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iJET International Journal of Emerging Technologies in Learning

iJET | eISSN: 1863-0383 | Vol. 19 No. 5 (2024) | OPEN ACCESS

https://doi.org/10.3991/ijet.v19i05.48937

PAPER

Digital Competence of Secondary School Teachers in Hanoi, Vietnam: A Study Based on the DigCompEdu Model

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ABSTRACT

Nowadays, technology poses significant challenges to education. Teaching tasks are closely linked to technology. Teachers use technology as a vital tool in teaching. Technology is constantly changing, requiring teachers to be continuously assessed for their digital competence to identify their strengths and weaknesses, thereby finding solutions to enhance their digital skills and meet the high learning demands of students. This study focuses on analyzing the digital competence of teachers currently teaching at secondary schools in Hanoi, Vietnam, using the DigComEdu model to measure teachers' digital competence. The research sample consists of 445 teachers, indicating that the majority of teachers have digital competence at the B2 level, with the "Assessment" area of digital competence being the lowest. Interestingly, teachers under the age of 25 exhibit the lowest level of digital competence. The results gathered and analyzed concerning teachers' digital competence, along with the conclusions drawn from this study, aim to develop teachers' digital competence.

KEYWORDS

DigCompEdu, digital competence, secondary school teachers, education, teacher training

1 INTRODUCTION

The integration of technology in education has fundamentally transformed the traditional paradigms of teaching and learning, offering unprecedented opportunities for personalized instruction, interactive learning experiences, and the development of essential digital literacy skills. In the digital age, educators are tasked with the responsibility of not only imparting subject-specific knowledge but also equipping students with the digital competencies necessary to thrive in an increasingly technology-driven society [1]. Teachers' digital competencies play a crucial role in shaping professional activities within educational settings [2]. As highlighted by [3], the effective utilization of digital technologies by educators is essential for

Pham, N.S., Thi, H.Y.N., Vu, T.Q. (2024). Digital Competence of Secondary School Teachers in Hanoi, Vietnam: A Study Based on the DigCompEdu Model. *International Journal of Emerging Technologies in Learning (iJET)*, 19(5), pp. 20–34. https://doi.org/10.3991/ijet.v19i05.48937

Article submitted 2024-03-04. Revision uploaded 2024-04-04. Final acceptance 2024-04-04.

creating dynamic and engaging learning environments, facilitating communication and collaboration, and promoting critical thinking and problem-solving skills among students. Moreover, teachers' digital competencies are integral to the successful implementation of innovative pedagogical practices, such as blended learning, flipped classrooms, and project-based learning, which leverage digital tools to enhance the learning experiences of students.

The role of teachers' digital competencies extends beyond the mere use of technology as a supplemental tool; it encompasses the ability to integrate digital resources seamlessly into instructional practices, adapt to diverse learning needs, and foster digital citizenship among students. In this context, the digital competencies of educators are closely intertwined with their capacity to leverage technology for differentiated instruction, formative assessment, and the creation of inclusive learning environments that cater to diverse learning styles and abilities [1]. Digital competence of teachers is defined as a collection of knowledge and skills regarding information and communication technology related to the teaching profession, enabling them to address subject-specific issues or teaching methods in the knowledge society [4], [5]. Assessing teachers' digital competencies is essential for identifying areas of strength and areas that require further development.

There are several toolkits available to assess the digital competence of teachers, such as the UNESCO ICT Competency Framework for Teachers [6], studies [7], [8] that argue that the DigCompEdu framework of the European Union for educators is the most suitable. The DigCompEdu framework, proposed by the European Commission, serves as a comprehensive tool for evaluating educators' digital competencies across six key areas, including professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence [9]. This framework provides a structured approach to assessing the digital competencies of teachers, enabling educational institutions to identify specific areas for targeted professional development and support.

