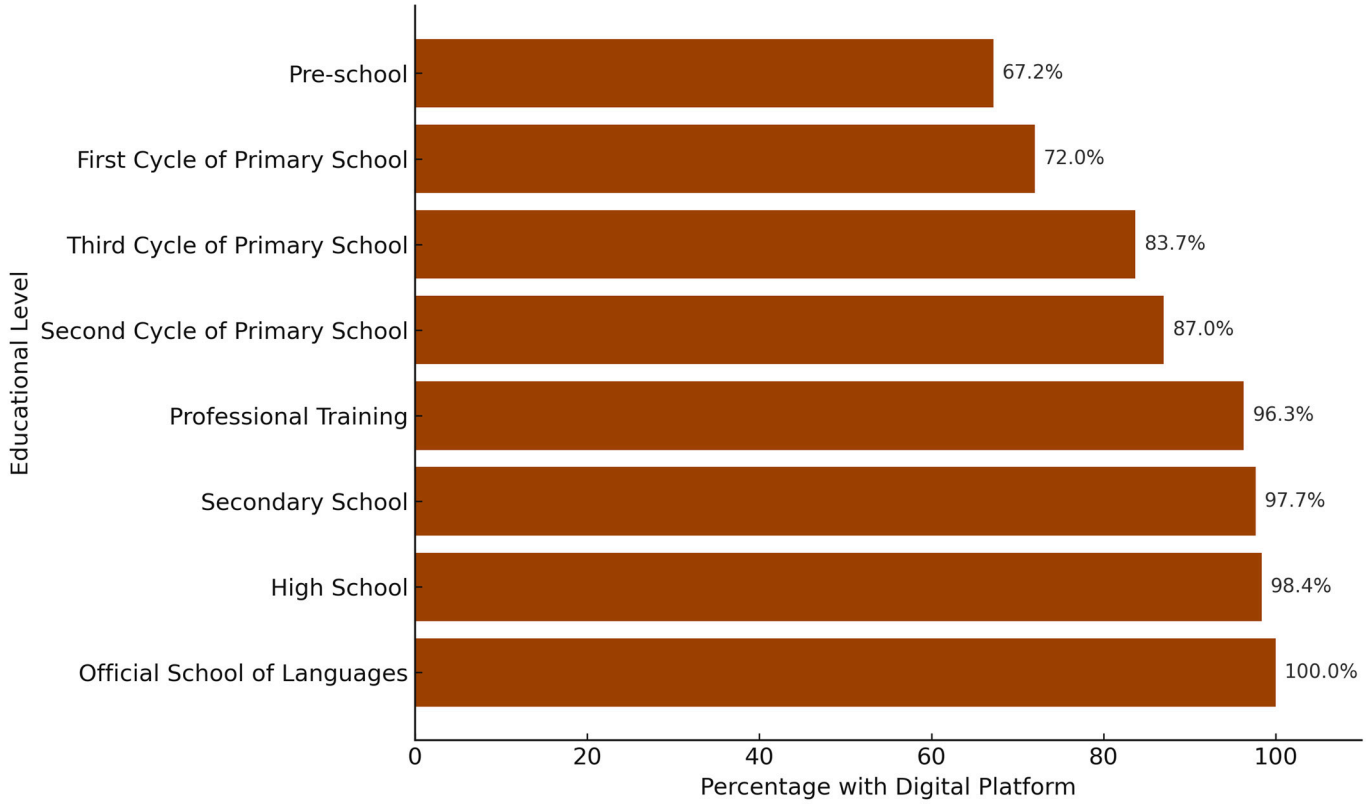

Figure 2. Percentage of educational institutions with digital platforms available for students, segmented by educational level.

The analysis of platform usage by educational level reveals significant differences. Although almost all secondary and higher education teachers offer structured online learning environments, the primary and preschool levels show lower adoption rates. These differences highlight the need for differentiated digital training approaches at all stages of education.

The assessment of teachers' digital competencies reveals significant variations in proficiency levels across different skills. A notable finding indicates that less than one-third of respondents demonstrate proficiency in managing digital identity, while knowledge of digital security measures remains limited (fewer than 200 participants). These findings highlight a critical gap between infrastructure investment and professional development in digital competencies.

In addition to issues related to educational investment, this study provides relevant insights into teachers' digital competence profiles. While a large majority of respondents (92.5%) reported confidence in navigating, searching, and filtering online information related to instructional content, other areas of digital competence remain significantly underdeveloped.

Specifically, less than one-third of teachers indicated proficiency in managing digital identity, and only 34.2% demonstrated awareness of digital security measures. Likewise, competencies such as problem-solving using digital tools, technical troubleshooting, and creative integration of technology were reported by fewer than half of the respondents.

Moderate levels of self-reported proficiency were observed in areas like social media resource sharing, digital platform use, and digital information management (ranging from 62% to 76%).

