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The Influence of Gender and Training Sector on the ICT Competency of Pre-Service Teachers in Vietnam: Using the UNESCO ICT Competency Framework

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Abstract. Information and communication technology (ICT) is a powerful educational change and reform tool. Teachers are a direct subject in promoting the application of information technology (IT), and the ability to integrate technology into teaching affects the application of IT in

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teaching. Integrating ICT into education requires teachers to be competent in using ICT. In other words, teachers are required to have sufficient ICT competence to use ICT for education. Faced with this requirement, teacher training schools have made positive changes to improve the ICT capacity of pedagogy students and prepare graduates to perform their duties in the context of digital transformation in education today. This study collected information on pre-service teachers' competency in using ICT as future teachers in Vietnam. Using the ICT competency framework of UNESCO, the research surveyed 1698 fourth year teaching students (pre-service teachers) from 10 provinces in 3 regions of Vietnam. The results indicate that although pre-service teachers in Vietnam are well educated on ICT policy issues in education, for the issue of ICT exploitation to support curriculum implementation and assessment, they still need ICT skills to support effective teaching and learning methods. In addition, there are significant differences in gender and training specialization in some aspects, such as the application of digital skills and the use of ICT in organization and administration. These results are the basis for in-depth research into establishing influencing factors and measures to improve the ICT application competency of pre-service teachers, contributing to ensuring the quality of education in Vietnam.

Keywords: assessment competency; gender; ICT competencies; pre-service teacher; training sector; Vietnam

1. Introduction

Information and communication technology (ICT) is considered a powerful tool for educational change and reform, especially in the context of digital transformation (Dao et al., 2023; Mospan, 2023). Indeed, several previous studies have shown that the appropriate use of ICTs can enhance the quality of education and connect learning with real-life situations (Njoku, 2015). In the 21st century of higher education, mastering ICT to shape students' digital competence plays a significant role (Dai & Marquet, 2019). ICT helps to transform the teaching environment into a learner-centered one (Castro Sánchez & Chirino Alemán, 2011), where learners actively participate in classroom learning processes with ICT applications, making decisions and learning plans (Lu et al., 2010).

Teachers are a direct subject in promoting the application of information technology (IT), and the ability to integrate technology into teaching affects the application of IT in teaching. Integrating ICT into education requires teachers to be competent in using ICT. In other words, teachers must have sufficient ICT competence to use ICT for education (Aslan & Zhu, 2017). The UNESCO ICT Competency Framework for Teachers (ICT−CFT) published by UNESCO in 2018 outlined three successive stages of teacher professional development: understanding technology, deepening knowledge and creativity, and raising standards and requirements for teachers in integrating ICT into classrooms for effective teaching (UNESCO, 2018). Teacher ICT competency is essential to maintaining and developing their career (Rana et al., 2022).

There have been many studies related to the assessment of ICT-use capacity for different audiences: elementary, middle, and high school students (Siddiq et al., 2016); university students (Burns et al., 2023; Casillas Martín et al., 2020; Nwosu et al., 2018); trainee teachers (Mat-Jizat & McKay, 2011); lecturers (Hafifah & Sulistyo, 2020); and teachers (Pourkarimi & Nazarzadeh Zare, 2016). Studies have used many approaches to assess ICT capacity. These include understanding comprehension of ICT with simulation-based tasks (Senkbeil & Ihme, 2020) and using the Internet-based self-service technology (ISST) model in assessment (Pourkarimi & Nazarzadeh Zare, 2016). These studies have shown that ICT literacy development is essential to lifelong learning and is of concern to universities and higher education institutions worldwide.

