# Teacher training in lifelong learning—the importance of digital competence in the encouragement of teaching innovation

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***Keywords***
*teacher training; digital competence; information and communication technologies; educational challenges*

***Abstract***

*The rapid advancements in society over recent years have necessitated changes in the expectations placed upon both citizens and educators. The integration of information and communication technologies (ICT) into the educational landscape has highlighted the importance of developing digital competence among teachers, which has emerged as a critical challenge for teacher training programs. In light of this context, this study aims to evaluate the digital competence of educators involved in Lifelong Learning within the Delhi/NCR region. To achieve this objective, a quantitative, cross-sectional research design was employed, involving a sample of 40 teachers from various schools in the area. The findings revealed a significant deficit in teachers' skills across the five dimensions of digital competence, with particular weaknesses noted in the area of digital content creation. Additionally, the analysis clarified that there is a direct correlation between prior ICT training and the dimensions of communication and collaboration, as well as content creation. The research also indicated that the teachers who expressed concerns about their preservice ICT training tended to be younger and had less than ten years of professional experience. This demographic insight suggests that younger educators may feel less prepared to integrate digital tools effectively into their teaching practices. In conclusion, the ongoing development of digital teaching competence remains a pressing challenge for the education system. Addressing this issue is imperative, as it will continue to be a central focus in the training of current educators. Enhancing digital competence is essential for fostering innovative teaching methods and ensuring that educators can adapt to the evolving demands of the digital age. By prioritizing this development, we can establish a foundation for a transformative educational landscape that supports effective learning and prepares students for the future.*

## Introduction

In an increasingly digitalized world, the realm of education is evolving at a rapid pace. Teachers, as the cornerstone of learning, are tasked with not only imparting knowledge but also guiding learners through the ever-changing landscape of skills, tools, and competencies that define modern life. The traditional model of education, which emphasized foundational knowledge and rote learning, is being replaced by an approach that prioritizes adaptability, creativity, and continuous innovation. At the heart of this transformation is the concept of lifelong learning—a philosophy that stresses the ongoing development of skills and knowledge throughout one's life. Within this context, teacher training plays a crucial role, particularly in the cultivation of digital competence and the encouragement of teaching innovation. Lifelong learning is no longer a choice but a necessity in our fast-paced, technology-driven society. As industries evolve and new technologies emerge, the skills required to navigate the professional and personal landscapes also shift. For educators, this means that their role as facilitators of learning must extend beyond the classroom and traditional educational frameworks. Teachers are now expected to be lifelong learners themselves, continuously updating their skills to keep pace with the changes in the educational environment. This includes a strong emphasis on digital competence—the ability to use digital tools and technologies effectively in both personal and professional contexts. Digital competence has become a key component of effective teaching in the 21st century. It encompasses a range of skills,

from basic computer literacy to more complex abilities such as creating digital content, analyzing data, and using digital platforms for communication and collaboration. As technology becomes more integrated into all aspects of life, the need for teachers to be proficient in these skills is paramount. Not only does digital competence enable teachers to enhance their own learning and professional development, but it also allows them to foster a learning environment that prepares students for the demands of a digital society. Furthermore, the integration of technology in education has been shown to encourage teaching innovation, leading to more engaging and effective learning experiences for students.

Teacher training programs have a significant role to play in the development of digital competence among educators. In the past, teacher training often focused on pedagogical theories and classroom management strategies. While these are still important, there is a growing recognition of the need to incorporate digital literacy and competence into teacher education. This requires a shift in both the content and the delivery of teacher training programs. Pre-service and in-service training must now include modules on the use of digital tools, online teaching strategies, and the ethical implications of technology in education. Additionally, teachers must be encouraged to adopt a mindset of continuous learning, where they are open to experimenting with new technologies and teaching methods in their practice. Innovation in teaching is closely linked to the use of technology in the classroom. Digital tools provide educators with the opportunity to experiment with new ways of engaging students and presenting information. For example, interactive platforms, such as learning management systems (LMS), allow teachers to create dynamic lessons that can be accessed by students anytime, anywhere. This flexibility not only accommodates different learning styles but also promotes student autonomy and self-directed learning. Moreover, the use of multimedia resources, such as videos, podcasts, and virtual simulations, can enhance the learning experience by making abstract concepts more tangible and relatable. The adoption of technology in education is not without its challenges. One of the main barriers to the effective use of digital tools in teaching is the lack of digital competence among educators. While many younger teachers may feel comfortable using technology in their personal lives, they may not have the skills or confidence to integrate it into their teaching practice. Conversely, more experienced teachers may struggle with the rapid pace of technological change and feel overwhelmed by the need to continuously update their skills. Teacher training programs must therefore address these gaps by providing ongoing support and resources for educators at all stages of their careers.

In addition to building digital competence, teacher training programs must also foster a culture of innovation and creativity. Innovation in education is not just about the use of technology—it is about rethinking traditional approaches to teaching and learning. Teachers must be encouraged to experiment with new pedagogical models, such as flipped classrooms, project-based learning, and collaborative learning environments. These approaches shift the focus from teacher-centered instruction to student-centered learning, where students take an active role in their own education. By fostering a culture of innovation, teacher training programs can help educators develop the skills and confidence to implement new teaching strategies that enhance student engagement and learning outcomes. The role of leadership in promoting teaching innovation cannot be overlooked. School leaders play a critical role in creating an environment that supports teacher experimentation and innovation. This includes providing the necessary resources, such as access to digital tools and professional development opportunities, as well as fostering a culture of collaboration and continuous improvement. Teachers need to feel supported in their efforts to integrate technology into their practice, and this requires strong leadership at both the school and district levels.

Collaboration is another key component of teaching innovation. In a digital age, teachers are no longer isolated in their classrooms—they have access to a global network of educators who can share ideas, resources, and best practices. Teacher training programs should emphasize the importance of collaboration, both within the school and beyond. This can be achieved through the use of online professional learning communities (PLCs), where teachers can connect with their peers, share their experiences, and learn from one another. By fostering a collaborative mindset, teacher training programs can help educators stay connected to the latest trends and innovations in education. Moreover, teacher training should also address the ethical considerations that come with the use of digital tools in education.

