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Digital Competence of Teachers in PISA-participating Schools

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Abstract

This research explored key components of teachers' digital competence in PISA-participating schools. Considering the country's historically low performance in PISA, particularly in mathematics, science, and reading, there is a pressing need to enhance educational outcomes through targeted interventions. The study identified the existing levels of digital competence among teachers. Employing a quantitative, descriptive-comparative-correlational research design, the study involved 72 teacher respondents in PISA-participating schools in the division of Nueva Ecija, Philippines. Data were gathered through structured questionnaires and analyzed using descriptive and inferential statistics to describe variables and test hypotheses.Results revealed that teachers' digital competence was at the Integrator level. Furthermore, significant correlations were found between teachers' digital competence and their educational attainment, position, and attendance at ICT training. Notable differences in teachers' digital competence emerged when grouped by age and educational background. The study's ultimate goal was to provide actionable insights to enhance teachers' digital competence to improve learners' digital literacy towards improving performance in future PISA assessments.

Keywords: Digital Competence, Digital Literacy, Programme For International Student Assessment (PISA)

1. Introduction

In 2018, the Philippines participated in the Programme for International Student Assessment (PISA) for the first time. In mathematics, science, and reading, they scored below the Organization for Economic Cooperation and Development (OECD) average. Although the 2022 PISA results showed slight improvements, the country still ranked among the lowest in reading, mathematics, and science. These outcomes underscored the necessity for targeted interventions aimed at enhancing educational performance.Challenges encountered during participation in PISA included inadequate facilities for online assessments and a digital divide that limited students' digital literacy. Some schools had to borrow computers, and many students struggled with the online format due to unfamiliarity with technology (Chi, 2024). Additionally, this digital divide hinders teachers' efforts to improve their digital competence (Miras et al.,2023), essential for adequately preparing students for large-scale assessments.

The PISA 2025 assessment was set to focus on science and a new innovative domain, "Learning in the Digital World," highlighting the importance of students' abilities to engage in knowledge-building

and problem-solving using digital tools. It highlights the importance of applying scientific methods and computational thinking to real-world problems (OECD, 2023).According to OECD (2023), given the rapid rate of technological change, students today must develop broad skills and perspectives that support lifelong learning in novel and unfamiliar digital environments. This emphasis further reinforced the necessity of both educators' digital competence and students' digital literacy to navigate and succeed in an increasingly digital educational environment. The shift aimed to better prepare students for the demands of the contemporary world, where digital skills were becoming increasingly essential.

Digital literacy is essential in modern education, enabling students to navigate a digitized world effectively. It involved using technology to find, evaluate, organize, create, and communicate information safely and responsibly. Teachers' digital competence was necessary to foster students' digital literacy, which is especially important for international assessments such as PISA.Improving digital competence among teachers and digital literacy among students was crucial for better performance in PISA. Educators with strong digital skills could effectively integrate technology into teaching, making lessons more engaging and impactful. Such preparation helped students develop critical thinking, problem-solving skills, self-directed learning abilities, and the capability to navigate digital environments safely and ethically. Hence, this study's primary aim is to assess teachers' digital competence, specifically, it evaluates teachers' digital competence to integrate digital tools into their teaching to develop students' literacy in using digital tools and navigating online environments.

Research Questions

This study focused on determining the digital competence of teachers in PISA-participating schools.Specifically, it sought answers to the following research problems:

1.How may the profile of teacher-respondents be described in terms ofsex, age, specialization, years in service, highest educational attainment, position,number ofICT trainings attended, and number of PISA training attended?
2. How may the digital competence of teacher-respondents be described in terms of, professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence?
3.Is there any significant relationship between the profile and digital competence of teacher-respondents?
4. Is there any significant difference in teachers' digital competence when grouped according to profile?

2. Methodology

Research Design

This study employed a descriptive comparative-correlational research design. It primarily focused on exploring the extent to which variables were related or correlated. The objective of the study was to analyze the digital competence of teachers teaching PISA subjects and investigate potential differences based on their profile characteristics, as well as their relationship to digital competence levels. The descriptive aspect of the design systematically described teacher respondents in terms of demographic and professional variables, including sex, age, specialization, years of teaching service, highest educational attainment, position, and training attended. The comparative aspect explored differences teachers' digital competence when grouped according to profile characteristics.