Pedagogy students must have high levels of ICT competency because ICT is essential in modern education. Faced with the continuous development of technology, ensuring the ICT competency of pedagogy students is an advantage and a requirement to ensure learning quality and prepare them for future participation in the 4.0 educational environment. Most of the studies on the assessment of ICT-use competency were conducted in developed countries. Examples include an analysis of essential issues in training the ICT competency of pre-service teachers (Belgium) (Tondeur et al., 2018); changes in the ICT competency model of pre-service teachers; and digital reading and learning experiences of pre-service teachers (Poland) (Tomczyk, 2020); and the relationship between pre-service teachers' ability to use ICT and their beliefs; and planning strategies to improve the IT capacity of pre-service teachers (Finland) (Valtonen et al., 2015). There are only a few research results on this topic in developing countries, except for Türkiye. Research directions here include investigating the readiness of the pre-service teacher to integrate technology into education (Cuhadar, 2018), gender issues when accessing energy using IT (Çoklar, 2014), and factors affecting the use of ICT in education for the pre-service teacher (Tezci, 2011).

In Vietnam, applying and using technological equipment in teaching and education is a criterion for determining the professional standards of general teachers. Before this requirement came into effect, studies had been conducted on developing the capacity to use ICT in specific subjects, such as mathematics (Ban & Thao, 2018), or on building a competency framework for applying ICT in teaching chemistry pedagogy students (Minh & Bieu, 2016).

Although a few studies have evaluated the competency to use ICT for pre-service teachers in Vietnam, a developing country, more general and inclusive research is still needed. Research on the ICT competency of pedagogy students in Vietnam will help supplement the research results on ICT competencies for students in other developing countries. In addition, the recommendations from the research results can also be a suitable reference source for other developing countries in the region and around the world. Based on research on the ICT competency of teachers, in this study, we build an ICT competency framework for pre-service teachers suitable to the context in Vietnam. We use the framework to survey and

evaluate the competency of pre-service teachers to use ICT. The research attempted to answer the following questions:

1. Is the ICT application competency of pre-service teachers in Vietnam guaranteed to meet the general requirements of the UNESCO ICT−CFT?
2. Are there any significant differences between genders and training sectors in the ICT-use competency of pre-service teachers?

2. Literature Review

2.1 ICT as a Trend in Modern Education

In the context of Industry 4.0, digital transformation with the integration of digitization, hyper connectivity, and intelligent data processing is taking place in the world at a fast pace. It is becoming an inevitable trend, helping to increase labor productivity, promote innovation, and enhance national competitiveness (Schwarzmüller et al., 2018). Many countries have launched specific strategies and action plans on digital transformation in various fields (Gray & Rumpe, 2017).

Reality shows that digital transformation has become a priority for higher education institutions in the second decade of the 21st century. In addition, it is a necessary natural process for organizations that claim to be leaders of change and that are highly competitive in their field (Barzman et al., 2021). In particular, in the context of the complicated development of the Covid-19 pandemic, which has directly affected all aspects of life, the importance of digital transformation is increasingly affirmed (Marks et al., 2020). This challenge is urgent for higher education institutions as they ever-increasingly strive to secure a competitive position in the global market to select the best students and researchers (Faria & Nóvoa, 2017). UNESCO believed that ICT will be fundamentally, systematically, and highly integrated into education through the provision of ICT competency frameworks for teachers (e.g., the ICT-CFT) (Fallis, 2018). These frameworks aim to help countries develop comprehensive ICT competency policies and standards for teachers.

In Vietnam, with the trend of internationalization of education, the government has also launched a project to increase the integration of IT in education. The project contributes to modernizing and improving the quality of education and training or implementing tasks and solutions to promote the management and administration activities of the Vietnam Ministry of Education and Training (MoET) in the digital environment (Vietnam MoET, 2020a). The Vietnam Ministry of Information and Communications (2014) has researched and issued regulations on IT skills, including six basic and nine advanced skill standards.