The rise of technology in the classroom raises important questions about data privacy, digital citizenship, and the digital divide. Teachers must be equipped with the knowledge and skills to navigate these issues responsibly. This includes understanding how to protect student data, promote responsible use of technology, and ensure that all students have access to the digital resources they need to succeed. By addressing these ethical concerns, teacher training programs can help educators create a safe and inclusive learning environment for all students.

The Horizon Report highlights that while technology and digital tools are pervasive in modern society, they often fail to enhance learning when not meaningfully integrated into the educational process. Simply having access to digital resources is insufficient unless they are strategically used to enrich the teaching and learning experience. In line with this, the Sustainable Development Goals (SDGs), introduced by the United Nations as part of the 2030 Sustainable Development Agenda, have started to be linked to various educational initiatives. Among the 17 goals, SDG 4: Quality Education is the most directly related to the field of education. Achieving this goal requires a focus on digital teacher competence, which is seen as a critical skill for improving instructional effectiveness.

In this context, digital competence has become one of the essential skills that all individuals must develop by the end of their basic education, particularly in Europe. Within India the INTEF (National Institute of Educational Technologies and Teacher Training) plays a key role in promoting educational practices that incorporate ICTs into classrooms across different educational settings. The institute is also responsible for initiating both initial and ongoing teacher training in five specific areas of digital competence. This emphasis ensures that teachers are equipped to integrate technology effectively, fostering not only educational improvement but also supporting the broader objectives of the Sustainable Development Goals. (Table 1)

Table-1

| | |
|---|---|
| Information and Information Literacy | Identify, locate, obtain, store, organize, and analyze digital information, data, and digital content, which assess their purpose and relevance to teaching tasks |
| Communication and Collaboration | Communicate in digital environments, share resources through online tools, connect and collaborate with others through digital tools, interact and participate in communities and networks, which all lead to cross-cultural awareness |
| Digital Content Creation | Create and edit new digital content, integrate and rework previous knowledge and content, create artistic productions, multimedia content and computer programming, to know how to apply intellectual property rights and licenses for use |
| Security | Acknowledge protection of information and personal data, protection of digital identity, protection of digital content, as well as security measures and a responsible and safe use of technology |
| Problem Solving | Identify needs to use digital resources, make informed decisions about the most appropriate digital tools according to the purpose or need, solve conceptual problems through digital media, use technologies creatively, solve technical problems, and update their own competence and that of others |

In conclusion, it is important to consider additional definitions of digital competence that complement earlier ones. These definitions highlight four key competencies: (1) technical proficiency, (2) the ability to use digital technologies effectively in the workplace, (3) the capacity to critically assess digital tools, and (4) the motivation to engage with and contribute to digital culture.

To assess the level of digital literacy, several organizations have established frameworks to measure an individual's competence. Notable examples include the Common Framework for the Digital Competence of Teachers in Spain, the European Framework for the Digital Competence of Educators (DigComp), and the ISTE standards. Similar to how language proficiency is measured, these frameworks enable the evaluation of a person's digital competence based on their demonstrated skills, providing a clear understanding of their proficiency level.

**ICT use vs. ICT integration in pedagogy**

In response to the demands of the digital era, teachers are now expected to incorporate Information and Communication Technology (ICT) into their everyday teaching practices, moving away from traditional methods and embracing modern tools. However, it is essential to distinguish between merely using ICT and truly integrating it into pedagogy. As Nkula and Krauss (2014) emphasized, ICT integration is not simply about placing computers in classrooms or using technology to support conventional teaching methods. Instead, it involves leveraging technology to enhance the teaching-learning process, where students actively engage with ICT to acquire new knowledge and skills. This type of integration positions ICT at the core of the learning experience, encouraging its use across various subjects rather than as a standalone component. Thus, effective ICT integration promotes cross-curricular application, connecting different areas of learning, rather than treating ICT as an isolated subject (Nkula and Krauss, 2014).

Flanagan and Jacobsen (2003) further argued that ICT integration should serve as a bridge between teachers, students, parents, and the broader community. Similarly, Wilson-Strydom and Thompson (2005) noted that the concept of ICT integration arose in response to the limitations of early computer use in schools, which focused primarily on developing computer literacy or technical skills. They explained that merely teaching students how to use computers is considered "implementation without integration," while using ICT to facilitate learning across various subjects is "implementation with integration." UNESCO (2002) has also encouraged member states to strike a balance between traditional educational tools and newer technologies, providing guidance on incorporating multimedia, e-learning, and distance education into national education systems. However, effective ICT integration in teaching remains a complex challenge, as it requires the coordinated functioning of multiple internal and external factors.

Despite the increasing availability of ICT tools in schools, research from different cultural contexts suggests that teachers are not yet using these tools to their full potential (Aldunate and Nussbaum, 2013). Several internal factors influence teachers' ability to integrate ICT, including their beliefs about technology, their attitudes toward ICT integration, their confidence and motivation to use ICT, and their perceptions of its effectiveness (Al-Ruz and Khasawneh, 2011; Chen, 2008; Lin, Wang, and Lin, 2012; Palak and Walls, 2009; Sang et al., 2010, 2011; Tezci, 2011). Teachers' readiness and self-efficacy, particularly in terms of technological, pedagogical, and integration skills, also play a significant role.

Sang et al. (2010) found that preservice teachers with strong constructivist beliefs are more likely to integrate technology into their future teaching practices. However, Frederick et al. (2006) identified additional internal challenges, such as student mobility, special needs, and anxiety, which can complicate the process of ICT integration. Thus, while progress has been made in making ICT tools available, a variety of personal and contextual factors still influence the extent to which teachers can successfully integrate technology into their teaching.