These disparities suggest the existence of a meaningful gap between the infrastructure available in schools and teachers' preparedness to make pedagogically effective use of

it. As such, there is a pressing need to implement professional development programs focused on strengthening key areas of digital competence, particularly those related to data protection, active methodology integration, and the creative, secure use of ICT tools in the classroom.

Figure 3 presents the percentage of teachers who reported having fully acquired various digital competencies, categorized according to the DigCompEdu framework. The highest self-reported proficiency levels were in browsing, searching, and filtering digital information (92.4%), followed by organizing digital content (76.0%) and using virtual learning platforms (73.3%). Moderate skills were reported in areas like digital information management and the use of social media for collaborative purposes (approximately 62–66%).

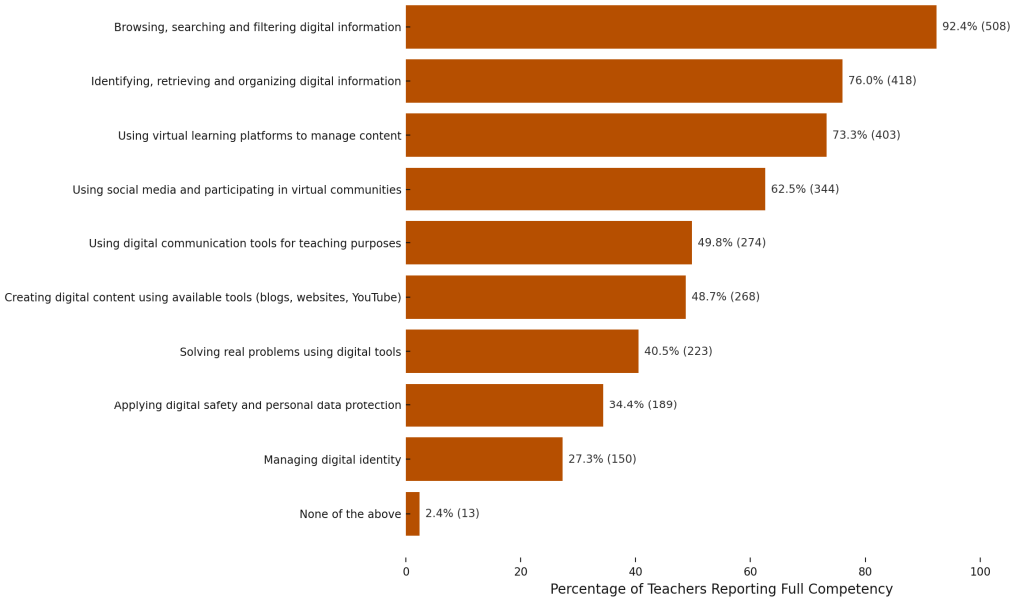

Figure 3. Knowledge acquired by teachers on digital competences, based on the DigCompEdu framework.

In contrast, only 27.3% of respondents indicated proficiency in managing digital identity and 34.4% in applying digital safety and data protection measures. These disparities suggest an uneven digital competence profile, with strong performance in information literacy but critical gaps in identity management, safety, and problem-solving with digital tools.

The findings reveal significant deficiencies in critical areas of digital competence. Less than 30% of teachers reported proficiency in managing digital identity, and only 34.2% reported proficiency in digital security. Other areas such as problem-solving using digital tools, technical troubleshooting, and creative integration of technology were reported by fewer than half of the respondents.

Additionally, while nearly 90% of teachers incorporate online materials into their instruction, only 50% report creating or adapting content specifically for digital platforms. This highlights a substantial gap between the availability of digital resources and the capacity to use them effectively.

Despite the widespread adoption of digital platforms across educational institutions (91%), teachers continue to express the need for training that enables the efficient and pedagogically sound use of these tools. Notably, more than 40% of respondents indicated a willingness to implement active learning methodologies, provided that appropriate training is offered.

These results underscore the importance of targeted professional development programs to address current shortcomings in digital competence and support the successful integration of educational technologies.

The identified deficiencies in digital identity and security competencies among teachers highlight a critical gap in professional development. This concern is particularly significant given teachers' crucial role in protecting student data. The current educational legislation emphasizes this importance, mandating 'the full integration of students in the digital society and the learning of responsible consumption and critical, safe use of digital media that respects human dignity.'

Although the questionnaire did not directly inquire about prior training in digital competencies, valuable insights can be drawn from the teachers' self-assessed proficiency levels across various digital skills.

A key limitation of this study is its reliance on self-rated questionnaires to assess teachers' digital competence. As the reviewer noted, self-perception may not always accurately reflect actual skills. To mitigate this, the questionnaire was aligned with established frameworks such as DigCompEdu and the Common Framework of Digital Competence of Teachers. However, the potential influence of perceived self-efficacy on teachers' willingness to adopt new digital tools cannot be discounted.