2.2 Pre-Service Teachers' Competence to Use IT is Considered a Component of Professional Competence

The consideration of pre-service teachers' ability to use IT as a component of their professional competence has attracted much interest from scholars worldwide. Many studies have been conducted on developing the IT capacity of students in general and the pre-service teacher in particular. This includes research on implementation planning strategies to improve the capacity to develop IT for pre-service teachers (Lim & Pannen, 2012), the readiness of pre-service teachers to

integrate technology in education (Cuhadar, 2018), and the impact of authentic learning experiences with IT in the teaching and learning of pre-service teachers (Valtonen et al., 2015). In Vietnam, research has also taken interest in developing the IT competencies of pre-service teachers of different disciplines, such as mathematics and chemistry (Ban & Thao, 2018; Minh & Bieu, 2016).

To assess the multidimensionality of the ability of pre-service teachers to use IT, a variety of research methods have been used, such as quantitative methods (Tezci, 2011; Tondeur et al., 2016), qualitative methods (Tomte, 2013; Tondeur et al., 2016), or a combination of qualitative and quantitative research methods (Xiong & Lim, 2015).

Studies have shown that pre-service teachers feel confident, value using ICT in teaching, and believe that they have the necessary skills to use ICT. However, in most cases, new pre-service teachers use ICT applications at a basic level (Tezci, 2011). In addition, the use of new ICTs is limited to lesson preparation (word processing, presentation software) and personal communication (email) (Aslan & Zhu, 2016; Tezci, 2011).

Many study results indicate that pre-service teachers need help integrating technology into the teaching and learning process (Tezci, 2011). Barriers to ICT integration among pre-service teachers in learning and teaching are believed to stem from their lack of understanding of IT (Lawrence & Tar, 2018; Tezci, 2011) as well as lack of trust, inexperience, and lack of ICT skills (Aslan & Zhu, 2015); lack of access to technology; or insufficient time to access IT or lack of skills to access IT (Aslan & Zhu, 2015). The relationship between gender and IT capacity has also been mentioned in many studies (Cuhadar, 2018; Tezci, 2011). However, the results of most studies show that gender does not have much influence on IT skills or the level of ICT use in teaching (Tezci, 2011). Furthermore, there needs to be more support organizations, and schools need more IT equipment. Incompetent ICT teachers and outdated views on using ICT in teaching are also considered influencing factors (Tomte, 2013).

The impact of subjective and objective factors is considered to improve the capacity of pre-service teachers to use IT. Subjectively, pre-service teachers should be provided with more opportunities to use IT in their courses to become competent users of IT integration in education (Aslan & Zhu, 2015). Furthermore, the objective factors to consider include lecturers with IT competence (Aslan & Zhu, 2015) and school environment and school support (class size, modern facilities, Internet, IT training on IT and sharing experiences in IT use, etc.) (Aslan & Zhu, 2015; Tezci, 2011). Recent studies have shown that to improve the competency of pre-service teachers to use IT, focus must be placed on improving the awareness, attitudes, and skills of pre-service teachers on integrating as well as applying IT in teaching (Aslan & Zhu, 2015; Tezci, 2011). Additionally, developing teacher training programs that integrate IT applications positively influences pre-service teachers' competency in using ICT (Tomte, 2013; Tondeur et al., 2012, 2018).

Thus, assessing the IT capacity of pre-service teachers will help higher education institutions detect the current situation and build plans to develop the IT capacity of students more effectively and in response to social needs.

3. Method

3.1 Participants

This study was a quantitative cross-sectional study. A multistage stratified sampling method was used to select the sample. First, we selected the universities that would participate in the survey. We sent the online survey as a link to 2050 final year students from 10 universities in Vietnam, including 4 universities of education and 6 multidisciplinary universities with pre-service teacher training. Surveying all universities in the country was not feasible due to time and resource constraints. Hence, universities were selected based on their representativeness in education (the universities of education and multidisciplinary universities have pre-service teacher training); number of years of establishment (newly opened, long-standing university); scale (large, small university); and geographical location (northern, central, or southern Vietnam).