**Background**

According to Cabero (2022), teachers in the 21st century must possess a comprehensive set of skills that enable them to guide students effectively through technology-enhanced learning processes. This view is supported by a growing body of literature that highlights the urgency of assessing and improving teachers' digital competencies to address the educational challenges of the future (Cabero et al., 2022; García et al., 2023; Johnson & Li, 2024). Given the increasing role of digital tools in modern education, it is imperative to evaluate the current levels of digital competence among teachers and take immediate action to enhance their proficiency in this area.

Various studies have focused on analyzing digital competencies among teachers across different educational levels. Research on pre-service teachers, particularly those preparing for careers in preschool and primary education, indicates that many future educators exhibit only an intermediate level of digital competence (Alvarez, 2021; Brown, 2022; Smith & Jones, 2023). While this level may be sufficient for personal use and self-directed learning, it falls short of the expertise required to effectively teach digital practices to students. As noted by García (2023), these future teachers may have a basic understanding of digital tools, but they are not yet equipped to integrate them meaningfully into classroom instruction.

Moreover, several studies highlight specific areas where teachers, both pre-service and in-service, struggle with digital skills. For instance, there is evidence of significant deficiencies in the informational dimension of digital competence, which includes research, selection, and synthesis of relevant information (Cabero et al., 2022; Pérez, 2023). This is a critical shortfall, as these skills are fundamental for effectively incorporating digital tools into the teaching-learning process. In addition to this, the literature emphasizes that current teachers often lack sufficient digital skills to meet the demands of the information society, especially in areas like collaboration, communication, and, most notably, content creation (Rodríguez, 2023; Williams et al., 2024). The creation of digital content is particularly underdeveloped, which hampers teachers' ability to leverage technology to its full potential in the classroom.

A recurring theme in this research is the need for higher education faculty to better understand the pedagogical applications of technological resources. Studies have shown that without adequate digital competence, teachers tend to use information and communication technologies (ICTs) merely as supplemental tools to support traditional teaching methods, rather than as innovative, transformative instruments (Johnson & Li, 2024). Teachers must move beyond this limited use of technology if they are to foster engaging, dynamic, and participatory learning environments.

Research also points to several factors that influence the development of digital competence among educators. These factors include the type of educational institution, gender, prior ICT training, academic qualifications, teaching experience, and the sociocultural context of the learning environment (Smith et al., 2023; García & Hernández, 2023). Each of these variables can significantly impact a teacher's ability to acquire and effectively use digital skills in their teaching practice.

International studies further corroborate the scarcity of digital competence, particularly when it comes to teachers' ability to create and share digital content within the educational community (Williams et al., 2024; Lee & Chen, 2024). This deficiency limits the integration of ICTs into teaching practices, reducing technology to a secondary, supportive role rather than a primary tool for instructional innovation. This situation underscores the need for concerted efforts to improve digital competence among teachers, particularly in the areas of content creation and sharing.

To address these challenges, researchers emphasize the importance of developing teachers' ability to employ active, technology-supported methodologies in the classroom. Approaches such as project-based learning, problem-based learning, the flipped classroom model, and mobile learning offer innovative ways to engage students and foster active participation (Rodríguez et al., 2023). By mastering these approaches, teachers can create more interactive and meaningful learning experiences that prepare students for the demands of the digital age. Therefore, enhancing teachers' digital competence is critical for fostering teaching innovation and ensuring that both educators and students can thrive in an increasingly technology-driven world.

**Research Objectives**

The literature review reveals that the level of digital competence among teachers varies depending on their educational context and stage of teaching. With this in mind, the primary objective of this study is to assess the digital competence of teachers in Lifelong Learning programs. From this main goal, the following specific objectives are outlined:

- Identify the areas where Lifelong Learning teachers show the greatest gaps in digital knowledge.
- Determine whether there are significant differences in digital competence based on the ICT training teachers have previously received.
- Analyze the factors that influence whether or not teachers receive prior ICT training.

**Technological Pedagogical Content Knowledge (TPACK)**

The TPACK framework stems from the recognition that teaching is a complex practice that requires the integration of several specialized knowledge areas. Effective teaching depends on the ability to draw from well-organized, interconnected knowledge that includes understanding how students think and learn, mastering subject matter, and most importantly, having knowledge of technology (Koehler &

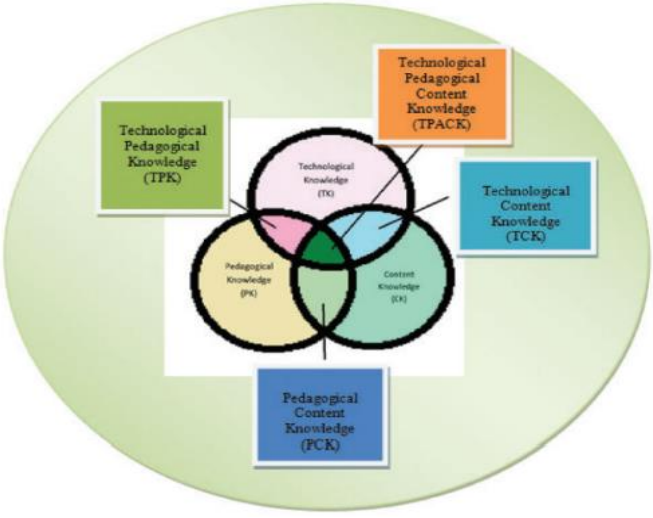
Mishra, 2008). The TPACK framework (Figure 1) emerges from the intersection of different types of knowledge as teachers incorporate ICT into their subject areas.

The main types of knowledge in the TPACK framework are **Pedagogical Knowledge (PK)**, **Content Knowledge (CK)**, and **Technological Knowledge (TK)**. These three core categories overlap to form additional knowledge types required for ICT integration: **Technological Content Knowledge (TCK)**, **Pedagogical Content Knowledge (PCK)**, **Technological Pedagogical Knowledge (TPK)**, and **Technological Pedagogical Content Knowledge (TPACK)** (Koehler & Mishra, 2008). TPACK is the point where all three knowledge types converge, forming a comprehensive understanding that is essential for effective ICT integration in teaching.