While this study provides a comprehensive overview of digital competencies among teachers in the Canary Islands, it is important to acknowledge certain limitations. Specifically, we did not collect data on the age of participants, which may be a relevant factor influencing teachers' digital competence and willingness to adopt new technologies [14,15]. However, our focus was primarily on assessing the overall digital competence levels and training needs across the teaching population, as defined by the DigCompEdu framework. Future research could explore the relationship between age, digital competence, and technology adoption in more detail, providing a more nuanced understanding of the challenges and opportunities associated with digital transformation in education.

Therefore, the data indirectly indicate a significant demand for specific training in digital competencies, which aligns with the identified need for comprehensive ICT training programs focused on enabling teachers to develop and adapt digital content.

In addition to the quantitative data, the questionnaire provided qualitative insights into teachers' experiences with digital transformation. For example, many teachers expressed a desire for more training in specific digital tools and strategies, as well as concerns about the digital divide among students. These qualitative insights provide a valuable context for interpreting the quantitative findings and highlight the need for targeted support and resources for teachers. Specifically, qualitative feedback revealed that teachers feel underprepared in areas such as 'digital content creation' and 'innovative teaching methodologies', which directly reflects gaps in DigCompEdu competencies and aligns with the article's objective of identifying areas needing immediate attention.

To provide greater clarity, the open-ended responses were thematically grouped into three main areas of need: (1) the desire for more training in the use and creation of digital content; (2) the need for concrete strategies to implement ICT-based active learning methodologies; and (3) concerns about digital safety, especially regarding student data protection and identity management. These categories reflect the areas in which teachers most frequently expressed uncertainty, and they align directly with the quantitative findings, reinforcing the urgency of targeted professional development in these domains.

While the study reveals the widespread adoption of digital platforms across educational institutions, the findings indicate that teachers lack adequate training for their effective and efficient utilization. This disparity between infrastructure availability and professional competency presents a significant challenge in contemporary education.

Regarding digital resource implementation, nearly 90% of teachers incorporate online materials in their instruction. However, only 50% create or adapt materials specifically

for online platforms, indicating a substantial gap between content utilization and content creation capabilities.

This finding underscores an urgent need for comprehensive ICT training programs focused on enabling teachers to develop and adapt digital content. Such training is essential not only for enhancing educational value but also for preventing the potential widening of the digital divide among students from different socio-educational backgrounds.

Figure 4 illustrates teachers' current disposition toward implementing active learning methodologies integrated with ICT tools in response to education's digital transformation. The analysis reveals encouraging data: more than 53% express immediate willingness to adopt these approaches, while an additional 40% would embrace them contingent upon receiving appropriate training. This positive attitude aligns with research indicating the importance of effectively incorporating digital technology into teaching methodologies [16].

