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Digital Competence Framework of University Students Majoring in Economics: The Case of Vietnam

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Abstract. In contemporary society, digital competence (DC) is acknowledged as one of the eight fundamental core competencies necessary for lifelong learning. Within the framework of digital transformation in education, it is imperative for university students to cultivate digital competencies in order to successfully navigate their studies and careers in the current open and global educational landscape. Countries like Vietnam, which are at a later stage of digital transformation, are making strides to establish a digital learning environment. Nonetheless, there is a significant deficiency in data assessing students' digital competencies in accordance with international benchmarks. Consequently, this paper seeks to create a measurement framework for the DC of university students specializing in economics and to investigate the personal factors that affect their DC in Vietnam. The study employs quantitative methods, conducting a survey with 2,379 economics students from three universities in Vietnam. The findings will serve as a foundation for recommending appropriate DC frameworks to enhance the digital skills of economics students in Vietnamese universities.

Keywords: digital competence; digital competence framework; students; university; Vietnam

1. Introduction

The rapid advancement of digital technologies has generated considerable interest in contemporary literature regarding their application for educational purposes (Winkler et al., 2021). Nations and organizations worldwide are striving to ensure quality education and fulfill the United Nations' sustainable development goals. The European Union has initiated the Digital Education Action Plan 2021-2027, aimed at

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fostering a highly effective digital education ecosystem and enhancing digital skills and competencies to adapt to the ongoing digital transformation (European Education Area, 2020). The ASEAN digital transformation report underscores the urgent need for governments to proactively address the economic repercussions of digitalization, and there is a pressing requirement to prioritize education and digital skills training to align with the changing demands of the workforce in various organizations and businesses (Chang & Huynh, 2016). Furthermore, the International Labor Organization has noted that Vietnam is experiencing the most significant employment impact among ASEAN countries, with 70% of workers in basic occupations being affected by digital transformation (Chang & Huynh, 2016). This scenario poses a considerable challenge for higher education in Vietnam, necessitating the training of skilled professionals who can adapt to and excel in utilizing technology throughout the economy's digital transformation.

Currently, university students and learners, in general, are growing up immersed in modern technology platforms (Prensky, 2007) and possess the ability to create and manage content and information, utilize communication tools, and resolve technological issues, rendering them more proficient and competitive in addressing contemporary societal needs (Eger et al., 2018). Furthermore, the COVID-19 pandemic has catalyzed advancements in education, profoundly influencing learning methodologies and pedagogical approaches. However, while university students must acquire digital skills to navigate emerging challenges (Toquero, 2020). A significant number lack the requisite level of digital proficiency (Cabezas-González et al., 2017). This deficiency in DC may hinder their capacity to effectively access information, collaborate in digital environments, and adapt to the requirements of a technology-oriented job market. Students with inadequate digital skills frequently encounter difficulties in self-directed learning and digital problem solving, both of which are essential in higher education and future employment settings. In the absence of sufficient skills, students face the risk of lagging behind academically and professionally.

As highlighted by Vuorikari (2022), DC transcends mere technical ability; it serves as a fundamental skill that shapes how individuals learn, communicate, and function in contemporary society. The cultivation of DC is a critical aspect of lifelong learning and is a matter of concern for universities and higher education institutions globally (Carretero et al., 2017), with numerous countries establishing DC frameworks aligned with their national educational objectives to ensure that learners can fulfill the demands of digital transformation. However, while the DC of university students is a vital element in the new educational paradigm and their academic and career progression, the integration of technology into the classroom and online instruction has not been executed effectively, with only university students possessing higher levels of DC tending to learn more effectively and exhibiting greater enthusiasm for learning (Bergdahl et al., 2020).