According to Koehler and Mishra (2009), TPACK involves understanding how to represent concepts using technology, applying pedagogical techniques that leverage technology to teach content, and addressing challenges students face in learning by using technology as a tool. It also requires knowledge of students' prior learning and theories of learning, as well as how technology can be used to build on and expand that knowledge. Successfully teaching with technology requires a dynamic balance between these components, continually adapting and renewing the approach.

The TPACK framework provided valuable insights for the researchers, helping them identify the types of knowledge the participants need for effective ICT integration. It also enabled them to assess which areas of knowledge were either present or lacking in the participants, which are crucial for the successful implementation of technology in education (Baran et al., 2011).

**Frame work:**




**Instrument**

The data collection instrument was a custom questionnaire developed to assess digital teacher competence based on established dimensions. It consisted of 91 items categorized as follows: 16 items addressing information and information literacy, 31 items on communication and collaboration, 16 items regarding digital content creation, 13 items related to digital security, and 15 items focused on problem-solving. The questionnaire utilized a Likert scale with 10 response options, ranging from 1 (never) to 10 (always). The coding scheme aligns with the different dimensions and the competencies they cover.

To verify the internal consistency of the variables, Bartlett's test of sphericity was conducted, producing a KMO value of 0.79 ($p < 0.001$). The instrument's reliability was further evaluated using Cronbach's alpha, which was 0.87, and the Guttman split-half method, yielding a value of 0.74. Both reliability measures indicated good consistency, affirming the effectiveness of the research tool.

**Procedure and Data Analysis**

Data collection took place in the first quarter of 2024 using a Google Form. The questionnaire was shared multiple times through online channels until voluntary responses were obtained from the sample participants. Data analysis was performed using SPSS version 25.0 and R-Studio version 4. Initially, descriptive statistics were calculated to determine the participants' perceptions of their digital competence levels. Following this, the data distribution was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests, as well as Levene's test for homogeneity of variance. To identify any significant differences between participants based on the independent variable "Previous ICT training," the Mann-Whitney U test and Wilcoxon's W test were employed. Additionally, to explore the relationship between this independent variable and the dependent variables, a predictive model was developed utilizing the H2O and Local Interpretable Model-agnostic Explanations (LIME) algorithms to evaluate the influence of various study variables on previous ICT training.

**Results**

Initially, we conducted an analysis of the descriptive statistics (see Table 3), which provided insights into the characteristics of the sample. The collected responses indicated a low level of digital competence, with no average scores reaching or exceeding five on the 1-10 scale. Notably, the dimension of digital content creation displayed particularly low scores, approaching zero. Conversely, the security dimension yielded the highest results, yet it still fell short of the minimum threshold required for it to be deemed optimal.

Table 3. Descriptive statistics.

| Dimension | Mean | SD | Asym | Kurt |
|---|---|---|---|---|
| B.1. | 3.239 | 1.616 | 1.221 | 1.637 |
| B.2. | 3.185 | 1.466 | 0.628 | 9.049 |
| B.3. | 1.843 | 0.966 | 2.046 | 5.885 |
| B.4. | 3.954 | 1.103 | −0.199 | −2.587 |
| B.5. | 3.695 | 1.096 | 0.592 | 0.134 |

To perform the inferential statistics, we first assessed the normality and homogeneity of variances. The Kolmogorov-Smirnov and Shapiro-Wilk tests were conducted, confirming that the distribution of the collected data did not follow a normal trend ($p < 0.01$). Subsequently, Levene's test was applied, which further supported this finding by indicating a lack of equality in variances ($p > 0.05$).

Following these determinations, nonparametric statistical methods were employed. Specifically, the Mann-Whitney U and Wilcoxon W tests were utilized, revealing no significant differences in the digital competence development of the surveyed teachers based on the independent variable "prior ICT training." However, significant relationships were identified between the independent variables and the dimensions of communication and collaboration, as well as digital content creation ($p < 0.05$) (see Table 4).

Table 4. U Mann–Whitney based on the variable "previous ICT training".

| Dimension | | Average Range | U Mann–Whitney | W. Wilcoxon | Z | *p* |
|---|---|---|---|---|---|---|
| B.1. | Yes | 70.796 | 1757.406 | 4522.795 | −1.164 | 0.178 |
| | No | 66.718 | | | | |
| B.2. | Yes | 72.214 | 1882.500 | 5080.790 | −0.906 | 0.047 |
| | No | 71.632 | | | | |
| B.3. | Yes | 69.613 | 1815.125 | 5278.875 | −0.982 | 0.033 |
| | No | 72.726 | | | | |
| B.4. | Yes | 71.690 | 1722.038 | 3019.269 | −0.657 | 0.272 |
| | No | 67.532 | | | | |
| B.5. | Yes | 70.471 | 1845.933 | 4639.933 | −0.762 | 0.122 |
| | No | 70.613 | | | | |

To more accurately define the dependency relationship of the variable "previous ICT training," we employed the H2O algorithm. This approach aimed to develop a comprehensive model that could elucidate the interactions between the dependent variables and the specified independent variable (see Figure 2).

For this analysis, we utilized the distributed random forest model, which is known for its robustness and effectiveness in handling complex datasets. The results yielded a significant R coefficient of 96%, indicating a high level of predictive reliability for the model. Additionally, the Root Mean Square Error (RMSE) was calculated at 0.79, demonstrating that the discrepancy between the original dataset and the predicted values was minimal, thereby confirming the model's effectiveness in accurately capturing the underlying relationships within the data.

