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The use of artificial intelligence and the development of digital competences of educational institutions employees as a key factor for the implementation of modern technologies and innovative methods in pedagogical and communication strategies

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Abstract

The purpose of the study is to examine the level of digital competence among secondary school teachers in Slovakia and explore their experience with the integration of artificial intelligence (AI) into pedagogical practice. A quantitative online survey was conducted among 154 teachers, evaluating their use of technologies (PCs, laptops, tablets, etc.) and tools (presentations, multimedia, graphic software) in line with the European DigCompEdu framework. The collected data were analyzed through descriptive statistics and correlation analysis to assess the relationship between teachers' age and digital proficiency. Four competence levels were identified: basic, intermediate, advanced, and expert. Most teachers demonstrated basic or intermediate skills, with the highest usage levels among those aged 46–55. Advanced users of digital tools were few, and a weak negative correlation was found between age and digital proficiency. In terms of AI integration, 48% of teachers were aware of its potential but lacked practical experience. Additionally, 26% had only basic knowledge, 15% were unfamiliar with AI, and just 10% had hands-on experience. The findings highlight the need for targeted professional development and support policies to enhance digital literacy and promote the effective use of AI in education.

Keywords: Artificial intelligence, Communication skills, Digital competences, Digital technologies, Educational institutions.

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1. Introduction

In the contemporary educational landscape, characterized by the proliferation of digital technologies and artificial intelligence (AI), educational institutions find themselves compelled to adapt their methodologies and practices in response

to the rapidly evolving demands of the modern learning environment. These innovations present both opportunities and challenges for pedagogical approaches and effective communication within individual institutions. A pivotal factor in the successful implementation of these technologies is the development of digital competencies among staff, particularly teachers, who assume primary responsibility for the integration of these tools into pedagogical practices. The objective of this paper is to explore the correlation between the use of AI, the development of digital competencies, and the effectiveness of the implementation of innovative methods in pedagogical and communication strategies. As Chaerani et al. [1] and Tomczyk [2] have noted, it is precisely the digital competencies of educational institution staff that are one of the prerequisites for the effective use of AI and other technologies that are significantly changing traditional educational models. The absence of a satisfactory level of digital literacy, it is asserted, can engender a preponderance of challenges, not only with regard to the intricacies of the technological systems in question but also with respect to the efficacy of the pedagogical process itself. Simultaneously, Schleicher [3] emphasizes that the cultivation of digital competencies, including the capacity to analyze and interpret data or to utilize diverse software tools grounded in artificial intelligence principles, empowers educators to more effectively address the requirements of pupils and students. This is achieved through the continual refinement and dynamic adaptation of their pedagogical practices to align with the evolving needs of these learners. In this regard, the implementation of a training program and ongoing professional development for school personnel is imperative to enhance their digital literacy.

As posited by Zhang et al. [4], the potential for artificial intelligence (AI) software tools to be integrated into the educational process is manifold. These tools can be applied in several areas, including the analysis of learning outcomes, the prediction of student achievement, the personalization of instruction, and the processing of big data. For instance, the analysis of educational data can assist school administrators in identifying the weaknesses of individual students and providing targeted interventions, thereby enhancing the success of the educational process as a whole. Furthermore, Ghanem et al. [5] emphasize that natural language processing algorithms have the potential to facilitate the development of intelligent chat systems and computer assistants, which may eventually replace conventional administrative tasks, thereby enhancing communication between educational institutions and students or their legal guardians. In a similar manner, Guan et al. [6] underscore the utilization of artificial intelligence in educational practice. The development of AI tools in pedagogical practice, as posited by these authors, is argued to have a twofold impact: it not only enhances teaching practices but also fosters internal communication and optimizes the management of educational institutions. Chiu et al. [7] contribute to these assertions by presenting the view that the capacity of AI to generate predictive models empowers management personnel in the business sector to competently plan and efficiently optimize available financial, material, and personnel resources to ensure the seamless operation of the entity and minimize potential risks that could jeopardize its uninterrupted functioning in the market. In this context, it is crucial to emphasize that, in addition to a robust technical infrastructure, the readiness of educational institutions' staff and management teams to adapt to new working practices, which, particularly through the automation of data processing, are expected to enhance accessibility to information for the general public, is of paramount importance. Finally, it is evident that the knowledge and everyday use of artificial intelligence tools can also be regarded as a means of increasing the innovative performance and competitiveness of educational institutions. It is imperative that these institutions are prepared to respond at the appropriate level to the imminent challenges and demands of the labor market, which they must address in the long term, taking into account the nature of the educational activities provided.