The utilization of assessment tools aligned with these frameworks enables educational institutions to gauge the digital competencies of their teaching staff, identify areas for targeted professional development, and ultimately enhance the integration of technology in educational practices. By systematically assessing teachers' digital competencies, educational leaders can design tailored professional development programs, provide targeted support, and foster a culture of continuous improvement to ensure that educators are equipped to meet the evolving demands of digital literacy in education [10]. There have been several studies on the digital competence of teachers, such as: Dzikite's analysis shows that teachers' competence is relatively low [11]; Fernández's research suggests a certain influence of age on digital skills [12], with younger individuals often having higher digital competence [13], and a significant relationship between academic level and technology competence [14]. There is a gender difference in digital competence, with men tending to score higher [15]. However, there has been no study on assessing the digital competence of teachers currently teaching at secondary schools, nor the relationship between gender, age, and digital competence. Therefore, the objectives of this study are:

1. To explore the digital competence of teachers currently teaching at secondary schools in Hanoi, Vietnam.
2. To explore and compare the digital competence of secondary school teachers based on gender and age.

2 LITERATURE REVIEW

The European Digital Competence Framework for Educators (DigCompEdu) has emerged as a prominent and internationally recognized framework in the field of education. Acknowledged for its comprehensiveness, it serves as a model for defining and evaluating the digital competence of educators. DigCompEdu encompasses multiple competence areas, including information, communication, content creation, security, problem-solving, and the use of digital technologies [16]. Developed by the European Commission, it reflects efforts to address the digital competence needs of educators and provides a paradigmatic example of aligning teacher competence frameworks to 21st-century challenges [9]. The framework serves as a benchmark for defining digital competences characteristic of teachers.

DigCompEdu's impact is examined through its application in different contexts. Research studies have used the framework for developing assessment tools and questionnaires to evaluate the digital competence level among educators [17]. Its application in the university context for validating teacher digital competence showcases its adaptability and relevance in diverse educational settings [4]. Additionally, the framework has influenced the development of transdisciplinary professional competence models for teachers, emphasizing its impact in shaping educational practices [18]. The significance of DigCompEdu is underscored by its role in guiding the professional development of teachers in higher education. Integration into European projects aimed at empowering educators in digital assessment exemplifies its practical implementation [19]. Systematic literature reviews further emphasize its prominence as a topic of scholarly inquiry and relevance in higher education research [20].

DigCompEdu's influence extends beyond Europe, with research showcasing its application in the evaluation of digital competence among educators in the United Arab Emirates, demonstrating its global relevance [17]. Moreover, its use in the development of educator-specific digital competences through serious game design emphasizes its role in shaping innovative educational practices [21]. Extensive research on DigCompEdu reflects its significance in the education domain. Studies have evaluated digital competencies in higher education, emphasizing DigCompEdu CheckIn as a self-assessment model [22]. The framework has been examined in educational policy documents, reaffirming teachers' need for special skills in using digital resources [23]. Specific competencies, such as using digital technologies for providing feedback and decision-making, have been explored [24].

DigCompEdu's influence extends to health sciences teachers, academics, and primary and secondary education teachers in various contexts [25]. It has been utilized in research on college teachers' digital competence, both within and beyond Europe. Studies have explored the framework's role in evaluating digital competences during the COVID-19 pandemic and its impact on English Language Teaching (ELT) teachers [26]. The DigCompEdu framework is one of the models used to determine digital competence for users, and many countries using this framework tend to discuss and guide teacher training policies [27]. Additionally, DigCompEdu has shaped educational practices and policies, stimulating further research and serving as the basis for the development of new models [28]. Apart from research, DigCompEdu has contributed to the development of instruments for measuring pre-service teachers' knowledge and has been used in educational interventions aimed at enhancing educators' competence in digital pedagogy [7], [29]. The extensive research on DigCompEdu reflects its widespread adoption and influence in shaping digital competence among educators, both in Europe and beyond. The literature collectively

emphasizes DigCompEdu's integral role in contemporary educational practices and the need for continued exploration of its multifaceted impact.