Respondents

The respondents consisted of teachers who handled PISA subjects (Mathematics, Science, and Reading), in the three selected PISA-participating schools in the Division of Nueva Ecija during the School Year 2024-2025.The respondents were selected using stratified random sampling which ensured that each member of the population had an equal chance of selection, with proportional representation per stratum. The sample size was calculated using a confidence level of 95% and a margin of error of 5%. The criteria for their selection included teachers who majored in Mathematics, Science, and English and who were actively teaching at the selected PISA-participating national high schools in the division of Nueva Ecija.

Table 1: Distribution of Respondents

Respondents	Population	Sample Size	Percentage of Sample
School A	45	37	51.00
School B	33	28	39.00
School C	9	7	10.00
Total	**87**	**72**	**100.00**

Table 1 presents the distribution of teacher respondents in three PISA-participating schools in the Division of Nueva Ecija.

3. Analysis and Discussion

Profile of the Respondents

The profile of teacher-respondents provides valuable insights into the characteristics and backgrounds of the educators participating in the study. The key aspects of the teacher profile included sex, age, specialization, years in service, highest educational attainment, position, and number of trainings attended.

Table 2: Profile of Teacher Respondents

Variable	*f(n=72)*	%
Sex		
Male	16	22.20 %
Female	56	77.80%
Age		
21-30 yrs old	15	20.80%
31-40 yrs old	26	36.10%
41-50 yrs old	18	25.00%
50 years old or above	13	18.10%
Specialization		
Mathematics	25	34.70%
Science	24	33.30%
English	23	31.90%
Years in Service		

Variable	*f(n=72)*	**%**
0-3 years	10	13.90%
4-6 years	9	12.50%
7-9 years	11	15.30%
10 years above	42	58.3%
Highest Educational Attainment		
Bachelor's Degree	35	48.60%
Masters Degree	36	50.00%
Doctorate Degree	1	1.40%
Position		
Teacher I	17	23.60%
Teacher II	6	8.30%
Teacher III	41	56.90%
Master Teacher I	7	9.70%
Master Teacher II	1	1.40%
No. of ICT Training		
0-1	56	77.80%
2-3	10	13.90%
4-5	3	4.20%
5 above	3	4.29%
No. of PISA Training		
0-1	54	75.00%
2-3	10	13.90%
4-5	7	9.70%
5 above	1	1.40%

The data in table 2 reveals that 16 teachers (22.20%) are male and 56 (77.80%) are female. It indicates a significant gender imbalance among the teacher respondents, with a higher proportion of female teachers. This could reflect broader trends in the teaching profession, where women are often more represented, particularly in certain educational levels and subjects.

The age distribution of respondents shows that 15 teachers (20.80%) are in the age range of 21-30 years. The older group, 26 teachers (36.10%),is31-40. Eighteen teachers (25.00%) are in the age range of 41-50 years old, and 13 teachers (18.10%) are in the age range of 50 yrs. Old above. This implies that most teachers are in the age range of 31-40 years. Old. This group may have substantial teaching experience but might be less familiar with newer digital tools and technologies. They could benefit from targeted professional development to build their digital competence and confidence in using technology in the classroom (Althubyani, 2024). Encouraging peer mentoring and collaboration with younger teachers can facilitate knowledge sharing and skill development.

The data shows that 25 teachers (34.70%) specialized in Mathematics, 24 teachers (33.30%) specialized in Science,and 23 teachers (31.90%) specialized in English. This implies that teachers' digital competence can vary significantly based on their teaching subject. For instance, Mathematics and

Science teachers might need specialized software and digital tools for simulations, data analysis, and interactive learning (OECD, 2023). Ensuring these teachers have access to and training in relevant digital tools can enhance their teaching effectiveness and improve student outcomes in PISA assessments.

The data reveals that 10 teachers (13.90%) are teaching for 0-3 years, nine teachers (12.50%) are teaching for 4-6 years, 11 teachers (15.30%) are teaching for 7-9 years, and 42 teachers (58.3%) are teaching for 10 years above. Teachers with 10 years or more of experience represent the majority. While they bring a wealth of teaching experience, they may face challenges adapting to new digital tools and technologies.

The data reveal that 35 teachers (48.60%) hold a bachelor's degree, 36 teachers (50.00%) hold a master's degree, and only one teacher (1.40%) holds a doctorate. This implies that most teachers are pursuing or have completed their master's degree, indicating a strong commitment to furthering their education. However, the fact that only one teacher has attained a doctorate suggests that there may be barriers or challenges in achieving the highest academic qualification.