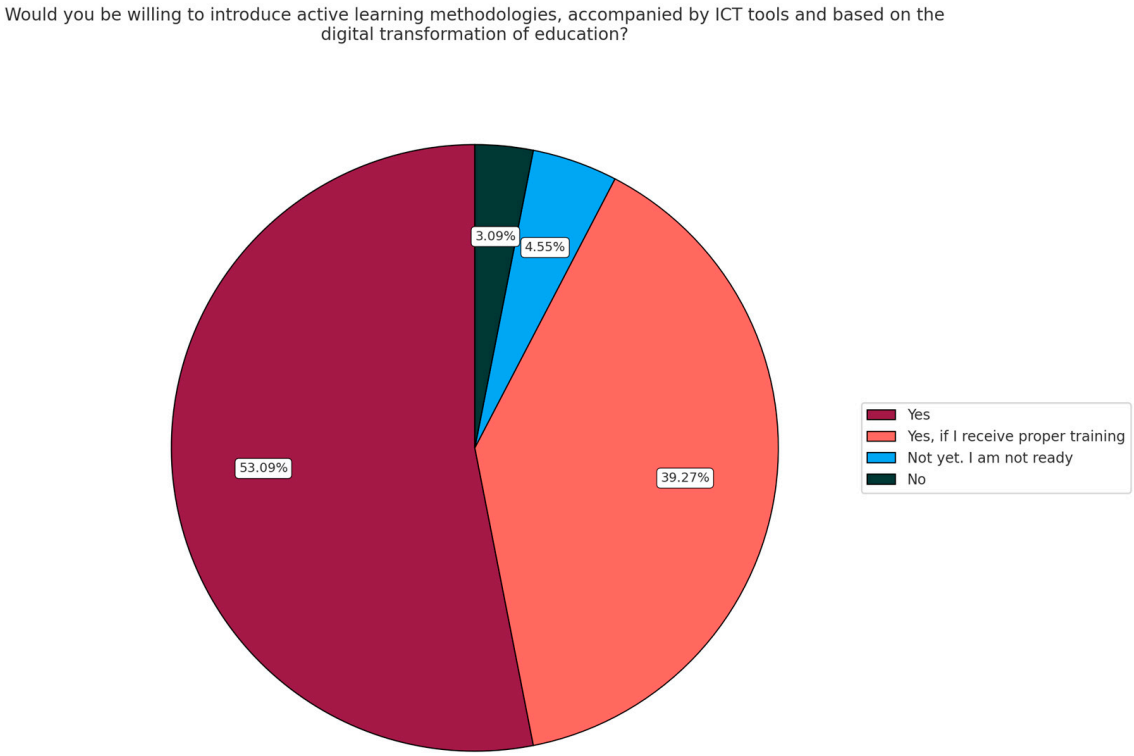

Figure 4. Would you be willing to introduce active learning methodologies, accompanied by ICT tools and based on the digital transformation of education?

These findings collectively suggest a transformative opportunity in education, where teachers' receptiveness to digital integration coexists with clear needs for targeted professional development. Addressing these needs could significantly enhance educational outcomes through improved digital competency and more effective technology integration in pedagogical practices.

This research has identified three critical questions regarding digital education implementation:

First, the extent of teachers' preparedness for digital instruction and innovative pedagogical techniques. Second, whether current financial investments effectively target the enhancement of teachers' digital competencies and the integration of ICT tools to improve educational quality. Finally, the availability of resources and expertise necessary for teachers to develop and implement high-quality digital content on learning platforms.

These questions emerged as fundamental considerations in understanding the current state of digital education.

4. Discussion

The analysis of this study reveals critical insights regarding educational investment and digital transformation in the Spanish education system. The findings underscore the complex relationship between financial allocation, teacher preparation, and technological integration in educational settings.

Investment in education emerges as a fundamental factor in addressing current pedagogical challenges. The data indicate that insufficient or improperly directed investment, particularly in enhancing teachers' digital competencies and ICT implementation, significantly impedes the adoption of innovative educational techniques. This observation aligns with current research on educational transformation processes [17].

In addition to investment-related issues, the analysis of teachers' digital competencies reveals notable patterns. The most widely acquired skill is the ability to browse, search, and filter Internet-based information relevant to instructional content (92.5%).

However, substantial gaps remain in areas such as digital identity management (less than 30% of respondents), digital safety (34.2%), problem-solving using digital tools, creative integration of technology, and educational use of communication tools, which were all below 50%.

These findings emphasize the urgent need for professional development programs focused on critical digital competencies, especially those directly related to student data protection and innovative pedagogical practice.

Beyond their statistical relevance, these results reveal important pedagogical and organizational dynamics that help explain the current state of digital transformation in education. The contrast between widespread digital access and limited teacher proficiency in areas such as safety, identity management, and content creation suggests that infrastructure alone does not guarantee effective digital integration in schools.

Moreover, the accelerated digitalization driven by the COVID-19 pandemic has likely exacerbated pre-existing disparities in teacher preparedness. In the specific context of the Canary Islands, where educational resources and digital infrastructure can vary considerably between islands, these gaps underscore the need for context-sensitive strategies. Tailored professional development and policy measures are essential to ensure equity and effectiveness in digital education across different educational levels and territories.

The use of the DigCompEdu framework in this study provides a structured lens to interpret these gaps. It not only enables a more precise diagnosis of professional needs but also points toward actionable strategies for teacher development. These findings reinforce the idea that digital innovation must be accompanied by sustained institutional support, pedagogical alignment, and continuous professional learning to be truly effective.

Examining Spain's educational investment reveals several noteworthy patterns. The General State Budget (GSB) shows a progressive increase in education expenditure, from 4893 million euros in 2021 to 6408 million euros in 2023, with similar projections for 2024 due to budget extension [18,19]. However, despite this apparent growth, several concerning factors emerge. Nearly 50% of educational investment is directed toward scholarships and grants, while Spain ranks among the five lowest EU countries in public education spending. Particularly noteworthy is that only 300,000 euros were allocated to the digital transformation of education in 2022, primarily as a pandemic response measure.

The Canary Islands' case study provides valuable insights into regional educational investment patterns. Investment increased from EUR 2081 million in 2022 to EUR 2257 million in 2023, with staff costs consuming approximately three-quarters of the educational budget.

Notably absent are specific allocations for digital competency development, highlighting a significant gap between infrastructure needs and actual investment.

The research identifies significant disparities between infrastructure availability and teacher preparation.

This study's findings reveal critical insights into the relationship between educational investment, digital transformation, and teacher preparation in the Spanish education system. While investment in education is increasing, particularly in response to the pandemic, its effective allocation remains a challenge. Significant disparities persist between infrastructure availability and teachers' digital competencies, exacerbated by limited resources for digital content creation and professional development.