3 METHODOLOGY

3.1 Teachers at secondary schools in Hanoi, Vietnam

Hanoi, the capital of Vietnam, has a population of approximately 8.6 million people. It serves as the cultural, political, social, and educational center of the country. Education is a prioritized sector, with significant investments in infrastructure, resulting in leading educational outcomes nationwide. Currently, Hanoi has over 2.2 million students and about 124.5 thousand teachers [30]. Comprehensive innovation and digital transformation in education to meet the requirements of the Fourth Industrial Revolution have been initiated in Hanoi. On June 3, 2020, the Prime Minister of Vietnam approved the National Digital Transformation Program [31], where education is among the eight priority sectors for implementation. The education sector aims to make Vietnam one of the leading countries in digital transformation in education and training. In recent times, especially since the outbreak of Covid-19, schools in collaboration with technology enterprises in Vietnam have intensified the application of new technologies in online education. Indeed, the Covid-19 pandemic has demonstrated the excellent adaptability of both students and teachers to utilizing technology in education.

As society progresses rapidly, there are increasing demands for innovation placed on Hanoi. Therefore, teachers at secondary schools must continually learn, improve their professional qualifications, particularly in utilizing technology in their professional activities. Assessing the current digital competence of teachers is crucial for their development, as it helps teachers recognize their limitations and facilitates policymakers in formulating appropriate policies to support teachers' professional development.

3.2 The European framework for the digital competence of educators

The DigCompEdu framework distinguishes six different areas in which educators' Digital Competence is expressed with a total of 22 competences (Figure 1).

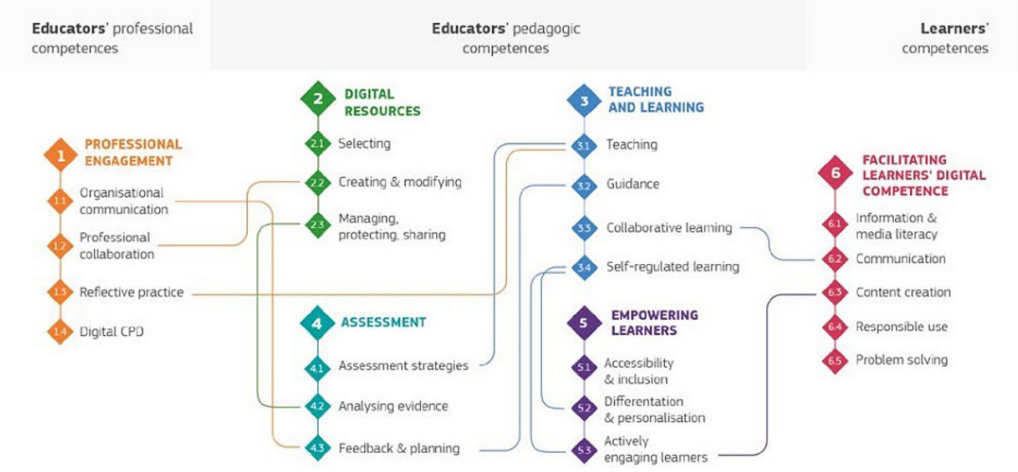

Fig. 1. The DigCompEdu framework [32]

The six DigCompEdu areas focus on different aspects of educators' professional activities:

Competence Areas	General Description
Professional engagement	Using digital technologies for communication, collaboration and professional development
Digital Resources	Sourcing, creating and sharing digital resources
Teaching and Learning	Managing and orchestrating the use of digital technologies in teaching and learning
Assessment	Using digital technologies and strategies to enhance assessment
Empowering Learners	Using digital technologies to enhance inclusion, personalisation and learners' active engagement
Facilitating Learners' Digital Competence	Enabling learners to creatively and responsibly use digital technologies for information, communication, content creation, wellbeing and problem-solving

The proposed progression model is intended to help educators understand their personal strengths and weaknesses, by describing different stages or levels of digital competence development. For ease of reference, these competence stages are linked to the six proficiency levels used by the Common European Framework of Reference for Languages (CEFR), ranging from A1 to C2 [32], including, Newcomer (A1); Explorer (A2); Integrator (B1); Expert (B2); Leader (C1) and Pioneer (C2).

3.3 Survey

The digital competence of secondary school teachers in Hanoi is measured using the DigCompEdu toolkit, which we have adjusted to suit the Vietnamese context. The toolkit comprises six areas of digital competence consisting of 22 component digital competencies, along with some additional questions regarding personal information (gender, years of experience, specialization, etc.).