3.2 Research Tools

The UNESCO ICT−CFT was proposed by UNESCO in 2008. The framework was adjusted and supplemented in 2011 and 2018. The six areas in the capacity framework proposed by UNESCO are diverse, requiring tools and theoretical understanding, policies, and applying those tools in teachers' specific activities. In addition, the requirement for teachers' ICT competency in teaching is only at the level of proficient and effective use of existing equipment. It encourages the level of creativity and creation of new things based on the level of creativity in practical requirements. In this study, we used the UNESCO ICT−CFT version 3 proposed to assess the IT competency of students (UNESCO, 2018).

The survey form consists of two parts. The personal information section includes four questions about gender, ethnicity, training sector, and university. The content section consists of 84 questions designed on a Likert scale of 5 levels, from 1 (*completely inappropriate*) to 5 (*completely suitable*), to measure the 6 aspects of students' ability to use IT. These aspects are: 1) understanding of ICT policy in education; 2) understanding of ICT exploitation to support curriculum implementation and assessment; 3) pedagogy; 4) application of digital skills; 5) organization and administration; and 6) the professional learning of teachers. The aspects have between 6 to 25 questions each. Students could complete the online survey through Google Forms to evaluate the above six aspects; with each question, students had to select the level most suitable to them out of the five proposed levels.

3.3 Data Collection

The study was conducted with the voluntary consent of the surveyed students. It was clearly indicated that the survey's purpose is purely scientific, not for profit purposes, and that the opinions of the survey respondents will be kept entirely confidential. The students who participated in the survey were guided by the class

lecturer to complete the survey and rate the content of the 84 questions using the Likert scale.

3.4 Design and Analyses

The questionnaire was coded and the data captured using Excel and SPSS software version 25.0. We cleaned the data using the frequency command in SPSS to filter entered values that were invalid (values outside the conventional values) and then compared it with the original answer sheet to check the accuracy of the data. After cleaning the data set, data analysis was conducted to verify the scale. This study used descriptive statistical analysis methods to analyze information about the surveyed subjects and analyze data on the ICT-use capacity of pedagogy students. Next, we used inferential statistical analysis through parametric (*t*-test and analysis of variance [ANOVA]) and non-parametric (Mann–Whitney and Kruskal−Wallis) tests to determine the differences.

4. Results and Discussion

The study obtained 1737 responses from university students via the survey link. Cleaning the data involved removing the questionnaires where not all survey items had been answered and where wrong answers not included in the questionnaire had been entered. This left 1698 eligible questionnaires to use for data analysis.

4.1 Descriptive Statistics

Table 1 presents respondent data regarding university, gender, and ethnicity.

Table 1: Respondent demographic information

No	Region of Vietnam	University	Gender		Ethnicity		Total
			Male	Female	Ethnic minority	Kinh	
1	Southern	An Giang University	33	242	17	258	534 (31%)
2		Can Tho University	21	111	17	115	
3		Tra Vinh University	10	117	20	107	
4	Northern	University of Education − Hanoi National University	7	115	10	112	596 (35%)
5		Hung Vuong University	2	113	24	91	
6		University of Education − Thai Nguyen University	21	117	37	101	
7		Hanoi National University of Education 2	19	202	24	197	
8	Central	University of Education, University of Da Nang	3	99	15	87	568 (34%)
9		University of Education, Hue University	2	96	14	84	
10		Vinh University	10	358	78	290	
Total			**128 (7.5%)**	**1570 (92.5%)**	**256 (15.1%)**	**1442 (84.9%)**	**1737 (100%)**

The results in Table 1 show an unequal distribution of respondents in the 10 surveyed universities regarding gender and ethnic composition. Specifically, out of the 1698 questionnaires completed, only 128 were completed by male students (accounting for 7.5%). One of the basic characteristics in the pedagogy profession in Vietnam is that women consistently make up the majority of university teachers and the majority of human resources in pedagogy (Vietnam MoET, 2020b). Regarding the ethnic composition of the sample, the Kinh ethnic group, which is the majority ethnic group in Vietnam (Vietnam Committee for Minority Affairs & General Statistics Office, 2020), dominated, with 84.9%; other ethnic minorities accounted for only 15.1% of the sample. This proportion is also consistent with the characteristics of the students studying at the 10 universities in the 3 regions of Vietnam where this survey was conducted.