While educational centers generally possess digital platforms, teachers demonstrate insufficient training for their effective utilization. This gap is further exacerbated by limited resources for generating and adapting digital content, coupled with an absence of sustained investment in teacher digital competency development.

The analysis of this study reveals critical insights regarding educational investment and digital transformation in the Spanish education system. Our findings underscore the complex relationship between financial allocation, teacher preparation, and technological integration in educational settings, directly supported by the data collected from 546 teachers in the Canary Islands.

The data indicate that less than one-third of respondents demonstrate proficiency in managing digital identity, and knowledge of digital security measures remains limited. This is directly related to insufficient or improperly directed investment in enhancing teachers' digital competencies and ICT implementation, significantly impeding the adoption of innovative educational techniques.

Despite widespread internet access among Spanish students (93%), disparities persist, affecting both hardware and software availability. Urban–rural disparities in technological access and implementation further compound this issue.

The digital divide remains a critical concern, with disparities in technological access and implementation affecting vulnerable populations. Addressing this divide requires targeted investment in infrastructure, teacher training, and digital competency enhancement.

More than 53% of teachers express immediate willingness to adopt active learning methodologies integrated with ICT tools, and an additional 40% would embrace them contingent upon receiving appropriate training. This receptiveness presents a transformative opportunity if targeted professional development is provided. Our findings align with current research on educational transformation processes, emphasizing the necessity of ICT integration in classroom environments and the importance of contextual factors.

Similar to the Emedus study, our research underscores the need for enhanced professional development opportunities for educators to acquire and maintain digital competencies. Consistent with Starkey, our analysis highlights the importance of addressing technical knowledge disparities among teachers and reducing equipment inequalities between educational centers. Current investment patterns reveal a limited correlation between expenditure and ICT improvement needs, with insufficient focus on teacher professional development in digital competencies.

Therefore, the development of comprehensive teacher training programs in digital competencies is essential. The implementation of sustainable technological infrastructure improvement plans is necessary. The creation of specific funding streams for educational innovation is crucial. The establishment of mechanisms to address the digital divide is vital. The findings demonstrate that strategic investment in teacher training, infrastructure development, and targeted initiatives to address the digital divide is essential

for improving educational outcomes and fostering successful technology integration in pedagogical practices.

Digital divide implications present another critical aspect of the current educational landscape. This study reveals that while 93% of Spanish students aged 10–15 have internet access, 7% remain without connectivity. This national figure becomes more concerning when viewed in a global context, where approximately two-thirds of school-age children lack internet connection [20]. Furthermore, urban–rural disparities in technological access and implementation persist, with resource inequalities affecting both hardware and software availability.

Current investment patterns raise several critical concerns regarding strategic allocation and effectiveness. There exists a limited correlation between expenditure and ICT improvement needs, insufficient focus on teacher professional development in digital competencies, and inadequate attention to educational innovation frameworks. These issues are compounded by the need for more targeted investment in technological infrastructure.

The research identifies several key areas requiring immediate attention for future development. Primary among these is the development of comprehensive teacher training programs in digital competencies, coupled with the implementation of sustainable technological infrastructure improvement plans. Additionally, the creation of specific funding streams for educational innovation and the establishment of mechanisms to address the digital divide emerge as crucial priorities.

The findings suggest necessary policy adjustments across multiple domains. Current educational investment strategies may not optimally address contemporary needs, particularly in ICT implementation and improvement [21,22]. This misalignment between resource allocation and educational needs presents significant challenges for achieving desired educational outcomes. The study highlights the critical importance of addressing the digital divide, particularly in vulnerable populations [22]. This challenge extends beyond mere access to technology, encompassing the development of associated skills and competencies necessary for effective educational participation.

Furthermore, the research underscores the necessity of reconsidering education policies to address current challenges [23]. This reconsideration should encompass strategic resource allocation, professional development programs, infrastructure development, and digital competency enhancement initiatives. The successful implementation of educational innovation requires sustained and targeted investment in teacher training, comprehensive infrastructure development, the systematic evaluation of outcomes, and the regular assessment of evolving needs.

Future policy adjustments should prioritize comprehensive teacher training programs, sustainable technological infrastructure, and specific funding streams for educational innovation. Addressing technical knowledge disparities among teachers and reducing equipment inequalities between educational centers are also urgent priorities. Further research should incorporate objective measures of digital competence alongside self-assessments to provide a more comprehensive evaluation.

Looking toward future considerations, this study indicates several areas requiring attention in the coming years. Technical knowledge disparities among teachers must be addressed, along with reducing equipment inequalities between educational centers. The development of comprehensive digital competency frameworks and the implementation of systematic evaluation mechanisms are now urgent priorities.