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Cross-Validation Metrics Summary:
                            mean          sd cv_1_valid cv_2_valid cv_3_valid cv_4_valid cv_5_valid
accuracy                0.40555555 0.119379826 0.44444445 0.33333334        0.5      0.125      0.625
err                     0.59444445 0.119379826  0.5555556  0.6666667        0.5      0.875      0.375
err_count                      5.0         1.0        5.0        6.0        4.0        7.0        3.0
logloss                 15.254475   4.7035155  19.484055  19.647358   9.520807  22.383183   5.236972
max_per_class_error            1.0         0.0        1.0        1.0        1.0        1.0        1.0
mean_per_class_accuracy 0.8173913 0.044125617  0.7826087 0.73913044  0.8913044  0.7826087  0.8913044
mean_per_class_error    0.1826087 0.044125617  0.2173913 0.26086956 0.10869565  0.2173913 0.10869565
mse                     0.6438276  0.09854118 0.66256404  0.7099992 0.51061374 0.85963285  0.4763281
r2                     0.96605754 0.016466757 0.98510057  0.9610366 0.98223954 0.92262095 0.97929007
rmse                    0.7976993 0.061251257  0.8139804 0.84261453  0.7145724 0.92716384  0.6901653

Slot "leaderboard":
                                model_id mean_per_class_error  logloss      rmse       mse
1              XRT_0_AutoML_20190429_093957            0.3202899 4.770575 0.7227303 0.5223391
2  GBM_grid_0_AutoML_20190429_093957_model_8            0.3422705 1.749438 0.6714478 0.4508422
3              DRF_0_AutoML_20190429_093957            0.3975845 5.859866 0.7340869 0.5388836
4 GBM_grid_0_AutoML_20190429_093957_model_10            0.4062802 2.415437 0.8929760 0.7974061
5  GBM_grid_0_AutoML_20190429_093957_model_0            0.4084541 2.722078 0.6697797 0.4486049
6 GBM_grid_0_AutoML_20190429_093957_model_11            0.4352657 2.143427 0.8003761 0.6406019
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Figure 2. Model elaborated through the H2o algorithm.

Next, cross-validation employing a multilayer perceptron was conducted to further investigate the factors influencing the prior ICT training of the analyzed teachers (see Figure 3). The LIME algorithm was utilized to demonstrate that "age" is the most significant factor affecting whether teachers receive ICT training. Following this, aspects related to digital security, information and information literacy, and teaching experience were identified in descending order of impact.

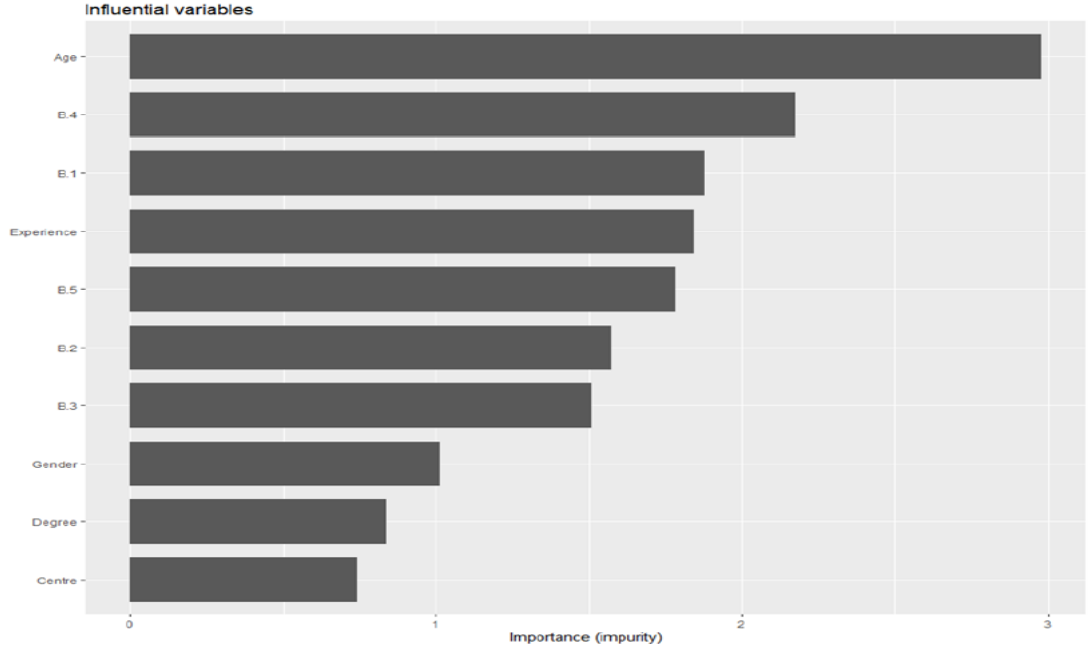


Figure 3. Variables affecting previous ICT training.

Additionally, the analysis conducted using the LIME algorithm enabled us to identify the variables that had the most significant impact on the formulation of the previous predictive model (see Figure 4). Notably, it was found that participants who demonstrated a high proficiency in B.3 and had at least ten years of teaching experience were the strongest contributors to the "previous ICT training" variable. Other influential factors included teachers aged between 33 and 37 and those possessing a solid understanding of B.1. On the other hand, teachers who scored less than 56 points in the B.4 category were found to contribute less to this variable. This analysis highlights the intricate relationships between various factors and their roles in shaping the prior ICT training of educators.