The data presented shows that 17 teachers (23.60%) are Teacher I, six teachers (8.30%) are Teacher II, 41 teachers (56.90%) are Teacher III, and seven teachers (9.70%) are Master Teacher I. Onlyone teacher (1.40%) is a Master Teacher II. This distribution indicates that most teachers are in the Teacher III position, suggesting significant experience and expertise within the teaching staff.The implications for teachers' digital competence are noteworthy. Teachers in higher positions, such as Teacher III and Master Teacher, will likely have more experience and possibly more training opportunities, which could enhance their digital competence. However, the relatively small number of teachers in the Master Teacher I and II positions might indicate a need for more professional development opportunities to help teachers advance to these higher levels. Additionally, supporting teachers at the Teacher I and II levels in developing their digital skills could be crucial for their career progression and for integrating technology effectively in the classroom.

The number of ICT training sessions attended by teacher-respondents for the school yearreveals that 56 teachers (77.80%) have attended 0-1 training sessions, 10 teachers (13.90%) have attended 2-3 training sessions, three teachers (4.20%) have attended 4-5 training sessions, and only three teachers (4.29%) have attended more than five training sessions.This distribution implies that most teachers have had limited exposure to ICT training, with most attending only one or no sessions. This could suggest a need for increased access to and encouragement for participating in ICT training programs. The relatively low number of teachers attending multiple training sessions indicates potential barriers such as time constraints, lack of awareness, or insufficient training opportunities.The data shows that 54 teachers (75.00%) have attended 0-1 training, 10 teachers (13.90%) have attended 2-3 trainings, seven teachers (9.70%) have attended 4-5 trainings, and only one teacher (1.40%) has attended more than five trainings. This distribution implies that the majority of teachers have also had limited exposure to PISA training, with most attending only one or no sessions at all. This could suggest a need for increased access and opportunities to participate in PISA training programs. Teachers who receive several training sessions

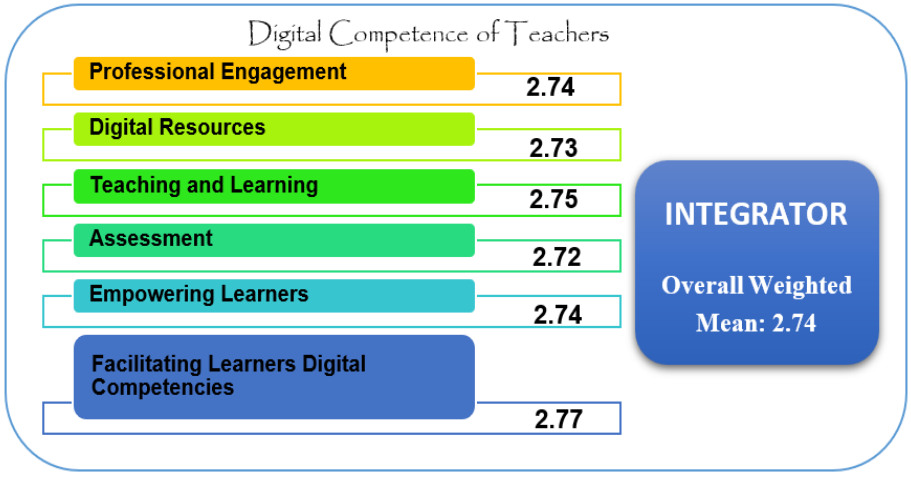
related to PISA are better equipped to facilitate the exam, as they gain a deeper understanding of the assessment's framework, objectives, and methodologies.

Overall, the data presents a well-qualified and experienced teaching workforce, predominantly female and within the 31–40 age range, with strong academic backgrounds and subject expertise in core areas like Mathematics, Science, and English. However, despite their strengths, the teachers have had limited exposure to ICT and PISA-related training, highlighting a critical gap in professional development. This suggests that while the teaching staff is capable and committed, there is a pressing need to enhance their digital competence and assessment readiness through more accessible, relevant, and sustained training programs to meet the evolving demands of 21st-century education.

Digital Competence of Teacher-Respondents

The digital competence of teacher=respondents is a critical factor in the effective integration of technology in education, directly impacting students' digital literacy and performance in assessments such as PISA. As digital literacy becomes increasingly important in the 21st century, teachers must be proficient in using digital tools and resources to enhance their teaching practices and support students in developing essential digital skills. This section explores the digital competence of teacher respondents based from DigCompEdu (Redecker,2017), focusing on the key areas of professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating students' digital competencies, discussing the implications for students' digital literacy and ability to perform well in PISA assessments.