Figure 1 is a graphical distribution of respondents according to university and training sector.

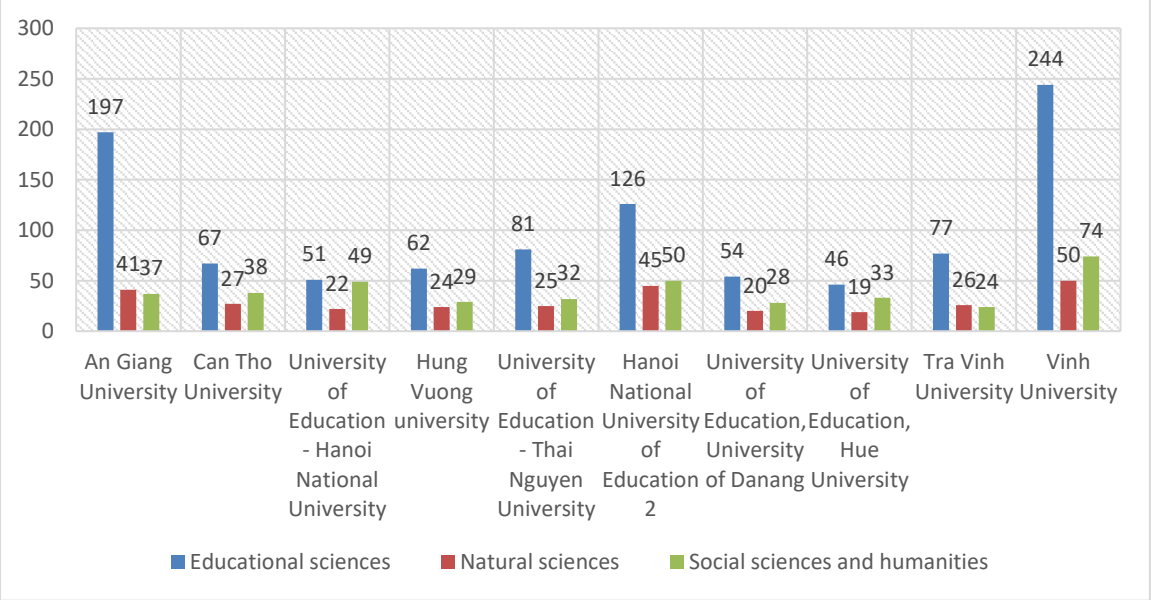

Figure 1: Graphical distribution of respondents according to training sector

Respondents were relatively equally distributed across the three study regions. Approximately 35% (n = 596) of respondents were from the northern region. Four of the universities are in this region: University of Education − Hanoi National University; Hung Vuong University; University of Education − Thai Nguyen University; and Hanoi National University of Education 2. The central region accounted for 33% (n = 568) of respondents. Universities in this region included the University of Education, University of Da Nang; University of Education, Hue University; and Vinh University. Lastly, the southern region accounted for 31% (n = 534) of respondents. The three universities in this region were An Giang University, Can Tho University, and Tra Vinh University.

Regarding distribution across training sector, educational sciences accounted for the most significant proportion of the sample, with 59% (n = 1005). The training

sector with the lowest proportion of respondents was natural sciences, accounting for 18% (n = 299).

The competencies of participating pre-service teachers in using ICT in digital transformation were assessed according to the six aspects of the ICT−CFT. Table 2 presents the descriptive statistics attained for these aspects.