To measure the level of digital competence, a 5-point Likert scale was utilized, scored from one to five points, Very Low = 1; Below Average = 2; Average = 3; Above Average = 4; Very High = 5. For all the items, each value of the scale gradually referred to a level of digital competence, ranging from a basic level (A1 and A2), intermediate level (B1 and B2), to advanced level (C1 and C2), as in the Common European Framework of Reference for Languages (CEFR) [32]. We utilize Google Forms tool to construct the questionnaire. A link along with a QR code is provided to the teachers for them to submit their responses (https://forms.gle/Co3gYRCDMmDWQYUs5).

4 RESULTS

4.1 Data analysis

The questionnaire was constructed using Google Forms and was administered from May 2022 to December 2023 in training classes for secondary school teachers. Teachers' personal information was kept confidential, enhancing the reliability of the responses. The collected data were processed using SPSS software version 22.0. After filtering the data, the responses of 445 teachers were entered into the SPSS software for statistical analysis. To verify the reliability, Cronbach's Alpha coefficient was used, resulting in a Cronbach's Alpha value of 0.917, indicating the reliability of the collected data. The information of participating teachers is summarized in Table 1.

Table 1. Descriptive statistics

		Count	N%
Sex	Female	344	77.3%
	Male	101	22.7%
Year old	Under 25	51	11.5%
	25–29	106	23.8%
	30–39	163	36.6%
	40–49	106	23.8%
	50–59	19	4.3%
	Over 60	0	0.0%

The average values of the six areas of digital competence are summarized in Figure 2. Among these, the Empowering learners area has the highest value (mean = 3.49), while the Assessment area has the lowest value (mean = 3.17).

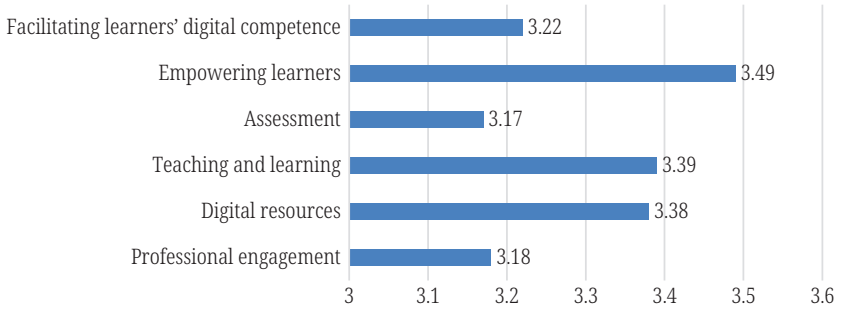

Fig. 2. The average value of digital literacy across regions

Converted to the DigCompEdu scale, with levels A1 (mean ≤ 0.83); A2 (0.83 < mean ≤ 1.66); B1 (1.66 < mean ≤ 2.50); B2 (2.50 < mean ≤ 3.32); C1 (3.32 < mean ≤ 4.17); C2 (4.17 < mean ≤ 5.00), the overall results are represented in the chart in Figure 3. We observe that 50.11% of teachers achieved level B2, while 35.96% reached level C1, indicating that the digital competence of most teachers is at a "good" level. There are no teachers at levels A1 and A2. This can be explained by the fact that currently in Hanoi, the minimum requirement for a teacher is to have basic-level information technology skills.