Figure 1: Digital Competence of Teachers



The computed overall weighted mean of 2.74 for teachers' digital competence, corresponding to the "Integrator" level, indicates that teachers demonstrate a moderate level of digital competence. This suggests that while many educators are capable of integrating digital tools into their teaching practices, there is still room for growth particularly in more advanced or transformative uses of technology.Notably, the "Assessment" domain received a slightly lower mean score of 2.72, highlighting a specific area where teachers may require additional support and professional development. This gap is particularly significant in the context of PISA 2025, which emphasizes the importance of using digital

tools not only for instruction but also for formative and summative assessment aligned with global standards.

According to Fallon (2020), a comprehensive framework for teacher digital competence must go beyond technical skills to include the pedagogical integration of digital tools. This includes the ability to assess student learning using digital platforms, interpret digital data, and provide feedback through technology-enhanced methods.Research from Lin et al. (2022) further supports this, showing a significant correlation between ICT training, digital capacity, ethical technology use, and collaboration skills. Teachers with higher digital competence were found to foster more interactive, ethical, and student-centered learning environments.In parallel, Reblinca (2024) found that when teachers are proficient in using and integrating digital tools, their students are more likely to develop strong digital literacy skills, reinforcing the idea that teacher competence directly influences student outcomes.The findings further suggest targeted professional development focused training on digital assessment strategies that addresses PISA-aligned assessment practices, ensuring teachers are prepared for international benchmarking. Enhancing teacher digital competence, especially in assessment, ensures more equitable and personalized learning experiences for students preparing students for digital assessments like PISA, where self-regulation, problem-solving, and digital navigation are key.

Correlation between the Profile and Teachers' Digital Competence

Table 3 shows the correlation between teacher respondents' profiles and digital competence using the Pearson Correlation Coefficient.

Table 3:Correlation of Profile and Digital Competence of Teacher Respondents

Variables	DIGITAL COMPETENCE	
	r-value	p-value
Sex	-0.12	.923
Age	.006	.962
Specialization	.150	.209
Years of service	.137	.250
Highest Educational Attainment	.331	.005*
Position	.303	.010*
No. of ICT Training	.240	.042*
No. of PISA Training	-.013	.915

*Legend: * significant at 0.05 level*

The computed correlation between sex and digital competence is r = -0.12 (negligible correlation), and the alpha level or p-value Sig (2-tailed) is 0.923. The result shows no significant correlation between the respondents' sex profiles and digital competence. The computed correlation between age and digital competence is r= 0.006 (negligible correlation), and the alpha level or p-value Sig (2-tailed) is 0.962. The results show no significant correlation between the respondents' age profiles and digital competence. The computed correlation between specialization and digital competence is r=0.150 (negligible correlation), and the alpha level or p-value Sig (2-tailed) is 0.209. Thus, there is no significant correlation between the respondents' specialization profiles and digital competence.The computed correlation between years of service and digital competence is r=0.137 (negligible correlation), and the alpha

level or p-value Sig (2-tailed) is 0.250. The results show no significant correlation between the respondents' years of service profile and digital competence. The computed correlation between the highest educational attainment and digital competence is r=0.331 (moderate correlation), and the alpha level or p-value Sig (2-tailed) is 0.005. The results show a significant correlation between the respondents' highest educational attainment profile and digital competence. According to Althubyani (2024), teachers with higher educational qualifications, such as master's or doctoral degrees, tend to exhibit higher levels of digital competence. This is because advanced degrees often involve more extensive use of digital tools and technologies, which enhances teachers' digital skills. The computed correlation between position and digital competence is r= 0.303 (moderate correlation), and the alpha level or p-value Sig (2-tailed) is 0.010. The result significantly correlates with the respondents' position profiles and digital competence.