Table 2: Descriptive statistics regarding use of ICT in digital transformation

Aspect	Mean	Std. deviation
Students' understanding of ICT policy issues in education	3.52	0.99
Students' understanding of ICT exploitation to support curriculum implementation and assessment	3.56	0.94
Pedagogy	3.59	0.95
Application of digital skills	3.65	0.93
Organization and administration	3.47	1.01
Student career learning	3.63	0.95

The information presented in Table 2 shows that the majority of the surveyed pre-service teachers agreed with the statements about the suitability of the six aspects. This is especially true for the aspect of applying digital skills, which received the highest mean value (M = 3.65). This aspect relates to assessing the appropriateness of using IT equipment and computer software to manage teaching and learning activities. This aspect represents the degree to which a combination of digital tools and resources is used to create an integrated digital learning environment that supports students' problem-solving and higher order thinking skills and the ability to apply digital platforms in teaching and learning. This result shows that the surveyed universities respond quite well to using digital skills in learning and teaching activities. This result is similar to the study of Ban and Thao (2018), who conducted a survey examining the ICT capacity of students majoring in mathematics pedagogy at An Giang University. The results show that the aspect of application of digital skills achieved the highest level of competence compared to the other aspects.

Figure 2 illustrates the competency of respondents in the use of ICT in relation to the six aspects as distributed across northern, central, and southern Vietnam. Results show that respondents in all three regions had an appropriate level of assessment, that is, the learning activities of students at universities that demonstrate their competency to use ICT are quite effective. Southern Vietnam performed best in all aspects, especially in applying digital skills, followed by pedagogy and student career learning. The results for central Vietnam and northern Vietnam are similar.

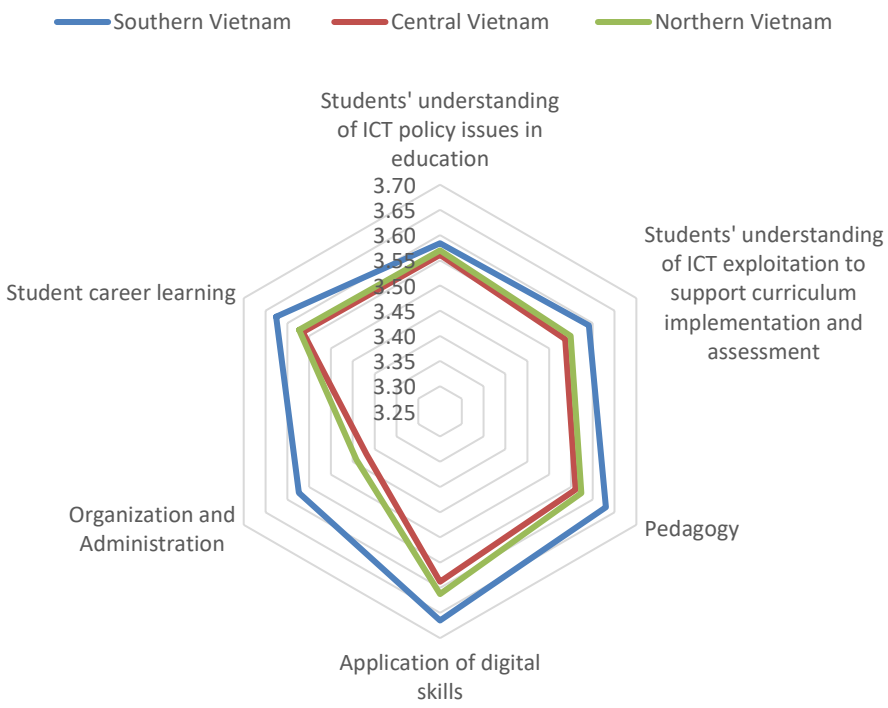

Figure 2: Competency of respondents in the use of ICT across the three study regions

The aspect of applying digital skills in teaching received the highest effectiveness rating among the six aspects in all three regions. This is entirely relevant because, in the teacher training programs of the universities, these issues have been identified in the output standards for pre-service teachers on their ability to apply IT in teaching and education. The difference in efficiency level between the three regions is most evident in the organization and administration aspect, which is the organization and administration evaluation aspect. This result is quite consistent with the regional characteristics in Vietnam in terms of accessing, investing in, and supporting ICT development in universities in southern Vietnam that take place earlier and more synchronously than in the universities in northern and central Vietnam. Respondents' understanding of the aspect of ICT policy issues has the slightest difference, showing that the evaluations of ICT policy issues in education in the three regions are relatively uniform. This is because although there are policies on IT and the application of IT in teaching, which are national uniform regulations, there are still specific characteristics in localities (due to the influence of local laws) that influence the socio-economic development of regions.