While global models such as DigComp and UNESCO's Digital Literacy Global Framework have informed many systems, Vietnam is still in the process of aligning its educational policies and tools with international standards. Based on the 2018 UNESCO report, Vietnam is currently applying three DC frameworks developed by international organizations and enterprises, namely ICDL, IC and Microsoft's S digital competency standard, i.e. Digital Literacy Standard Curriculum (Law et al., 2018). But these DC frameworks are now seen as insufficient for fostering DC in today's environment, as they primarily address basic to intermediate practices and fail to consider the cognitive complexities associated with DC (Bartolomé et al., 2018). These frameworks tend to be tool-focused, concentrating mostly on desktop and laptop usage, while 85% of individuals in the EU now depend on mobile devices for Internet access (Eurostat, 2023).

The DigComp 2.1 framework is presently acknowledged by UNESCO as the most current and thorough DC framework, featuring a series of specific guidance documents. It has been widely adopted and published by numerous higher education institutions globally, making it highly useful for reference, comparison, and application tailored to the practical circumstances of higher education institutions in Vietnam. Nonetheless, despite the introduction of several specialized competence groups in UNESCO's Digital Literacy Global Framework (DLGF), there is a lack of detailed guidance documents on its application and practical declarations regarding its use (Thơ et al., 2021).

Furthermore, while Vietnam's education system is transitioning to a digital learning environment, there is an absence of data to assess students' DC against international standards. Consequently, this paper seeks to establish measurement scales for the DC framework, specifically for university students majoring in economics, drawing upon UNESCO's DC framework within the context of Vietnam's digital economic development. Also, this paper will explore the impact of personal factors such as gender, region, training in information technology and year on digital competence, which will be the novel points of this research.

2. Literature Review

Digital pedagogy theory began to develop in the late 1990s and early 2000s, when information and communication technologies became increasingly popular in education (Sadiko et al., 2019). However, integrating these opportunities into the curriculum and teaching practice is a major challenge. The way in which these tools are applied and implemented seems to be improvised, rather than systematic (Sadiko et al., 2019). The initial obstacles to the incorporation of digital technology in educational settings encompass insufficient resources, time constraints, limited access, and inadequate technical support, with the resulting challenges pertaining to educators' perceptions of digital technology and their instructional practices in the classroom (Prestridge, 2010). Consequently, research focusing on students' DC in the context of teaching and the integration of technology has garnered significant interest

from researchers and empirical investigations. Notably, the exploration of students' views on DC and the actual levels of DC has emerged as a prominent area of study.

In their examination of DC at Northern University of Bangladesh, Chowdhury et al. (2017) raised concerns regarding the DC levels of university graduates. This highlights the necessity for targeted programs and metrics to enhance digital competence, thereby bridging the DC divide across gender and age demographics. Meanwhile, Fleaca and Stanciu (2019) investigated students' perceptions of specific digital skills at Politehnica University, utilizing a survey framework based on the European DigComp DC framework. However, certain competencies, such as the ability to differentiate between reliable and unreliable information, the capacity to create diverse electronic portfolios, and the skill to curate information for personal needs or objectives, received lower ratings. Additionally, other research has focused on particular types of perceptions; for instance, studies conducted at universities in Spain and Italy examined students' communication and collaboration competencies with findings from these studies suggesting that the majority of students possess an average level of digital competence, indicating that they have attained a certain degree of digital proficiency (Llorent Vaquero et al., 2020).

In a study conducted by Almenara et al. (2020), tools for assessing students' DC were examined to evaluate the reliability and validity of the DigCompEdu Check-In questionnaire, which involved student participation. The findings indicate that the DigCompEdu Check is a highly reliable and relevant tool; moreover, the DC scale designed for university students participating in technology-integrated learning shows strong measurement reliability (Wang et al., 2021). The authors developed a digital competency framework based on an initial scale, incorporating 23 indicators derived from prior research on digital competencies conducted at two universities in China. Khan et al. (2021) also based on previous studies on digital competencies, to propose a model consisting of 10 core factors, determining the digital competencies of graduates toward Industry 4.0. However, there are some limitations in the research results in that they only go as far as creating a basis and foundation for educational institutions to build standard training programs for students to meet the necessary requirements of digital competencies and have not yet provided specific indicators according to an international standard digital competency framework. In addition, the research on the digital competency framework according to UNESCO's framework for students in the economic sector has not been empirically verified in universities. Thus, researching the digital competency framework according to international standards and specifying the indicators to measure the digital competency framework for students is the basis for developing modern digital pedagogical theories and methods.