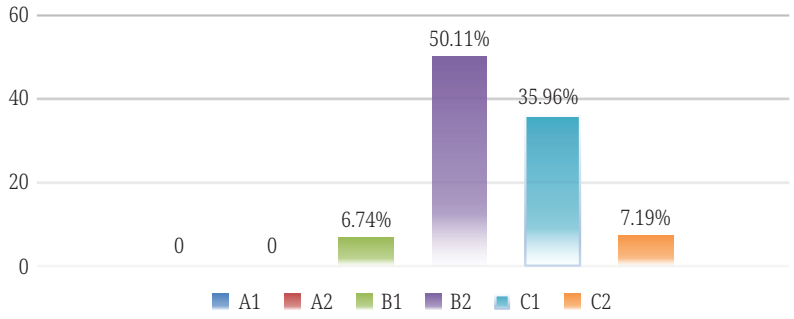

Fig. 3. The percentage of assessment according to the DigCompEdu scale

The summary of average values for the 22 component digital competencies indicate that the three competencies with the lowest values are: I systematically use different digital channels to enhance communication with students, parents and colleagues (mean = 3.02); I set up assignments which require students to use digital means to communicate and collaborate with each other or with an outside audience (mean = 3.02); I analyse all data available to me to timely identify students who need additional support (mean = 3.05). The three digital competencies with the highest average values are: I use digital technologies for students to actively participate in class (mean = 3.60); When I create digital assignments for students I consider and address potential digital problems (mean = 3.62); I carefully consider how, when and why to use digital technologies in class, to ensure that they are used with added value (mean = 3.83).

4.2 Analysis of comparing digital competence with gender and age

Digital competence and gender. To examine the correlation between digital competence and gender of teachers, an ANOVA analysis was conducted. The Levene's test statistic is 0.105 with a significance value (Sig.) of 0.746 > 0.05, meaning that the variances between the groups are homogeneous (Table 2). This allows for further analysis of mean differences using One-way ANOVA.

Table 2. Test of homogeneity of variances

Levene Statistic	df1	df2	Sig.
.105	1	443	.746

The results in Table 3 indicate that the Sig value is 0.398 > 0.05, meaning that there is no significant difference between gender and the mean value of digital competence.

Table 3. ANOVA analysis

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.217	1	.217	.716	.398
Within Groups	134.207	443	.303		
Total	134.424	444			

Although not significantly different, the chart in Figure 4 also shows that the digital competence of male teachers (mean = 3.34) is higher than that of female teachers (mean = 3.28). Specifically, the two areas of competence showing the most significant differences are Professional Engagement (3.33 and 3.13) and Digital Resources (3.47 and 3.35). The remaining four areas of competence exhibit similar levels between male and female teachers. Interestingly, the digital competence in "Empowering learners" of female teachers (mean = 3.5) is higher than that of male teachers (mean = 3.45).

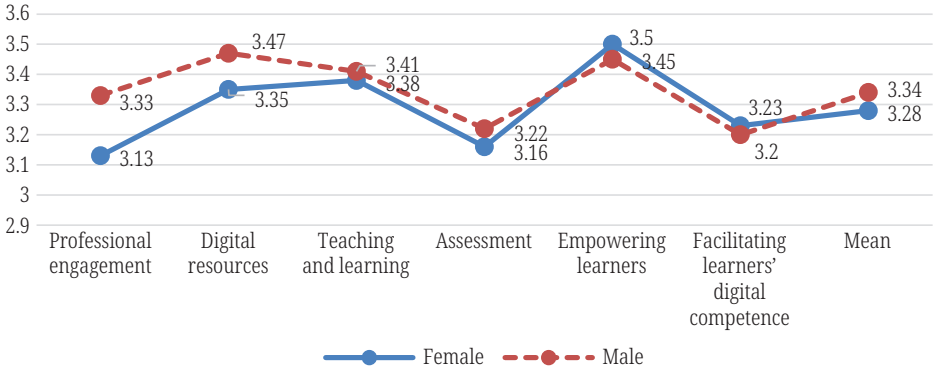

Fig. 4. The chart depicts the average values of digital competence areas by gender

Digital Competence and Age. Table 4 provides descriptive statistics for the variable "Digital Competence and Age" broken down by age group. The table shows the count, mean, standard deviation, standard error, and 95% confidence interval for the mean, minimum, and maximum values for each age group.