However, the descriptive statistical analysis was not sufficient to determine whether there is any difference in ICT-use capacity between male and female students and between students specializing in different training sectors. As such, inferential statistical analysis was employed to indicate differences between the major groups in terms of ICT competency.

4.2 Inferential Statistics

Tests of difference were performed to determine the normal distribution of the six aspects (i.e., aspects of ICT-use capacity) by gender and training sector. We used the Kolmogorov−Smirnov and Shapiro−Wilk tests to confirm the normal distribution with a suitable sample size (from 4−2000) (Patrício et al., 2017). The results indicate that for all aspects by gender and training sector group, data were not normally distributed (sig. = 0.000 < 0.05). Therefore, we used the Mann−Whitney and Kruskal−Wallis tests as alternative to the parameter test (*t*-test, ANOVA) to compare the difference in ICT-use capacity between genders or training sectors.

Table 3 presents the results of the Mann−Whitney and Kruskal−Wallis tests to examine the competency of respondents in using ICT according to gender and training sector, respectively (Table 3).

Table 3: Mann−Whitney and Kruskal−Wallis test results for the six aspects in relation to gender and training sector

Aspect	Gender	Training sector
	Sig.	Sig.
Students' understanding of ICT policy issues in education	.636	.001
Students' understanding of ICT exploitation to support curriculum implementation and assessment	.689	.000
Pedagogy	.757	.000
Application of digital skills	.014	.000
Organization and administration	.000	.000
Student career learning	.102	.93

Regarding gender, four of the aspects, namely students' understanding of ICT policy issues in education; students' understanding of ICT exploitation to support curriculum implementation and assessment; pedagogy; and student career learning all have a significance value > 0.05. This shows that there is no difference in the mean value for male and female respondents in the assessment of understanding of policy issues. Although there is no difference in the mean values between the two genders in relation to these four aspects, there is a significant difference in the number of surveyed female students compared to male students. The remaining two aspects, that is application of digital skills and organization and administration, have a significance value < 0.05. This shows a significant difference in the assessment of male and female respondents in relation to applying digital skills and organizational management. In addition, the average values for male respondents for application of digital skills and organization and administration are higher than that for female respondents, showing that the male respondents' suitability assessment is higher than that of the female respondents.

Concerning training sector, the aspects of students' understanding of ICT policy issues in education; students' understanding of ICT exploitation to support curriculum implementation and assessment; pedagogy; application of digital skills; and organization and administration all have significance values = 0.000 < 0.05. This shows that there is a difference between sectors

regarding respondents' assessment in aspects in demonstrating their ability to use ICT. Specifically, the results in the mean rank show that the natural sciences group has the highest mean value, and the social sciences and humanities group the lowest. The aspect student career learning has a significance value = 0.93 > 0.05, which means that there is no difference in the assessment of respondents across the three training sectors.

The research results show that the general requirements for pre-service teachers' competencies to use ICT in the context of digital transformation in Vietnam include six components of competence: (1) students' understanding of ICT policy issues in education, (2) students' understanding of ICT exploitation issues to support curriculum implementation and assessment, (3) pedagogy, (4) application of digital skills, (5) organization and administration, and (6) student career learning. The ICT-use competencies of the surveyed pre-service teachers in universities in Vietnam was rated at a high level, with capacity aspects reaching average values of 3.5 to 3.72 on a 5-point Likert scale. The southern region achieved the best performance in all aspects, especially in the fourth aspect (application of digital skills), while the results for the central and northern regions were similar. The high value for this aspect is because pedagogy students have an excellent ability to use IT equipment and computer software in managing teaching and learning activities. In addition, they possess the ability to use a combination of digital tools and resources to create an integrated digital learning environment that supports students' higher order thinking and problem-solving skills. Furthermore, they are able to utilize digital platforms in teaching and learning. This is the foundation for encouraging solutions to support students' self-study and self-research with the support of digital technology, which is also suitable for digital transformation at universities in Vietnam. The research results provide scientific bases and valuable suggestions for curriculum development, training modules, programs, and professional training activities related to the use and application of ICT for universities of pedagogy. Mainly, learning must focus on practice and access to new requirements of the labor market.