2.1 Digital Competence

Digital competence is intricately associated with digital literacy, often termed media literacy (Martin & Grudziecki, 2006). Digital literacy focuses on practical elements, such as the operational and creative skills essential for the proficient use of digital

technologies (Falloon, 2020; Helsper et al., 2015). While these terms may be used interchangeably at times (Calvani et al., 2012; He & Zhu, 2017), they stem from distinct concepts and possess unique definitions (Iordache et al., 2017). In particular, digital literacy is centered on the skills and tasks necessary to attain DC in information technology (Ferreira et al., 2023). Researchers contend that DC transcends digital literacy by integrating attitudes and mindsets along with skills (Fraillon et al., 2014; Iordache et al., 2017; Jin et al., 2020). Some research advocates the prioritization of digital literacy in educational contexts, as it underscores ethical, safety, and social aspects while encompassing a wider range of knowledge and capabilities (Falloon, 2020; Foulger et al., 2017; Lund et al., 2014).

DC is a complex concept that is widely acknowledged in policy, research, and higher education (Guðmundsdóttir et al., 2020), one which includes the attitudes (A), skills (S), and knowledge (K) required for the effective utilization of digital technology in everyday life (Ferrari, 2012). Recognized as one of eight fundamental life skills, it entails engaging with digital technologies in a confident, critical, and responsible manner to learn, work, and contribute to society (Commission, 2018). Defined by cognitive, attitudinal, and technological capabilities, DC addresses the challenges posed by the contemporary knowledge-based society (Janssen et al., 2013). It goes beyond mere technical skills, incorporating the social and emotional dimensions of digital technology use, thereby linking technical, cognitive, and ethical considerations with integrated skill development.

2.2 Digital Competence Framework

To effectively evaluate and enhance digital skills, various international frameworks have been established. One of the most prominent is the European Digital Competence Framework (DigComp). Since its initial publication in 2013, DigComp has progressed to versions 2.0 and 2.1, providing a detailed model comprising 21 competencies categorized across five domains: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving (Carretero et al., 2017). The introduction of eight proficiency levels in DigComp 2.1 renders it particularly suitable for thorough assessment and incremental development within formal educational contexts (European Commission, 2018). Thus, the digital competency framework serves as a system that outlines the A-S-K essential for individuals to utilize digital technologies effectively, safely, and responsibly in their educational, professional, and everyday activities. Another noteworthy model is the UNESCO Global Framework for Digital Literacy Skills, which was developed in 2018 by integrating insights from 47 frameworks globally (Law et al., 2018) which, while similar in structure to DigComp, model adds a global and inclusive perspective, expanding the competence areas to include career-related digital skills, such as digital financial management and data interpretation (Law et al., 2018). This addition is particularly relevant for economics students preparing for roles in increasingly digitalized financial systems.

A key distinction between the two frameworks lies in their scope. DigComp is granular and progression-focused, supporting curriculum integration and personalized learning paths (Caena & Redecker, 2019), whereas, in contrast, UNESCO's framework emphasizes inclusivity and accessibility, which makes it especially appropriate for diverse educational contexts, including developing countries (Jashari et al., 2021). Some frameworks are designed specifically for students in higher education, such as the Students' Digital Competence Scale (SDiCoS). However, while SDiCoS focuses on practical skills like mobile device use and online learning management (Tzafilkou et al., 2022). It lacks the comprehensive structure and global applicability found in the DigComp and UNESCO models. Given the increasing specialization of economics education, a hybrid approach - leveraging DigComp's depth and UNESCO's career orientation offers an optimal solution. Such a model would align well with the interdisciplinary demands of economics students who must combine technical, analytical, and ethical competencies.