Table 4. Descriptives

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Under 25	51	3.2371	.61767	.08649	3.0634	3.4108	2.05	4.77
25–29	106	3.3671	.58070	.05640	3.2552	3.4789	2.23	4.73
30–39	163	3.2493	.49302	.03862	3.1730	3.3256	2.23	4.59
40–49	106	3.3298	.58028	.05636	3.2180	3.4415	2.14	4.55
50–59	19	3.2464	.46977	.10777	3.0200	3.4728	2.59	4.36
Total	445	3.2950	.55023	.02608	3.2437	3.3463	2.05	4.77

Looking at the mean values, we can see that the highest mean value is for the age group "30–39" with a mean of 3.2493, while the lowest mean value is for the age group "Under 25" with a mean of 3.2371. The mean values for the other age groups fall in between these two values. The standard deviation values show the amount of variability in the data for each age group. The standard deviation values range from 0.46977 for the age group "50–59" to 0.61767 for the age group "Under 25." This indicates that the data for the age group "50–59" is less variable than the data for the age group "Under 25." The 95% confidence interval values show the range of values within which we can be 95% confident that the true population mean falls. For example, for the age group "30–39," we can be 95% confident that the true population mean falls between 3.1730 and 3.3256.

The Levene's test statistic is 1.839 with a significance value (Sig.) of 0.120 > 0.05, indicating that the variances between the different age groups are homogeneous (Table 5). This allows for further analysis of mean differences using One-way ANOVA.

Table 5. Test of homogeneity of variances

Levene Statistic	df1	df2	Sig.
1.839	4	440	.120

The results in Table 6 indicate that the ANOVA results show a significant difference in digital competence scores across different age groups (F = 1.020, p = 0.397).

Table 6. ANOVA analysis

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1.235	4	.309	1.020	.397
Within Groups	133.189	440	.303		
Total	134.424	444			

The summary chart of digital competence statistics by age group is presented in Figure 5.