In relation to the aforementioned points, Abbas [8] also seeks to utilize the research findings to emphasize several practical challenges and ethical, legal, and moral concerns pertaining to the implementation of AI and other digital technologies in application practice. Primarily, this concerns the security of the personal data analyzed and how it is processed and stored. Additionally, concerns have been raised regarding the transparency of the algorithms embedded within AI models. Such concerns have been posited to potentially stem from flaws that can result in the generation of distorted, inaccurate, or erroneous data by these systems. Addressing these concerns can be achieved through a targeted approach to system modification, with the aim of enhancing its performance and ensuring the reliability of the final output. It is imperative to adhere to ethical standards when handling information to mitigate concerns regarding the reliability of outcomes and to ensure that AI systems function equitably for all. It is evident that the establishment of robust ethical frameworks and principles constitutes the foundation for the judicious utilization of the latest information and communication technologies within the milieu of educational institutions. The cultivation of digital competencies among pedagogues is designed to facilitate a more efficacious and secure application of contemporary technologies in educational praxis. This endeavor is expected to manifest in the enhancement of critical thinking, digital literacy, and ethical conduct among pupils and students, equipping them with the aptitude to circumvent the perils inherent in the digital domain. Kaban [9] further asserts that investment in digital learning and support in AI are prerequisites for creating a flexible and modern learning environment that supports not only institutional development but also higher levels of learning.

2. Literature Review

The gradual development of a modern educational environment that can simultaneously incorporate the requirements of inclusion, the development of transversal skills and functional literacies, and the elimination of socio-pathological phenomena occurring in the online environment represents a necessity rather than a mere requirement for the further development of the public school system, not only in the Slovak Republic. In this context, there is a growing discourse on the imperative for digital transformation in education, aiming to enhance the adaptability of graduates to the evolving demands of society, particularly in the context of the fourth and fifth industrial revolutions, which are increasingly focused on the virtual environment [10, 11]. However, in opposition to the described paradigm of building a flexible digital

education system, according to McGarr [12] there are factual realities resulting not only from the lack of organizational adaptation of internal structures to the educational system (state school programs and curricula), but also from the insufficient personnel and material capacities of educational program providers. The development of educational structures that are aligned with the anticipated advancements in the field of artificial intelligence (AI) can be facilitated by the incorporation of AI software tools into educational programs and pedagogical practices. These tools can be utilized by teaching staff to address learning tasks in innovative ways, as evidenced by the research conducted by Skrypka [13], Simuț et al. [14], and Duan and Zhao [15].

In order to achieve the common goal of enhancing the educational process, which should also possess a participatory character based on cooperation with pupils and students, it is necessary to conclude that the choice of the most effective means to achieve this goal is the use of modern technologies in the teaching process. This is because, according to Nychkalo et al. [16], pupils and students should not be exclusively passive recipients of information, but also partners in the creation and subsequent sharing of information in the digital environment. However, the successful realization of this vision is contingent upon two fundamental elements, which are successive in nature and must be given equal consideration in their simultaneous development.