Based on the analysis, several key recommendations emerge for improving educational outcomes. First, the development of targeted investment strategies for digital competency enhancement must be prioritized. Second, comprehensive teacher training programs need to be implemented systematically. Third, the creation of evaluation mechanisms to

assess progress and identify areas for improvement is essential. Fourth, infrastructure development plans must be established and maintained. Finally, specific initiatives to address the digital divide need to be developed and implemented.

These findings and recommendations align with current research indicating the importance of sustained, strategic investment in educational technology and teacher preparation [24,25]. The success of educational innovation initiatives depends significantly on appropriate resource allocation and systematic implementation strategies.

The analysis of this study reveals critical insights regarding educational investment and digital transformation in the Spanish education system. The findings underscore the complex relationship between financial allocation, teacher preparation, and technological integration in educational settings.

While the descriptive analysis of survey data provides a valuable overview of digital competencies among teachers in the Canary Islands, it is important to contextualize these findings within the broader scholarly literature on digital transformation in education. Specifically, our results align with previous research indicating that teachers often lack adequate training for the effective utilization of digital resources, despite widespread access to technology.

Furthermore, the identified gaps in digital competencies have significant implications for policy development and resource allocation in education. Insufficient investment in teacher training programs, coupled with a lack of strategic planning for technology integration, may hinder the successful implementation of educational innovation initiatives.

In relation to the DigCompEdu framework, our findings highlight the need for targeted professional development programs that address specific competency gaps, particularly in areas such as digital content creation, digital identity management, and digital security measures. By aligning training initiatives with the DigCompEdu framework, educational institutions can ensure that teachers are equipped with the skills and knowledge necessary to effectively navigate the digital landscape and promote student learning.

This study concludes that current educational challenges require a comprehensive approach encompassing financial investment, professional development, and technological integration. This approach must consider both immediate needs and long-term educational objectives while addressing existing disparities in access and implementation. The future success of educational systems will largely depend on the ability to effectively address these challenges through strategic planning and targeted resource allocation. While the primary objective of this study was to assess general trends in digital competence across the Canary Islands, preliminary observations suggest that variations exist according to both educational level and geographical location. For example, digital platform usage seems to be more frequent in secondary and vocational education compared to early education stages. Although a detailed segmented analysis is beyond the scope of this paper, recognizing these differences underscores the importance of designing future studies to explore them in depth, thereby enabling more focused and context-sensitive interventions.

5. Conclusions

This research reveals several significant conclusions regarding digital competencies in education and their relationship with current investment patterns and teacher preparation.

It is important to highlight that education in the Canary Islands is managed by the regional Government of the Canary Islands, which gives particular relevance to the findings of this study. Since educational competences are decentralized to the regional level, the proposals formulated in this work are directly applicable to the educational reality of the region. Identifying deficiencies in digital competencies and gaps in strategic investment for teacher training serves as a key starting point for decision-making in the educational sector.

Therefore, the recommendations derived from this research not only reflect global trends in digital transformation in education but also respond to the specific needs of the Canary Islands, providing a valuable reference framework for future educational policies.

The findings demonstrate that despite substantial infrastructure and technological deployments, teachers lack adequate training for the effective utilization of these resources to optimize student academic performance.

This study evidences significant gaps in teachers' digital competencies, despite their demonstrated willingness to incorporate technological tools in their practice. While nearly 90% of teachers provide online materials to students, only half create or adapt these materials themselves, highlighting a critical gap between technology availability and effective utilization. This disparity aligns with our previous findings regarding the misalignment between infrastructure investment and professional development needs.

The research strongly supports the adoption of DigCompEdu as a reference framework for improving the current educational model. Achieving full digital transformation in classrooms requires a comprehensive approach encompassing several key elements. Investment decisions should be informed by professional consultation to ensure efficiency and address the digital divide effectively. This aligns with our earlier findings regarding the current inefficiencies in educational spending patterns.

A systematic teacher training plan focused on digital competencies and educational innovation emerges as crucial. This need is particularly evident given our analysis of the current budget allocation, which shows limited specific investment in teacher digital competency development. Furthermore, infrastructure investments must align with the actual needs of educational centers' digital transformation, addressing the disparities identified in our research.

The implementation of effective educational innovation models requires coordination with the Digital Education Action Plan (2021–2027) [26], which provides a framework for the sustainable adaptation of EU education systems to the digital era. This initiative significantly contributes to addressing the challenge posed by Spain's position in terms of educational investment within the EU, as our results reveal.

Our research also emphasizes the importance of utilizing existing resources, including the European Union literature on media and information literacy policies [27] and the Digital Learning Research Manual [28], as essential references for achieving digital competency objectives. These resources can guide the development of training projects that ensure the acquisition of necessary digital skills.

The collected data on digital competencies play a crucial role in understanding student learning patterns and identifying areas for improvement. As demonstrated in recent studies [28–32], this information can contribute to performance enhancement, personalized education implementation, and dropout rate reduction. These outcomes align with our findings regarding the need for targeted investment in digital transformation and teacher preparation programs.