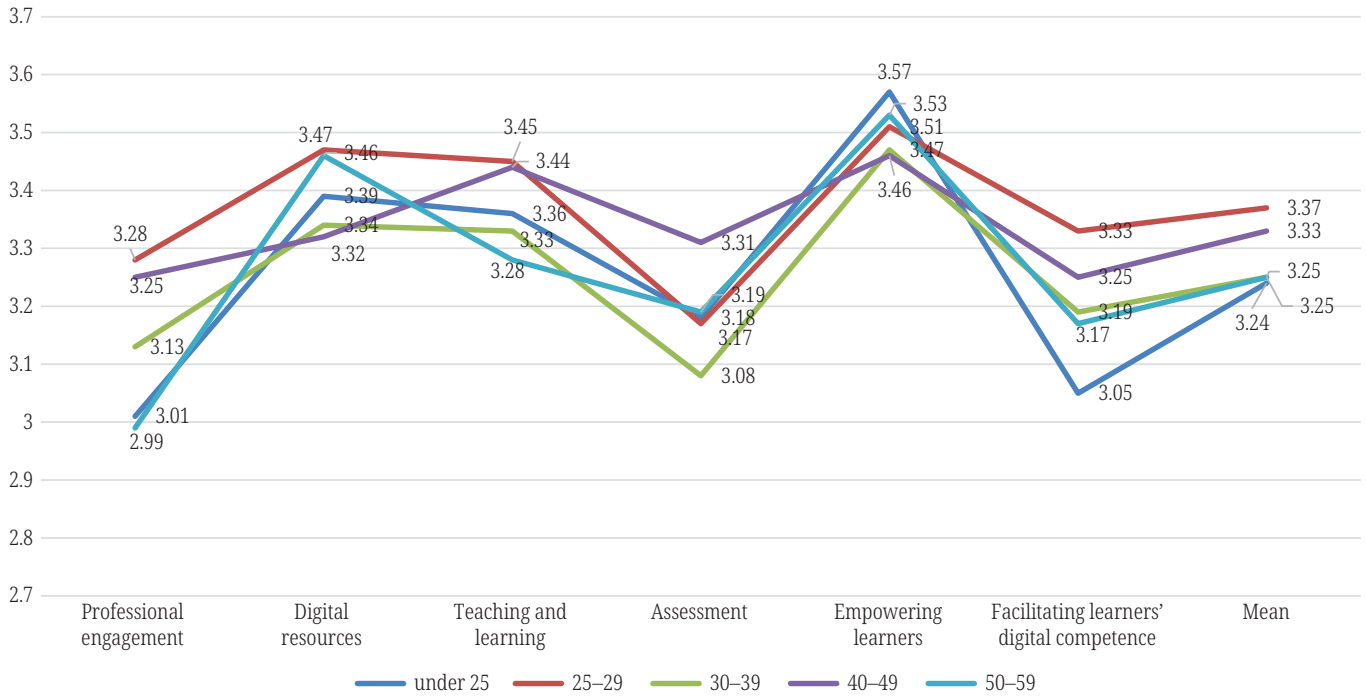

Fig. 5. Digital competencies across age groups

Professional Engagement: The age group under 25 and the age group 30–39 rated this factor the highest, indicating that they consider professional engagement as crucial for digital competency in education. The age group 40–49 also rated professional engagement relatively high, showing a similar level of importance compared to the younger age groups. The age groups 25–29 and 50–59 rated professional engagement slightly lower but still above the mid-point of the scale, suggesting a moderate level of importance for this factor.

Digital Resources: All age groups rated digital resources similarly, with the age group 30–39 giving it the highest importance. The other age groups rated digital resources consistently, indicating a shared perception of its significance in enhancing digital competency in education.

Teaching and Learning: The age group under 25 and the age group 30–39 rated teaching and learning as the most important factor among all categories. The age groups 25–29, 40–49, and 50–59 also rated teaching and learning highly, showing a consensus on its importance across different age groups.

Assessment: The age group under 25 rated assessment as the least important factor compared to the other age groups. The age groups 25–29, 30–39, and 40–49 rated assessment at a similar level, indicating a shared perspective on its importance. The age group 50–59 rated assessment slightly higher than the younger age group, but still lower than the other middle-aged groups.

Empowering Learners: These factors received relatively consistent ratings across all age groups, with minor variations indicating a general consensus on their importance in fostering digital competency in education.

Facilitating Learners' Digital Competence: This area of digital competence shows the most significant difference among age groups. The 25–29 age group exhibits the highest digital competence in this area, indicating that this age group possesses many skills to enable students to use technology creatively and responsibly in their learning process. Interestingly, although the under 25 age group has the best competence in the "Empowering Learners" area, they have the lowest competence in the "Facilitating Learners' Digital Competence" area.

Overall, the ANOVA analysis suggests that there is a significant difference in digital competence scores across different age groups, but the differences are relatively small. The descriptive statistics in Table 5 show that the mean digital competence scores are relatively similar across different age groups, and the Levene test in Table 6 suggests that the assumption of equal variances is met. Therefore, the ANOVA results in Table 6 can be interpreted with some confidence.

5 DISCUSSION

The DigCompEdu tool is highly suitable for assessing the digital competence of teachers for various purposes and different teacher populations. For example, Melo and Coutinho used it to assess the digital skills of computer science teachers [33], evaluate digital competence of teachers in the context of educational innovation [34], assess digital skills in teacher training [35], and compare the digital competence of STEM teachers using DigCompEdu [5].

However, there are very few studies assessing the digital competence of secondary school teachers. The results of this study show that the majority of teachers teaching at secondary schools in Hanoi, Vietnam, have digital competence at the B2 level. Regarding specific digital competences, the ability to use technology in teaching, stimulate student engagement, and use technology to solve challenging problems are the highest-scoring digital competences. This conclusion is also consistent with the study by [36], which found that teachers have the best digital competence in selecting digital resources and using technology in teaching.

There is no significant difference when comparing the digital competence of male and female teachers. However, overall, male teachers have slightly higher digital competence than female teachers, with the "Professional engagement" competence area showing the greatest difference. There are two competence areas where female teachers outperform male teachers: "Empowering learners" and "Facilitating Learners' Digital Competence". This conclusion is also consistent with the study by [37] which suggests that digital competence is independent of gender, and there is no difference in digital competence between males and females [38].