The primary process, and arguably the most significant, will be the actual introduction of modern technologies based on artificial intelligence into the educational process. This encompasses not only the integration of cutting-edge technologies, such as interactive whiteboards and online learning platforms, into the pedagogical approach [17] but also the adaptation of educational content to align with the principles of artificial intelligence. According to Reisoğlu [18] a more significant development appears to be the utilization of artificial intelligence for the creation of high-quality interactive content relevant to the subject matter, a prerequisite for providing an integral component of a modern educational system based on critical thinking and the practical application of acquired knowledge (i.e., the aforementioned use of digital tools to solve learning assignments). Indeed, AI tools have the capacity to eliminate, to a significant extent, the subjective and social characteristics of the beneficiaries of educational programs and provide them with a de facto equalization of opportunities despite their social status or various health limitations [19]. Concurrently, they are capable of providing them with more personalized learning materials, including the establishment of corresponding self-evaluation checklists to assess learning progress [20]. According to Kyrpa et al. [21], personalized teaching is equally capable of contributing to maximizing the personal potential of particular students or learners, precisely through the use of adaptable web-based software tools. Loureiro et al. [22] further posit that these tools facilitate enhanced educator integration into the learning process by presenting information in alternative formats, thereby facilitating comprehension and enabling interactive application to analogous scenarios. Additionally, these tools empower educators to create and deliver supplementary content, thereby engaging students and preventing feelings of frustration. This is particularly relevant in cases where the curriculum content appears straightforward, thus mitigating the risk of students developing a negative attitude towards school.

The second process will involve the actual characterization of the personnel substrate involved in the educational program, including teaching staff and their level of digital competence, enabling them to participate effectively in a modern learning environment. Carvalho et al. [23] posit the argument that, in the absence of a sufficient level of digital competences among teaching staff, the realistic utilisation of innovative software tools in the teaching process is not a viable expectation. Consequently, the design of digital learning programmes becomes substantially more challenging, particularly in selecting and utilising AI-based digital tools that are appropriate to the necessity to enhance teaching effectiveness and the ultimate successful outcomes of pupils and students, depending on the form and scale of the need to improve teaching effectiveness. According to Hidayat et al. [24] and Zhang et al. [25], the acquisition of digital competences and their subsequent utilization in the educational process constitute two discrete scenarios. In numerous respects, teaching staff are inadequately motivated to acquire these competences independently, not only due to the paucity of remuneration but also due to the subsequent absence of the aforementioned contemporary technologies through which they would be able to employ these new competences in the pedagogical process, even if only to stimulate pupils' and students' interest in teaching itself. However, when considering particular cases, it can be hypothesized that the acquisition of digital competence alone will not be sufficient for its effective use in the educational process, provided that the teacher involved does not approach its use critically and does not seek to simplify the teaching process through it, for example as an alternative to the monological interpretation of the material. In this context, Aydin et al. [26] articulated their conviction that the integration of contemporary digital technologies with pedagogical practices holds promise as a viable approach to leveraging modern technology in educational settings. This assertion is based on the premise that contemporary digital learning has the capacity to offer participants effective learning experiences, characterized by positive emotions derived from the learning process. However, it is crucial to recognize that this can only be achieved by taking into account the individual needs of pupils and students. In this regard, Antonietti et al. [27] and Dias-Trindade et al. [28] concurred that this necessitates a systematic analytical evaluation of not only the learning process but also the learners' outcomes (machine or deep learning). This, in turn, demands the creation of diverse variations in approaches through the utilization of appropriate algorithms to further or relearn shared knowledge. This, in essence, serves to enrich the learning process and promote the creative search for new solutions to the same learning tasks.

In conclusion, it is evident that a flexible and modern learning environment must be capable of accommodating the array of novel challenges that are likely to emerge as an integral component of the transformation to digital learning. Notwithstanding the potential risks of invasion of privacy and unauthorised interference with pupils' and students' personal data as outlined by Nikolova et al. [29] and Dolobac et al. [30] in terms of their legal status as a specially protected person in the legal order, the processing of another large set of personal data touching on the personality of individuals, e.g., when

working with online learning platforms that will secondarily analyze pupils' motivation, their mental state, etc., also comes into consideration. From an academic standpoint, a more significant problem is the so-called algorithmic bias (the integrated biases of artificial intelligence in creating or assessing pupils' results and inferring final assessments) and the absence of solutions to various morally or legally dubious problems for which there is no generally accepted normative answer. Consequently, this engenders a negative presumption of artificial intelligence answering its own question and propagating this unapproved answer in the educational system.