In summary, this study identifies significant gaps between digital infrastructure availability and teacher preparedness in key competence areas. Based on these findings, we recommend prioritizing investment in targeted training programs aligned with the DigCompEdu framework and promoting institutional support for digital pedagogical innovation. Future research should explore the relationship between variables such as age, teaching experience, and digital competence, as well as the long-term effects of professional development programs on the integration of technology in teaching practices.

Author Contributions: Conceptualization, V.D.-S., C.M.T.-G. and M.M.-P.; methodology, V.D.-S., C.M.T.-G. and M.M.-P.; software, V.D.-S.; validation, V.D.-S., C.M.T.-G., and M.M.-P.; formal analysis, V.D.-S., C.M.T.-G. and M.M.-P.; investigation, V.D.-S. and C.M.T.-G.; resources, V.D.-S., C.M.T.-G. and M.M.-P.; data curation, V.D.-S.; writing—original draft preparation, V.D.-S., C.M.T.-G. and M.M.-P.; writing—review and editing, V.D.-S., C.M.T.-G. and M.M.-P.; visualization, V.D.-S., C.M.T.-G., and M.M.-P.; supervision, C.M.T.-G.; project administration, V.D.-S., C.M.T.-G. and M.M.-P.; funding acquisition, C.M.T.-G. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Data are available from the corresponding author upon request.

Acknowledgments: The authors would like to thank the teachers of the Consejería de Educación, Universidades, Cultura y Deportes del Gobierno de Canarias, for their collaboration in the study developed in this article.

Conflicts of Interest: The authors declare that there is no conflict of interest that could influence the work presented in this article.

Abbreviations

The following abbreviations are used in this manuscript:

ITCs	Information and Communication Technologies
DigCompEdu	European Framework for the Digital Competence of Educators
GDPR	General Data Protection Regulation
ISTAC	Canary Statistics Institute
GSB	General State Budget
EU	European Union

References

1. Barragán Sánchez, R.; Palacios Rodríguez, A.; Corujo-Vélez, M.C. Claves organizativas para la integración de las TIC en los centros educativos. In *Centros Educativos. Transformación Digital y Organizaciones Sostenibles: Aprender y Enseñar en Tiempos de Pandemia*; Dykinson, S.L.: Madrid, Spain, 2021. [CrossRef]
2. Fernández, M.M. Métodos pedagógicos emergentes para un nuevo siglo ¿Qué hay realmente de innovación? *Teor. Educ.* **2019**, *31*, 5–34. [CrossRef]
3. López Iglesias, M.; Gallardo Fernández, I.M.; Fabregat Pitarch, A. Entorno Social y Formación del Profesorado en Alfabetización Digital en la Escuela del Siglo XXI. 2021. Available online: https://hdl.handle.net/10550/81236 (accessed on 2 April 2025).
4. Hartai, L. Report on Formal Media Education in Europe. Project 'EMEDUS: European Media Literacy Education Study'. EMEDUS. Available online: https://bit.ly/3f7A2Je (accessed on 2 April 2025).
5. Gisbert, M.; Esteve, V.; y Lázaro, J.L. (Eds.) *¿Cómo Abordar la Educación del Futuro? Conceptualización, Desarrollo y Evaluación Desde la Competencia Digital Docente*; Barcelona Octaedro: Barcelona, Spain, 2019.
6. Moriarty, D.; Fragueiro, M.S. Las TIC en Educación Primaria a través del aprendizaje en basado en proyectos. *EA Esc. Abierta* **2024**, *27*, 59–76. [CrossRef]
7. Mattar, J.; Ramos, D.K.; Lucas, M.R. DigComp-Based Digital Competence Assessment Tools: Literature Review and Instrument Analysis. *Educ. Inf. Technol.* **2022**, *27*, 10843–10867. [CrossRef]
8. Kiryakova, G.; Kozhuharova, D. The Digital Competences Necessary for the Successful Pedagogical Practice of Teachers in the Digital Age. *Educ. Sci.* **2024**, *14*, 507. [CrossRef]
9. Torres-Hernández, N.; Gallego-Arrufat, M.J. Toward an Education for Digital Safety Based on the Self-Perceived Competences of Pre-service Teachers. *Comput. Sch.* **2024**, *41*, 307–327. [CrossRef]
10. Luengo-Aravena, D.; Cabello, P.; Rodriguez-Milhomens Bachino, B. Online Collaborative Problem-Solving as a Tangible Outcome of Digital Skills in Technical and Vocational Higher Education. *Comput. Educ.* **2024**, *218*, 105079. [CrossRef]
11. Cabero-Almenara, J.; Palacios-Rodríguez, A. Marco Europeo de Competencia Digital Docente «DigCompEdu». Traducción y adaptación del cuestionario «DigCompEdu Check-In». *Edmetic* **2020**, *9*, 213–234. [CrossRef]
12. Redecker, C.; Punie, Y. *European Framework for the Digital Competence of Educators: DigCompEdu*; Publications Office of the European Union: Luxembourg, 2017. [CrossRef]