Teachers who participate in continuous professional development, especially those in higher positions, tend to have better digital skills (Tzafilkou et al., 2023). These programs often focus on enhancing digital literacy and integrating technology into teaching practices.The computed correlation between position and digital competence is r= 0.204 (moderate correlation), and the alpha level or p-value Sig (2-tailed) is 0.042. The result shows that there is a significant correlation between the respondents' ICT Training profile and digital competence.Continuous professional development is crucial for improving digital competence. Teachers who engage in ongoing training and education are more likely to develop and maintain high levels of digital literacy (Barahona et al., 2024).The computed correlation between PISA training attended and digital competence is r= -0.013 (negligible correlation), and the alpha level or p-value Sig (2-tailed) is 0.915. The result shows no significant correlation between the respondents' PISA training and digital competence. This implies that teachers' digital competence is influenced by other factors such as ongoing professional learning, access to technology, and institutional support not just one-off training sessions.

A 2025 study using PISA 2022 data found that digitization does not directly improve educational outcomes but works indirectly through teachers' and students' behaviors (Xu et al., 2025). This supports the idea that training alone is insufficient without behavioral and contextual integration. Moreover, the findings suggest that educational policymakers should reassess the goals of PISA-related training and consider integrating digital competence as a core component of teacher education and evaluation. Rakisheva and Witt (2023) highlight the need for empirically validated frameworks to guide teacher training in digital competence. They emphasize that pre-service and in-service training must be aligned with real-world digital teaching needs.

Differences of Teachers' Digital Competence Grouped According to Profile

This discussion delves into the differences in teachers' digital competence based on respondent profile variables such as sex, age, specialization, years in service, highest educational attainment, position, and training attended. The analysis is grounded in the data presented in Table 4.

Table 4: Differences in Teachers' Digital Competence According to Profile

Profile Variables	Mean	Std. Dev.	f-value	p-value
Sex				
Male	2.76	0.555	.010	0.923
Female	2.74	0.602		
Age				

Profile Variables	Mean	Std. Dev.	f-value	p-value
21-30 years old	2.50	0.614	4.177	0.009*
31-40 years old	3.03	0.630		
41-50 years old	2.53	0.413		
50 years old or above	2.76	0.469		
Specialization				
Math	2.67	0.602	1.015	0.368
Science	2.68	0.463		
English	2.89	0.681		
Years in service				
0-3	2.63	0.378	1.161	0.331
4-6	2.48	0.689		
7-9	2.92	0.792		
10 years above	2.78	0.540		
Highest Educational Attain-ment	2.75	.525	5.302	0.007*
Bachelor's Degree	2.88	.583		
Masters' Degree	4.00			
Doctorate Degree				
Position				
Teacher I	2.39	0.399	2.227	0.075
Teacher II	2.89	0.406		
Teacher III	2.84	0.673		
Master Teacher I	2.88	0.142		
Master Teacher II	3.00			
No. of ICT				
0-1	2.66	0.599	1.549	0.210
2-3	2.93	0.546		
4-5	2.86	0.075		
5 above	3.32	0.523		
No. of PISA Training				
0-1	2.76	0.639	2.172	0.099
2-3	2.71	0.184		
4-5	2.46	0.279		
5 above	4.00			

The mean scores for digital competence were almost similar for females (M = 2.76, SD = 0.555) compared to males (M = 2.74, SD = 0.602). The p-value (0.924) indicates no statistically significant difference between male and female respondents regarding digital competence. The mean scores for digital competence in various age group were slightly different for 21-30 years old (M = 2.5, SD = 0.614), 31-40 years old (M = 3.03, SD = 0.630), 41-50 years old (M = 32.53, SD = 0.413), and 50 years old above (M = 2.76, SD = 0.469). The p-value (0.009) indicates a statistically significant difference among age groups regarding their digital competence. Research indicates that digital competence tends to be higher

among younger age groups, particularly those in their 20s and 30s, compared to older age groups such as those in their 50s and 60s (Malakul &Sangkawetai, 2024). This is often attributed to younger individuals having grown up with digital technologies, making them more adept at using digital tools and resources.The mean scores for digital competence when grouped according to specialization were slightly similar: Math (M = 2.67, SD = 0.602), Science (M = 2.68, SD = 0.463), and English (M = 2.89, SD = 0.681). The p-value (0.368) indicates that there is no statistically significant difference among specializations in terms of their digital competence. The mean scores for years in service ranged from 2.92 to 2.48. Those with 7-9 years of service had the highest mean score (M = 2.92, SD = 0.792). The p-value (0.331) indicates no significant differences in digital competence based on years in service. A study by Alnasib (2023) investigated the digital competencies of pre-service teachers and found that the length of service did not significantly influence digital competence. The study suggested that digital competence is more closely related to the quality of training and professional development than the years in service.