The advent of modern education, predicated on software tools and artificial intelligence, signifies a substantial opportunity. Concomitantly, however, it engenders a plethora of issues that will need to be addressed on a daily basis by teaching staff. The level of their digital competence will therefore play a crucial role.

3. Research Methodology

This article presents the findings of primary research conducted with the objective of ascertaining the level of digital competence among secondary school teachers and their experiences of incorporating artificial intelligence into their pedagogical practices. The study was undertaken to understand the extent to which these teachers are prepared to adopt contemporary technologies in their teaching and communication strategies. The research was conducted through an inquiry survey using an electronic questionnaire that was distributed to secondary school teachers working in educational institutions in the Slovak Republic. A total of 154 teachers from various regions across the Slovak Republic participated in the study, thereby providing a comprehensive overview of the teachers' digital proficiency at the national level. The selection of participants was conducted through the utilization of simple random sampling, with the sample being drawn from a database of existing secondary schools. Basic descriptive statistics were used to process the data, and correlation analysis was employed to find the correlation between the age of teachers and their level of digital skills. The study was conducted in accordance with ethical standards for social research. The respondents were informed about the purpose of the study, the guarantee of anonymity, and the possibility to withdraw at any time. The data were processed anonymously, and information collection was limited to data relevant to the research objectives. The following research questions and hypotheses were defined at the commencement of the research:

RQ1: What is the current level of digital skills among secondary school teachers in Slovakia?
RQ2: What are the differences in the level of digital skills of secondary school teachers depending on their age category?
RQ3: How does a teacher's age correlate with their level of digital skills?
RQ4: To what extent do secondary school teachers have experience in using artificial intelligence?

H_1: A significant disparity in the level of digital skills is evident among teachers of different ages, with older teachers demonstrating lower levels of digital proficiency in comparison to their younger counterparts.

H_2: A significant correlation has been identified between teachers' age and their level of digital skills, with the level of digital skills decreasing with increasing age.

4. Results

The level of teachers' digital skills was measured according to the technologies (PC, laptop, mobile, tablet, etc.) and tools (presentations, multimedia files, graphic programs, etc.) used in the teaching process. The classification system employed was based on the European framework for the digital competence of educators, known as DigCompEdu, which delineates six categories of digital skills: zero, basic, intermediate, advanced, expert, and innovator. The study sample was used to identify four levels of teachers' digital skills: basic, intermediate, advanced, and expert. Furthermore, we identified variances in digital skills according to age, as well as the technologies and tools employed. The detailed results of the identified teachers' digital skill levels are shown in Table 1.

Table 1.
Teachers' level of digital skills.

Level of digital skills/ Age of teachers	**25-30**	**31-35**	**36-40**	**41-45**	**46-50**	**51-55**	**56 and more**	SUM
Basic level:								
Desktop computer/notebook (laptop)	13	12	20	18	25	17	37	142
	100%	100%	100%	100%	86%	74%	95%	92%
PowerPoint presentations	13	12	17	17	22	22	35	138
	100%	100%	85%	94%	76%	96%	90%	90%
Intermediate level								
Mobile/tablet/interactive whiteboard	13	12	20	18	24	16	26	129
	100%	100%	100%	100%	83%	70%	67%	84%
Video, film, multimedia files	13	12	17	14	20	15	27	118
	100%	100%	85%	78%	69%	65%	69%	77%
Advanced level								
Graphics tablet	0	0	0	1	2	0	0	3
	0%	0%	0%	6%	7%	0%	0%	2%
Mobile apps/digital games	10	12	17	12	12	12	9	84
	77%	100%	85%	67%	41%	52%	23%	55%
Expert								
Hands-on teaching aids	0	0	0	0	0	0	0	0
	0%	0%	0%	0%	0%	0%	0%	0%
Programs and tools (e.g., Sway, Padlet, Kahoot, Microsoft Teams)	0	1	1	3	10	1	2	18
	0%	8%	5%	17%	34%	4%	5%	12%

In the subsequent section, an investigation was conducted into the degree of association between age and level of digital skills. The mean values for each age interval were determined, and numerical values were assigned to each level of digital skills. 1 = basic level; 2 = intermediate level; 3 = advanced level; and 4 = expert level. For each age range, a weighted average of the digital level was then calculated according to the following formula:

$$\frac{\sum_{i=1}^{n}(N_i \times U_i)}{\sum_{i=1}^{n} N_i}$$

Where:
N_i is the number of teachers at level i in a given age group.
U_i is the numerical value of digital literacy level i.
n is the total number of digital literacy levels.
Pearson's correlation coefficient was utilised to ascertain the dependence between variables:

$$r = \frac{\sum(X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum(X - \bar{X})^2 \sum(Y - \bar{Y})^2}}$$

The results are displayed in Table 2.