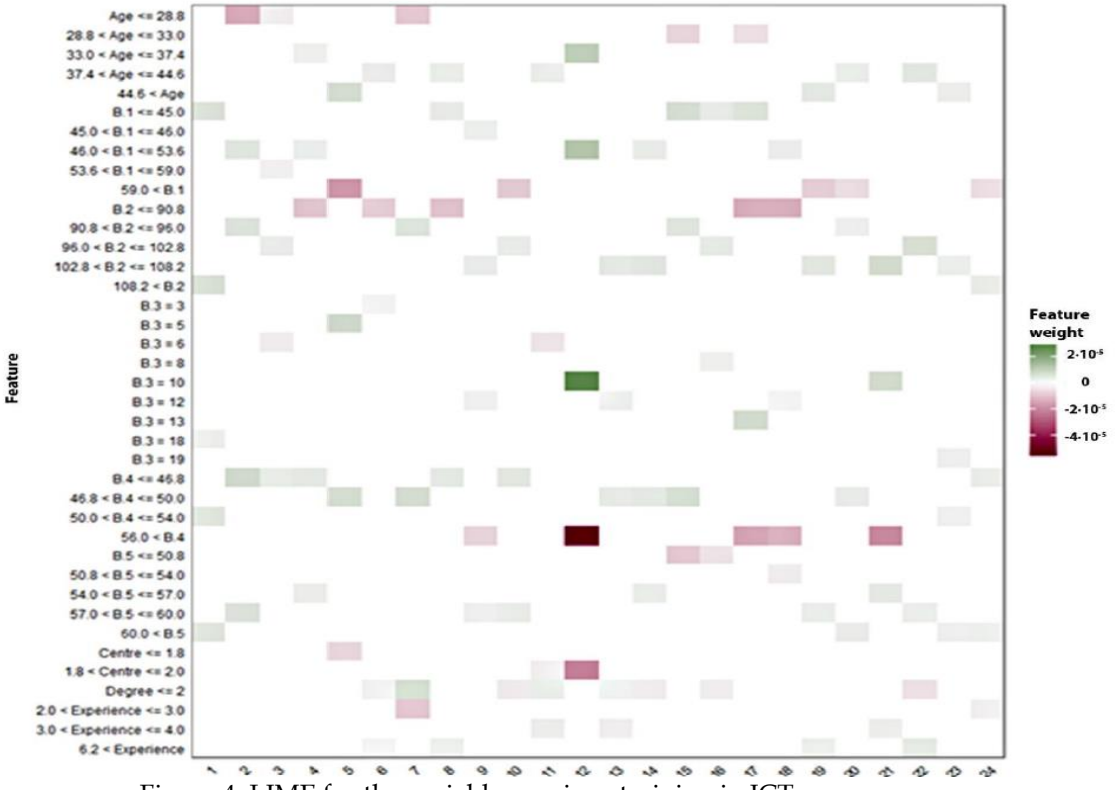


Figure 4. LIME for the variable previous training in ICTs.

**Discussion**

The advancement of digital teaching competence remains one of the most pressing educational challenges facing our education system today. This issue is particularly pronounced in the context of Lifelong Learning, where it has become evident that teachers still exhibit considerable deficiencies in the diverse skill sets required for effective digital instruction. These shortcomings necessitate an ongoing commitment to fostering both initial and continuing training for educators in this vital area. Consequently, the need for improved digital teaching competence is a widespread concern that spans all educational stages and levels【24, 25】.

The findings from the current study underscore a troubling trend: the teaching workforce demonstrates a low level of digital competence overall. In fact, none of the specific dimensions that comprise digital competence achieved optimal performance, highlighting a persistent issue that mirrors findings from other educational levels【33, 34】. This trend raises significant concerns about the ability of educators to effectively integrate digital tools and resources into their teaching practices. Among the various dimensions assessed, the area of digital content creation stands out as particularly alarming, as it approached a score of zero. Such a low level of proficiency suggests that teachers are still primarily utilizing Information and Communication Technologies (ICTs) merely as supplementary tools, rather than leveraging them to their full potential【37, 39】.

**Implication**

The implications of these findings are far-reaching. Teachers who lack the self-efficacy to create their own digital content and share it with their peers are unlikely to engage their students effectively in the digital learning landscape. The ability to create and curate digital content is essential in a world increasingly dominated by technology, where students expect learning experiences that are dynamic, interactive, and relevant to their lives. If educators are unable to produce their own digital resources, they may struggle to motivate students or provide meaningful learning experiences that foster critical thinking and problem-solving skills. Moreover, the low levels of digital competence observed in this study may impede the implementation of innovative teaching practices that could enhance learning outcomes. For instance, active learning methodologies, which rely heavily on the effective use of digital tools, cannot be fully realized if teachers are not equipped with the necessary skills to design and deliver such experiences. This scenario poses a significant barrier to educational progress and modernization, as it limits the potential for teachers to embrace new pedagogical approaches that are essential for fostering 21st-century skills in students. To address these challenges, it is imperative that education systems prioritize the professional development of teachers in the realm of digital competence. This requires a multi-faceted approach that encompasses both initial teacher training and ongoing professional development opportunities. By equipping educators with the skills they need to navigate the digital landscape, we can empower them to create engaging, meaningful learning experiences that resonate with today's learners.

Educational institutions must also focus on fostering a culture of collaboration among teachers, enabling them to share best practices and resources related to digital content creation and ICT integration. This collaborative environment can serve as a catalyst for professional growth and innovation, as teachers can learn from one another and collectively enhance their digital competencies.

Ultimately, the goal is to cultivate a generation of educators who are not only proficient in the use of technology but also confident in their ability to create and implement digital content that enriches the learning experience. By addressing the existing gaps in digital teaching competence, we can ensure that teachers are well-prepared to meet the evolving needs of their students in a rapidly changing educational landscape. The development of digital teaching competence is a critical issue that requires urgent attention across all educational stages, particularly in Lifelong Learning. The findings of this study reveal a concerning low level of digital competence among educators, emphasizing the need for comprehensive training and support. As we move forward, it is essential to prioritize the enhancement of teachers' digital skills to foster an educational environment that is both innovative and responsive to the needs of learners in the digital age. This effort will not only benefit teachers but also empower students to thrive in a technology-driven world, ultimately contributing to a more effective and relevant education system.

**Conclusions**

The advancement of digital teaching competence remains a significant challenge for the education system to confront. In today’s digital age, society increasingly expects educators to possess sufficient digital skills to effectively impart knowledge to students across various ages and educational levels. Among these groups, students in the Lifelong Learning sector hold particular importance. This demographic consists of adults who have not had extensive exposure to technological resources from a young age, making their entry into the digital landscape considerably more complex. As such, it is crucial for educational institutions to prioritize training in digital teaching competence. This should involve enhancing ongoing professional development for current educators while also improving the initial training programs for future teachers. Addressing this need is essential; it is the only viable pathway to achieving a meaningful transformation in both teaching and learning processes.

This study aims to provide insights into the realities faced by Lifelong Learning educators, contextualizing the importance of this educational stage for the research community while highlighting the urgent needs it presents. The findings indicate that teachers continue to face significant challenges in establishing a genuine connection with Information and Communication Technologies (ICTs). Furthermore, the study sought to clarify that prior ICT training among teachers did not significantly influence their overall digital competence, except in terms of their ability to create original content. This

suggests that existing ICT training programs require substantial enhancement to elevate the levels of digital competence demonstrated by teachers.