13. Cabero-Almenara, J.; Barragán-Sánchez, R.; Palacios-Rodríguez, A.D.P. DigCompOrg: Marco de referencia para la transformación digital de los centros educativos andaluces. *eCO Rev. Digit. Educ. Form. Profr.* **2021**, *18*, 1–21.
14. Asenjo Gomez, J.T.; Asenjo Gómez, F. La autopercepción de la competencia digital en los docentes: Variaciones tras el confinamiento. *Rev. Española Educ. Comp.* **2021**, 174–198. [CrossRef]
15. BlinkLearning. V Estudio Sobre el Uso de la Tecnología en la Educación. Available online: https://bit.ly/3dMLIPz (accessed on 2 April 2025).
16. Tarango, J.; García-Prieto, V.; González Quiñones, F. Brecha digital en didáctica de docentes de educación básica: Caso escuelas públicas en la ciudad de Chihuahua (México). *Obra Digit. Rev. De Comun.* **2021**, *21*, 51–68. [CrossRef]
17. Murray, R.S.; Larry, J.S. *Estadística*, 4th ed.; Mc Graw-Hill: Álvaro Obregón, Mexico, 2009.
18. Starkey, L. A review of research exploring teacher preparation for the digital age. *Camb. J. Educ.* **2019**, *50*, 37–56. [CrossRef]
19. Tzafilkou, K.; Perifanou, M.; Economides, A.A. Assessing teachers' digital competence in primary and secondary education: Applying a new instrument to integrate pedagogical and professional elements for digital education. *Educ. Inf. Technol.* **2023**, *28*, 16017–16040. [CrossRef] [PubMed]
20. Martín Fernández, A.; Jódar Reyes, M.; Valenzuela López, M.I. Tecnologías de la información y comunicación (TIC) en formación y docencia. *FMC-Form. Médica Contin. Atención Primaria* **2022**, *29* (Suppl. 1), 28–38; [CrossRef]
21. Unesco. *Marco de Competencias de los Docentes en Materia de TIC*, versión 3.0; Unesco: Paris, France, 2019. Available online: https://bit.ly/396mlqO (accessed on 2 April 2025).
22. SEPG. Presupuestos Generales del Estado Aprobados para el año 2021. Ministerio de Hacienda y Función Pública: Madrid, Spain, 2021. Available online: https://bit.ly/3IgluFl (accessed on 2 April 2025).
23. SEPG. Presupuestos Generales del Estado para el año 2023. Ministerio de Hacienda y Función Pública: Madrid, Spain, 2023. Available online: https://bit.ly/3E8naOu (accessed on 2 April 2025).
24. Unicef. How Many Children and Young People Have Internet Access at Home? Available online: https://bit.ly/3JVCkKH (accessed on 2 April 2025).
25. Bacher-Hicks, A.; Goodman, E.; Mulhern, C.; Starr, P. Inequality in Household Access to Technology and Children's Educational Outcomes During the COVID-19 Pandemic. *J. Policy Anal. Manage.* **2022**, *41*, 1005–1031.
26. Provecho, M.L.G.; Aguado, M.L.; Llamas, J.L.G.; Díaz, J.Q. La brecha digital en población en riesgo de exclusión social. *Pedagog. Soc. Rev. Interuniv.* **2021**, 123–138.
27. Jorquera-Rojas, G. El Futuro Donde Queremos Crecer. Las Políticas Públicas Esenciales Para el Bienestar de la Infancia. Save the Children. Available online: https://bit.ly/34xMk7j (accessed on 2 April 2025).
28. Voogt, J.; Fisser, P.; Good, K.; Mishra, P.; Yadav, A. Computational Thinking in K-6 Education: A Review of Concepts, Measures, and Instructional Approaches. *Rev. Educ. Res.* **2020**, *90*, 315–346.
29. Hwang, G.J.; Lai, C.L.; Wang, S.Y.; Tsai, C.C. Seamless ubiquitous learning in higher education: Current state, challenges, and future directions. *Comput. Educ.* **2015**, *84*, 119–130.
30. Comisión Europea. Plan de Acción de Educación Digital (2021–2027). Available online: https://bit.ly/3hP4LLN (accessed on 2 April 2025).
31. Comisión Europea. Alfabetización Mediática. Available online: https://bit.ly/4aqEZY7 (accessed on 2 April 2025).
32. Fuller, M.T. ISTE standards for students, digital learners, and online learning. In *Handbook of Research on Digital Learning*; Montebello, M., Ed.; IGI Global: Hershey, PA, USA, 2020; pp. 284–290. [CrossRef]