Table 2.
Means of age intervals and mean digital level (Y1 for technology used and Y2 for tools used) with calculated correlation coefficient.

X	**Y_1**	**Y_2**
27.5	1.5	1.92
33	1.5	2.05
38	1.5	2.05
43	1.65	2.02
48	1.55	2.16
53	1.48	1.84
60	1.41	1.7
r	- 0.2987076839536139	- 0.5064216743637117

In both cases, a negative correlation was identified, indicating that as the age of teachers increases, there is a tendency for a slight decrease in the level of digital skills. A weak correlation was observed in the case of the technologies used, while a moderate correlation was identified in the case of the tools used.

Finally, a survey was conducted among teachers to ascertain their experiences with artificial intelligence and the extent to which they use it in their teaching. The results indicate that the integration of AI in secondary school teaching is still in its nascent stage, with minimal practical implementation. Notably, the survey revealed that no teacher reported using

artificial intelligence in teaching on a regular basis. This finding suggests minimal adoption of AI in pedagogical practice. A more detailed breakdown of these results is presented in Figure 1.

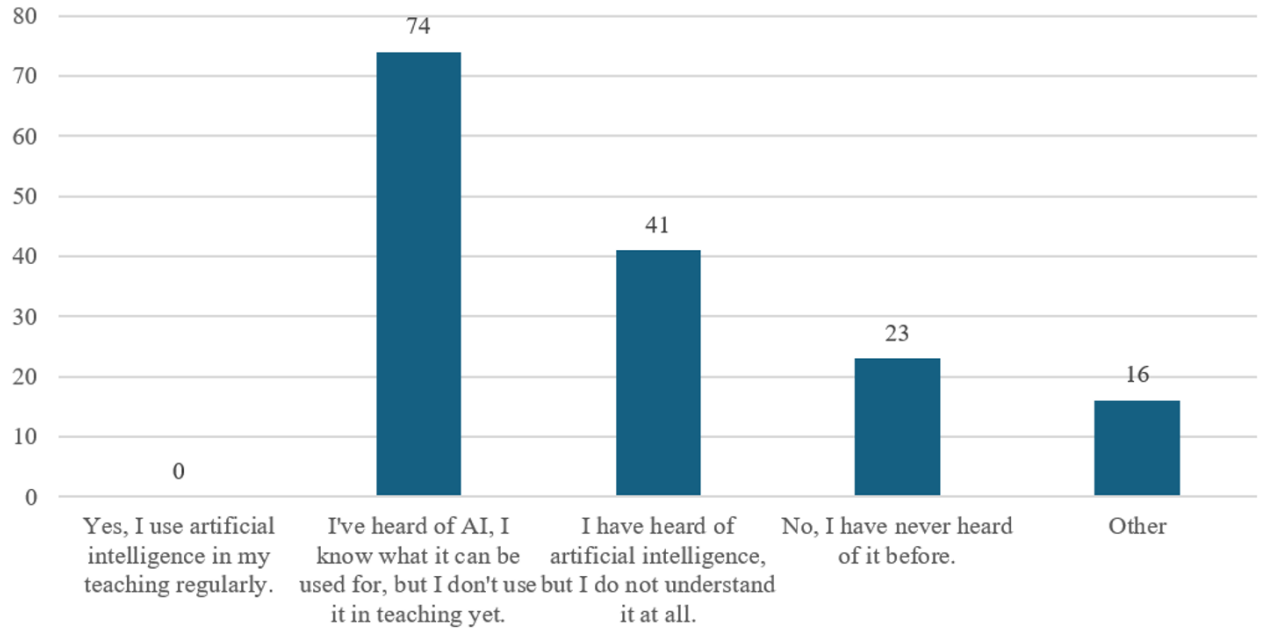

Figure 1.
Teachers' experience of using AI in teaching.