Significant differences in gender and training expertise affect the preparation and readiness of pedagogy students to integrate ICT into education. Female students often face challenges with confidence in using ICT, while male students may face pressure related to new and advanced techniques. Diversity in training expertise also creates heterogeneity in ICT skills and understanding. This requires training and support to provide pedagogy students with an in-depth understanding of ICT and the social skills to apply it effectively in an educational environment. Awareness and support from the university and teaching community are also essential to promote the readiness and confidence of pedagogy students when integrating ICT into teaching.

Based on the results of the difference between male and female respondents in the competency to use ICT, especially for the aspects of applying digital skills and organization and administration, it is necessary to have solutions that are more suitable for female students. This may include strengthening instruction in skills in using IT devices and computer software in teaching and learning management

activities; creating a positive learning environment that uses a combination of digital tools and resources to support students' problem-solving and higher order thinking skills; and increasing ability to employ digital platforms in teaching and learning.

Regarding the difference between groups of training sector majors, it is necessary to implement methods and programs suitable for different groups of students. Students in the humanities and social sciences must be motivated to enjoy the learning process and perform learning tasks. In addition, learning environments must be fostered that focus on establishing connections between the application and usefulness of ICTs to enhance the effective use of ICT competencies.

5. Conclusion

The ICT capacity of individuals in the current period is one of the important factors in assessing their competency to work and adaptability in a new environment. Therefore, it is necessary to consider the issues of improving ICT competency and ensuring that the information literacy requirements of students, especially pre-service teachers, are met before graduation. This will provide society with high-quality human resources, responding to rapid changes in all fields and industries in the context of Industrial Revolution 4.0.

In this study, the influence of gender and field of training on the ICT competencies of pre-service teachers in Vietnam, assessed through the UNESCO ICT−CFT, emphasizes the complexity and multifaceted nature of integrating technology into education. Initial results show that the ICT capacity of pedagogy students in Vietnam is average. Gender disparities highlight the need for targeted support to address gaps in trust and skills, while differences in training areas highlight the importance of diverse approaches to ICT education.

The study had several limitations. First, the time for conducting the research was limited. Second, although the research team tried to assist students who responded to the survey to understand the meaning of items in the questionnaire, some students still answered some questions without thoroughly considering them, which may have affected the statistical results. Third, within the scope of the study, we did not do an in-depth correlation or multiple regression analysis for the collected data.

Therefore, in the future, the research team will continue developing research directions on students' ICT competence at non-pedagogical schools, including inferential statistical analysis methods related to correlation and multiple regression. From there, research can consider whether the ICT capacity of Vietnamese students differs from that of students from other countries. We will also address questions such as: What factors affect Vietnamese students' ability to use ICT? and: In the context of digital transformation, what aspects of ICT competence should universities in Vietnam focus on to foster in students and teachers? These will be complementary and inherited research directions to develop the research results of this study.

6. Conflict of Interest

The authors disclose that they have no actual or perceived conflicts of interest.

7. Credit Author Statement

TTPT: conceptualization, methodology; NTTH: data curation, investigation; NDHG: writing − original draft preparation; DTMT: visualization, investigation; NDHN: supervision, investigation; HTKL: writing − original draft preparation, validation: HTN: writing − reviewing and editing; NVD: methodology, writing − reviewing and editing.

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