There is a significant difference when comparing the digital competence of teachers across age groups. The age group 25–29 demonstrates higher digital competence than other age groups, which aligns with the findings of other studies. For instance, Guillén-Gámez suggests that teachers with 15 years of experience

exhibit a significant difference in digital competence compared to other age groups [39]. However, Huillca-Huillca's study indicates that teachers aged 31–40 have better digital competence [40]. An interesting observation from the research is that teachers in the under 25 age group have the lowest average digital competence compared to other age groups. When considering specific areas of digital competence, teachers in the under 25 age group exhibit uneven digital competence across different competence areas. While they have the highest average digital competence in empowering learners, they have the lowest competence in creating conditions for learners' digital competence development. This finding raises questions about the effectiveness of current teacher training programs in equipping younger educators with the necessary digital skills. It is essential for educational institutions and policymakers to tailor professional development initiatives to address the specific needs of different age groups and ensure that all teachers receive adequate support to enhance their digital proficiency.

Assessing teachers' digital competence is crucial. The results of this study serve the development of teachers' digital skills, emphasizing the importance of assessing teachers' digital competence to identify areas for improvement and inform the development of targeted training programs. By understanding teachers' strengths and weaknesses in relation to digital skills, educational authorities can implement strategies to enhance overall teaching quality and students' learning outcomes. This underscores the importance of continuous assessment and professional development opportunities for educators to foster a culture of continuous improvement in the education sector. This assertion is also consistent with several studies deploying the assessment of teachers' digital competence, such as aiding in determining the level of teachers' digital skills prior to service, enabling targeted interventions and support [41]. Evaluating teachers' digital competence within the context of digital education and pedagogical activities can provide insights for the development of effective training programs and tools [42]. Assessing teachers' digital competence can help identify areas lacking skills and the use of digital technology, offering profound insights for professional development and training. Assessing teachers' digital competence can provide a more detailed overview of strengths and weaknesses, allowing for personalized support and improvement [43]. Assessing teachers' digital competence is crucial for the successful implementation of digital technologies in education and creating a digital educational environment [44].

Overall, the findings of this study provide valuable insights into the digital competence of secondary school teachers in Hanoi, Vietnam, and underscore the importance of ongoing professional development and support to enhance teachers' capabilities in utilizing technology for effective teaching and learning. By investing in the digital skills of educators, educational institutions can empower teachers to adapt to changing educational paradigms and prepare students for success in the digital age. It is crucial for educators to continually improve their digital competence to keep pace with the evolving landscape of education and meet the demands of 21st-century learners.

6 CONCLUSION

Assessing the digital competence of secondary school teachers in Hanoi, Vietnam, using DigCompEdu has illuminated the current landscape of teachers' technology utilization in their professional roles. The findings underscore the importance of assessing and enhancing teachers' digital skills to meet the developmental demands of

education in the digital era. The majority of teachers demonstrated a moderate level of digital competence, indicating a foundational understanding of digital technologies. However, there is room for improvement, particularly in addressing the needs of younger educators who exhibited lower and uneven levels of digital proficiency. This highlights the necessity of tailored professional development programs to support teachers of all ages in enhancing their digital skills and integrating technology effectively into their teaching practices. The study demonstrates the importance of investing in improving teachers' digital competence to help them navigate digital tools, engage students innovatively, and create dynamic learning environments. Through this, educational institutions can foster a culture of continuous improvement and ensure that teachers are equipped to face the challenges of 21st-century education.

Moving forward, it is crucial for policymakers, educational leaders, and teacher training programs to prioritize the development of teachers' digital skills and provide the necessary support for professional growth. By equipping teachers with the tools and knowledge to leverage technology effectively, schools in Hanoi and beyond can enhance teaching quality, student engagement, and overall educational outcomes. The results of this study serve as a call to action for stakeholders in the education sector to collaborate on initiatives that promote digital literacy among teachers, empower educators to embrace innovative teaching practices, and create a learning environment that prepares students for success in an increasingly digital world. By fostering a culture of digital competence and continuous learning, educators in Hanoi can play a pivotal role in shaping the future of education and equipping students with the skills they need to thrive in the digital age.

7 LIMITATIONS

This study was conducted with 445 teachers teaching at secondary schools in Hanoi, analyzing the relationship between gender and digital competence, as well as between age groups and digital technology. However, the study did not address the relationship between teachers' digital competence and the subjects they teach. Additionally, although there was an assessment of digital competence by age group, the study did not investigate the development of teachers' digital competence during their tenure, thus failing to assess the role of training and self-learning among teachers in their professional development process.

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