5. Discussion

The investigation yielded several noteworthy findings. For instance, pedagogues with a rudimentary degree of digital proficiency exhibited a high level of utilization of conventional instruments such as desktops, laptops, and PowerPoint presentations. These technologies were represented in almost all age groups, with the highest percentages of use occurring in the 46-50 age group (86% for laptops) and the 51-55 age group (96% for PowerPoint use). This finding suggests that teachers in this age group may place the greatest reliance on traditional digital tools for their work, perceiving them to be safe and effective. Teachers with intermediate levels of digital skills are characterized by the use of mobile devices, tablets, and interactive whiteboards. The use of mobile devices and multimedia files was evident across all age groups, with the 31-35 and 36-40 age groups demonstrating almost 100% utilization of these technologies. This high proportion of use of mobile devices and interactive technologies suggests that these age groups are flexible in adapting to modern learning aids and tools, which may be related to their openness to technological innovations and the availability of these devices. The advanced level of digital skills was characterized by the use of less traditional tools, such as graphic tablets, mobile applications, and digital games. The utilization of these tools exhibited a decline across age demographics, with graphic tablets demonstrating a mere 2% adoption rate. Mobile applications and digital games demonstrated a medium level of utilization (55%), though this utilization was reduced among older age groups. This finding indicates that, while some teachers are willing to adopt new digital tools, the overall penetration of these tools remains limited and is likely influenced by teachers' availability and readiness to use them. At the expert level, the utilization of contemporary tools such as Sway, Padlet, Kahoot, and Microsoft Teams, among others, was predominantly observed in the 46-50 age group (34%), while the aggregate utilization of these tools within the sample remained modest (12%). This finding suggests that a limited number of teachers are willing to adopt advanced digital solutions that necessitate a high level of digital literacy.

A correlation analysis was conducted to investigate the relationship between teachers' age and their digital proficiency. The findings revealed a modest negative correlation, indicating that as teachers' age increases, their digital skills tend to diminish. The findings suggest that as teachers' age increases, their digital proficiency level decreases, which may be due to several factors. These include older teachers being less willing to adopt new technologies and a preference for traditional tools. The correlation was found to be more pronounced in the context of the utilization of advanced tools and technologies, suggesting that younger teachers may demonstrate a greater degree of flexibility in incorporating novel digital tools into their teaching practices.

The study also yielded a number of surprising findings regarding the use of artificial intelligence in the teaching process. The predominant group, constituting 48% of the sample, comprises teachers who are cognizant of AI and its potential applications, yet lack practical experience in integrating it into their pedagogical practices. This demographic may be receptive to integrating AI into their pedagogical practice; however, they are likely to face challenges in accessing the necessary support and practical opportunities to do so. This interest in AI represents a significant opportunity for the school system, which could be strengthened through education and training on the possibilities and benefits of AI in education. A survey has revealed that more than 26% of teachers have only a basic awareness of AI and do not possess a comprehensive understanding of the subject. This finding indicates a clear need for more in-depth training to be provided to teachers, with the aim of enhancing their confidence and expertise in successfully integrating AI into their practice. A small but

noteworthy group of teachers (approximately 15%) is not yet acquainted with AI, indicating that a proportion of the teaching community may face challenges in accessing information regarding contemporary technological trends or may be reluctant to expand their professional repertoire to encompass novel technologies. This demographic would benefit from intensive support and educational initiatives to facilitate a deeper comprehension of how contemporary technologies can enhance pedagogical practices. A proportion of teachers (10%) represent a group with their own experience or views on artificial intelligence. These individuals may include those who utilize alternative digital technologies or have particular inquiries and reservations regarding AI. A more thorough exploration of this category could facilitate a more profound understanding of the barriers or specific requirements that teachers might have in relation to AI.