Ultimately, improving digital teaching competence is imperative not only for the professional development of educators but also for the successful integration of technology into educational practices. By addressing the gaps in training and support, we can better equip Lifelong Learning teachers to engage effectively with their students in today's digital environment. This concerted effort will not only benefit educators but also enrich the learning experiences of adult learners, enabling them to thrive in an increasingly digital world.

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|---|---|
| Information and Information Literacy | Identify, locate, obtain, store, organize, and analyze digital information, data, and digital content, which assess their purpose and relevance to teaching tasks |
| Communication and Collaboration | Communicate in digital environments, share resources through online tools, connect and collaborate with others through digital tools, interact and participate in communities and networks, which all lead to cross-cultural awareness |
| Digital Content Creation | Create and edit new digital content, integrate and rework previous knowledge and content, create artistic productions, multimedia content and computer programming, to know how to apply intellectual property rights and licenses for use |
| Security | Acknowledge protection of information and personal data, protection of digital identity, protection of digital content, as well as security measures and a responsible and safe use of technology |
| Problem Solving | Identify needs to use digital resources, make informed decisions about the most appropriate digital tools according to the purpose or need, solve conceptual problems through digital media, use technologies creatively, solve technical problems, and update their own competence and that of others |

**References**

Arzola, D.; Loya, C.; González, A. El trabajo directivo en educación primaria: Liderazgo, procesos participativos y democracia escolar. IE Rev. REDIECH 2017, 7, 35–41.

Starkey, L. A review of research exploring teacher preparation for the digital age. Camb. J. Educ. 2000, 50,37–56.

OECD. TALIS 2013 Results: An International Perspective on Teaching and Learning; OECD Publishing: Paris, France, 2014.

Prensky, M. Digital natives, digital immigrants. Horizon 2001, 9, 45–57.

Almenara, J.C.; Osuna, J.B. Los escenarios tecnológicos en Realidad Aumentada (RA): Posibilidades educativas. Aula Abierta 2018, 47, 327–336.

Escobar, S.D.; Rincon, V.M. Análisis Comparativo Sobre la Incorporación de las TIC¨S en la Formación Profesional de las Universidades de Sabana de Occidente, Frente a la Pontificia Universidad Católica de Chile y la Universidad de Princenton de EEUU. [Working Paper]. 2018. Available online:

http: //repositorio.ucundinamarca.edu.co/handle/20.500.12558/1006 (accessed on 15 January 2020). Sustainability 2020, 12, 2852 12 of 13

Trujillo, J.M.; Hinojo, F.J.; Aznar, I. Propuestas de trabajo innovadoras y colaborativas elearning 2.0 comodemanda de la sociedad del conocimiento. ESE 2011, 20, 141–159.

Adams, S.; Cummins, M.; Davis, A.; Freeman, A.; Hall, C.; Ananthanarayanan, V. NMC Horizon Report: 2017 Higher Education Edition; The New Media Consortium: Austin, TX, USA, 2017.

United Nations—UN. Transforming Our World: The 2030 Agenda for Sustainable Development; United Nations:New York, NY, USA, 2015.

Comisión Europea. Comprender Las Políticas De La Unión Europea: Agenda Digital Para Europa. Available online: https://europa.eu/european- ion/file/1501/download_es?token=3l7D0Fil (accessed on 16 January2020).

Recomendación 2006/962/CE Del Parlamento Europeo Y Del Consejo, De 18 De Diciembre De 2006, Sobre Las Competencias Clave Para El Aprendizaje Permanente. Available online: https://eur-lex.europa.eu/eli/reco/2006/962/oj (accessed on 30 March 2020).