Respondents with different educational attainments had mean scores of 2.75 (Bachelor's Degree, SD = 0.525), 2.88 (Master's Degree, SD = 0.583), and 4.00 (Doctorate Degree). The p-value (0.007) suggests a significant difference in digital competence based on educational attainment. This parallels the study of de Soriano et al. (2024), which suggests that teachers with higher educational qualifications exhibit higher levels of digital competence. This is because advanced degrees often involve more extensive use of digital tools and technologies, which enhances teachers' digital skills. The mean scores for different positions were as follows: Teacher I (M = 2.39, SD = 0.399), Teacher II (M = 2.89, SD = 0.406), Teacher III (M = 2.84, SD = 0.673), Master Teacher I (M = 2.88, SD = 0.142) and Master Teacher II (M = 3.00). The p-value (0.075) indicates no significant differences based on rank. A study by Sillat et al. (2021) reviewed various digital competence assessment methods in higher education and found that academic rank does not significantly influence digital competence. Parallel to the research by Tzafilkou et al. (2022), which highlighted that targeted professional development programs significantly impact digital competence among students and educators, regardless of rank.According to the several ICT training courses attended, the mean scores for the digital competences group ranged from 3.32 to 2.66. Those with five of the above trainings had the highest mean score (M = 3.32, SD = 0.523). The p-value (0.210) indicates no significant differences in digital competence according to several ICT training. According to the number of PISA training sessions attended, the mean scores for the digital competences group ranged from 4.00 to 2.46. Those with five of the above trainings had the highest mean score (M = 4.00). The p-value (0.099) indicates no significant differences in digital competence according to the number of PISA training sesions. The lack of significant differences in digital competence based on the number of ICT or PISA training sessions suggests that the quality of training may be more important than the quantity. A study by Alnasib (2023) found that targeted, high-quality professional development programs substantially impacted digital competence more than the number of training sessions attended. This implies that training programs should focus on delivering high-quality, relevant content that effectively enhances digital skills.

Overall, the data shows that digital competence among teachers is more influenced by age and education level than by gender, years of service, or rank. Younger teachers and those with higher degrees tend to have stronger digital skills. However, the number of trainings attended didn't significantly affect competence, suggesting that the quality of training matters more than quantity.

4. Conclusions

The study reveals a significant gender disparity among the predominantly female teacher respondents. Most teachers fall within the 31–40 age range and have over 10 years of teaching experience. Specializations are evenly distributed across Mathematics, Science, and English. Nearly half of the respondents hold a master's degree, and the most common job designation is Teacher III.Despite their experience and qualifications, attendance in ICT and PISA training remains limited, highlighting a need for expanded professional development opportunities in these areas.

Teachers demonstrated digital competence at the "Integrator" level, indicating their ability to effectively incorporate digital tools into professional engagement, teaching and learning, assessment, and the empowerment of learners' digital skills. However, the lowest mean scores were observed in the assessment domain, suggesting this area requires further improvement.

Statistical analysis shows no significant relationship between digital competence and variables such as sex, age, specialization, years of service, or PISA training. However, educational attainment, job position, and ICT training are positively associated with higher levels of digital competence. These findings suggest that initiatives to enhance digital competence should prioritize promoting higher educational qualifications, supporting career advancement, offering comprehensive and targeted ICT training programs.

Additionally, age and educational attainment are important factors for digital competence among teachers. Enhancing digital competence should focus on providing targeted support for different age groups and encouraging higher educational attainment. Moreover, the findings suggest to increase the availability and accessibility of professional development opportunities, particularly in ICT and PISA training. This can include workshops, online courses, and in-service training sessions. Specialized training programs should be offered to Mathematics, Science, and English teachers to help them integrate digital tools and resources into their specific subject areas. Training programs focused on digital assessment tools and platforms should be prioritized and tailored to different age groups. This will help teachers become more proficient in creating, administering, and analyzing digital assessments. To ensure alignment with international standards, workshops and courses that align with the PISA framework should be offered. It is recommended that educational institutions provide targeted support and training. Encourage and support teachers in pursuing higher educational qualifications, such as master's and doctoral degrees. Provide Career Advancement Opportunities and create clear pathways for career advancement within the teaching profession. Recognize and reward teachers who demonstrate high digital competence. Develop and implement robust ICT training programs that cover a wide range of digital tools and technologies.

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