6. Conclusion

The findings of the present study provide a comprehensive depiction of the extent of teachers' digital competencies and their practical engagement with artificial intelligence in the pedagogical environment. In exploring different levels of digital skills, the most commonly used technologies and tools in the teaching process were examined. Additionally, the correlation between teachers' age and their digital skill levels was analyzed. The initial six-level classification system was condensed into four levels (basic, intermediate, advanced, and expert) to improve the study's manageability and clarity. Levels zero and innovator were not represented in the sample. This finding suggests that the majority of teachers possess at least basic digital skills, which is a positive indication for future development and innovation in teaching.

In both cases, a negative correlation was identified. Regarding the technologies utilized (e.g., computers, tablets, or multimedia devices), only a weak negative correlation was observed. This finding suggests that older teachers are still capable of working with common technologies that have become essential in the teaching process. The utilization of these technologies is widespread, having been adopted by teachers across all age groups. This weak correlation indicates that differences in technology use between younger and older teachers are not significant. Concerning tools used in teaching, such as specialized software, mobile applications, or interactive content creation platforms, a slight negative correlation with age was found. This suggests that older teachers tend to use these tools less frequently compared to their younger counterparts. This disparity may be due to several factors, including diminished interest in technological innovation, limited experience with digital platforms, or a preference for traditional teaching methods. The relationship may also stem from differences in digital literacy, with younger teachers, having grown up with technology, being more receptive to experimenting with new tools. The findings imply that as teachers age, their digital skills experience a slight decline, especially in the use of more complex tools and digital platforms. Simultaneously, the weak correlation observed in the use of fundamental technologies indicates that most teachers have achieved proficiency with conventional technologies, regardless of age. However, a more noticeable gap between age groups appears concerning more advanced digital tools and applications.

The findings on the utilization of AI in pedagogical contexts suggest that while the majority of teachers possess fundamental knowledge of AI, they frequently face limitations in terms of practical experience and support, thereby hindering their ability to effectively integrate AI into their instructional practices. The group of teachers who are knowledgeable about AI yet not yet incorporated it into their practice represents a potential asset for the school system. The provision of appropriate education and training has the potential to enhance their readiness to utilize this technology. Conversely, a second group of teachers possesses only superficial knowledge of AI, underscoring the necessity for comprehensive educational support. A small but significant group has no information about AI, highlighting the need for specific educational initiatives and improved access to information. The findings indicate that the integration of AI into secondary school teaching would be most effectively achieved through the implementation of targeted educational programs and practical training initiatives. These educational initiatives should be designed to inform and practically train teachers, with a focus on those who are familiar with AI but lack practical experience and those who have only a rudimentary understanding of the technology. In the long term, it is crucial to support teachers in terms of improving their digital literacy and readiness to work with modern technologies, which can make a major contribution to enriching the educational process and better meeting the needs of students in the digital age.

The findings further suggest that systematic support and targeted digital learning are essential to increase the digital literacy of teachers at all levels. Consequently, educational institutions must devise diversified pedagogical and communication strategies that are tailored to the individual needs of teachers, contingent on their age and technological experience. Older teachers would benefit from more intensive and practically oriented training to boost their confidence and competence in using modern tools and technologies. Conversely, the younger generation of teachers would benefit from advanced courses that introduce them to the use of digital technologies in a more creative and comprehensive framework. It is imperative that all teachers have access to ongoing training to facilitate their ability to adapt to technological changes and new learning platforms. The findings of the study underscore that continuous digital skills development encompasses not only the mastery of tools but also the cultivation of critical thinking and innovative approaches to teaching. This necessitates targeted and contemporary approaches to teacher professional development. It is therefore incumbent upon educational institutions to implement communication strategies that highlight the benefits and practical applications of digital tools and demonstrate their contribution to more effective and engaging teaching.

7. Limitations of the Study

The present study is subject to several limitations. Firstly, the relatively small number of respondents compared to the total number of secondary school teachers may limit the generalizability of the results. Furthermore, the use of an electronic

questionnaire requires a certain level of digital literacy, which may result in sample selection bias based on teachers' technological proficiency.

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