Instituto Nacional de Tecnologías Educativas y Formación del Profesorado (INTEF). Marco de Competencia Digital; Ministerio de Educación: Ciencia y Deportes, Madrid, Spain, 2017.
Ilomäki, L.; Paavola, S.; Lakkala, M.; Kantosalo, A. Digital competence—An emergent boundary concept for policy and educational research. Educ. Inf. Technol. 2016, 21, 655–679.
Ferrari, A. Digital Competence in Practice: An Analysis of Frameworks; European Commission Joint Research Centre (JRC): Seville, Spain, 2012.
ISTE. National Educational Technology Standards for Students; ISTE:Washington, DC, USA, 2008.
Ley 17/2007, de 10 de Diciembre, de Educación de Andalucía (LEA). Art. 105. Available online: https://www.juntadeandalucia.es/boja/2007/252/1 (accessed on 30 March 2020).
García, J. Educación Comparada: Fundamentos y Problemas; Dykinson: Madrid, Spain, 1982.
Fernández Batanero, J.M.; Torres González, J.A. Actitudes docentes y buenas prácticas con TIC del profesoradode educación permanente de adultos en Andalucía. R. Compl. Educ. 2015, 26, 33–49.
Instefjord, E.; Munthe, E. Preparing pre-service teachers to integrate technology: An analysis of the emphasis on digital competence in teacher education curricula. Eur. J. Teach. Educ. 2016, 39, 77–93.
Alonso, S.; Aznar, I.; Cáceres, M.P.; Trujillo, J.M.; Romero, J.M. Systematic review of good teaching practices with ict in spanish higher education. Trends and challenges for sustainability. Sustainability 2019, 11, 7150.
Medina, B.; García, V.J.L. La educación permanente y las plataformas web en España. Estudio comparadopor comunidades de la presencia de la oferta formativa en línea. TEET 2014, 12, 15–27.
Cabero, J. Formación del profesorado universitario en TIC. Aplicación del método Delphi para la selecciónde los contenidos formativos. Educ. XX1 2014, 17, 111–132. [CrossRef]
Rodríguez, A.M.; Aznar, I.; Cáceres, P.; Gómez, G. Digital competence in higher education: Analysis of the impact of scientific production indexed in Scopus database. Espacios 2019, 40, 14.
Rodríguez-García, D.; Sánchez, F.R.; Ruiz, J. Digital competence, higher education and teacher training: A meta-analysis study on the Web of Science. Pixel Bit 2019, 54, 65–81.
Almenara, J.C.; Gimeno, A.M. Information and Communication Technologies and Initial Teacher Training. Digital Models and Competences. Profesorado 2019, 23, 247–268.
Centeno, G.Y.; Cubo, S. Evaluación de la competencia digital y las actitudes hacia las TIC del alumnado universitario. RIE 2013, 31, 517–536.
Varela-Ordorica, S.A.; Valenzuela, J.R. Use of information and communication technologies as a transversal competence in teacher training. Educare 2020, 24.
Escudero, V.G.; Gutiérrez, R.C.; Somoza, J.A.G.-C. Análisis de la autopercepción sobre el nivel de competencia digital docente en la formación inicial de maestros/as. REIFOP 2019, 22, 193–218.
Colás, P.; Conde, J.; Reyes, S. The development of the digital teaching competence from a sociocultural approach. Comunicar 2019, 27, 19–30.
Casillas, S.; Cabezas, M.; García, F.J. Digital competence of early childhood education teachers: Attitude, knowledge and use of ICT. Eur. J. Teach. Educ. 2019.
Llorente, P.A.; Iglesias, E.C. Development of digital competence in the initial teacher education of early childhood education. Pixel Bit 2018, 52, 97–110.
Méndez, V.G.; Martín, A.R.; Rodríguez, M.D.M. La competencia digital en estudiantes de magisterio. Análisis competencial y percepción personal del futuro maestro. Educ. XXI 2017, 35, 253–274. Sustainability 2020, 12, 2852 13 of 13
López, J.; Pozo, S.; Fuentes, A.; Trujillo, J.-M. Analytical competences of teachers in big data in the era of digitalized learning. Educ. Sci. 2019, 9, 177.
Nowak, B.M. The development of digital competence of students of teacher training studies-Polish cases. IJHE 2019, 8, 262–266.
Chandrasena, M. Lack of digital competence: The hump in a university—English for specific purpose—Classroom. IJSTR 2019, 8, 948–956.
Losada, C.; Rodriguez, J. Analysis of the digital education project (E-DIXGAL): The views of primary school teachers. Digit. Educ. Revolut. 2019, 36, 171–189.
Amhag, L.; Hellström, L.; Stigmar, M. Teacher educators' use of digital tools and needs for digital competence in higher education. J. Digit. Learn. Teach. Educ. 2019, 35, 203–220.
Fuentes, A.; Lopez, J.; Pozo, S. Analysis of the digital teaching competence: Key factor in the performance of active pedagogies with augmented reality. REICE 2019, 17, 27–42.
Del Moral, M.E.; Villalustre, L.; Neira, M.D.R. Teachers' perception about the contribution of collaborative creation of digital storytelling to the communicative and digital competence in primary education schoolchildren. Comput. Assist. Lang. Learn. 2019, 32, 342–365.

Guillén, F.D.; Mayorga, M.J.; Bravo, J.; Escribano, D. Analysis of teachers' pedagogical digital competence: Identification of factors predicting their acquisition. Technol. Knowl. Learn. 2020, 1–18.
Araiza, M.J.; Pedraza, E. Discernment of teachers by gender in the use of ICT in the classroom based on digital competences. Espacios 2019, 40, 21.
Hinojo-Lucena, F.-J.; Aznar-Diaz, I.; Caceres-Reche, M.-P.; Trujillo-Torres, J.-M.; Romero-Rodriguez, J.-M. Factors influencing the development of digital competence in teachers: Analysis of the teaching staff of permanent education centres. IEEE Access 2019, 7, 178744–178752.
Hung, E.S.; Sartori, A.S.; Marcano, B. Factors affecting the use of ICT in elementary school teachers in Colombia. Prism. Soc. 2019, 25, 464–487.
Ilina, I.; Grigoryeva, Z.; Kokorev, A.; Ibrayeva, L.; Bizhanova, K. Digital literacy of the teacher as a basis for the creation of a unified information educational space. IJCIET 2019, 10, 1686–1693.
Silva, J.; Usart, M.; Lázaro, J.-L. Teacher's digital competence among final year Pedagogy students in Chile and Uruguay. Comunicar 2019, 27, 31–40.
46.Fernández, M.; Manzano, D. Analyzing differences in digital competence of Spanish students. Papers 2018, 103, 175–198.
Omori, A.E.; Mabadeje, O.; Isah, A. The relevance of ICTS in the administration and organization of a functional continuing education program in Nigeria. Int. J. Interdiscip. Educ. Stud. 2015, 10, 37–44.
Korshunov, I.; Peshkova, V.; Malkova, N. Competitive strategies of vocational schools and universities in implementing continuing education programs. Vop Obraz 2019, 187–214.
Zhao, Y.; Llorente, A.M.P.; Gómez, M.C.S. An empirical study of students and teaching staff's digital competence inWestern China: Based on a case study of Gansu Agricultural University. In Proceedings of the 7th International Conference on Technological Ecosystems for Enhancing Multiculturality, León, Spain, 16–18 October 2019.
Valdivieso, T.S.; Gonzáles, M.Á. Competencia digital docente: ¿dónde estamos? Perfil del docente deeducación primaria y secundaria. El caso de Ecuador. Píxel Bit 2016, 49, 57–73.
Domingo, M.; Bosco, A.; Carrasco, S.; Sanchez, J.-A. Fostering teacher's digital competence at university: The perception of students and teachers. RIE 2020, 38, 167–182.
Asencio, E.N.; García, E.J.; Redondo, S.R.; Ruano, B.T. Fundamentos De La Investigación Y La Innovación Educativa; UNIR Editorial: La Rioja, Spain, 2017.
Hernández, R.; Fernández, C.; Baptista, P. Metodología de la Investigación; McGraw-Hill: Mexico City, Mexico, 2014.