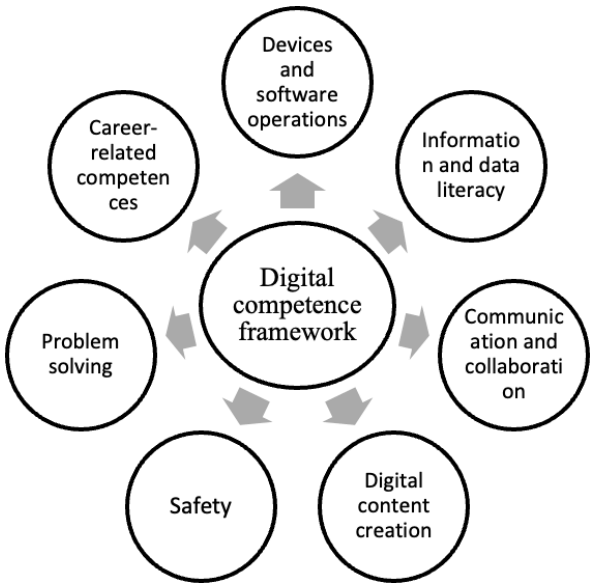

Figure 1: UNESCO Digital Competence Framework: A Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2

In 2018, UNESCO researched and compared more than 47 DC frameworks of different countries and regions around the world to build the global digital literacy framework (Law et al., 2018). UNESCO's digital competency framework was chosen because it broadens the scope of digital competencies by incorporating competencies associated with occupations and the operation of equipment and software, aiming to meet the global and diverse needs of countries, especially developing nations. The framework is inclusive, comprehensive, and adaptable to various educational contexts, assisting in providing learners with the digital skills needed in the era of information technology explosion. UNESCO adopted the European Commission's

DigComp framework after benchmarking 47 international DC models, finding strong alignment (Jashari et al., 2021). Designed for broad application, UNESCO's framework targets individuals aged 15–24 and adults (see Figure 1), covering seven areas: Devices and software operations, information and data literacy, communication and collaboration, digital content creation, safety, problem solving, and career-related competences. This study develops a DC scale for university students majoring in economics, adapting UNESCO's framework to align with their specific academic and professional skill requirements (see Table 1).

Table 1: Measurement Scale of Digital Competence of University Students Majoring in Economics

Digital Competence of UNESCO	Definition	Measurement Scale	Encode
Devices and software operations	"Identify and use data recognition technologies, hardware tools, and digital content to operate tools and technologies"	Comprehensive understanding of the components of a computer and how it is connected to other devices	DSO1
		Well-implementing the operations on electronic devices, login of software, peripheral devices, smart card readers	DSO2
		Proficient in using browsers and digital software/tools for learning	DSO3
		Capable of opening settings and updating applications/ software/ digital devices	DSO4
Information and data literacy	"Identify data needs, locate and access information and digital content; Consider sources and their content; Store, sort and organize data, information and digital content"	Build a personal search plan to find information and digital content	IDL1
		Consider the website's reliability and the currentness of the information	IDL2
		Manage and store information and data online systematically	IDL3
		Backup and restore data on all relevant digital devices	IDL4
	"Ability to interact,	Communicate with people through various digital applications	CC1

Digital Competence of UNESCO	Definition	Measurement Scale	Encode
Communication and collaboration	communicate and collaborate via digital technology, recognizing cultural and generational diversity; Interact via digital platforms and exercise the role of citizen; Self-managed of digital identity and reputation"	Comply with behavioral standards when interacting online	CC2
		Uses different tools to share data	CC3
		Collaborate with people using digital technology	CC4
		Choose appropriate digital tools for collaborative processes	CC5
Digital content creation	"Create and edit digital content. Upgrade and integrate digital information and content into existing knowledge bases; Understand current licenses and copyrights; Understand how to issue commands to a computer system"	Design images, publications, short videos	DCC1
		Proficient in updating and editing digital content	DCC2
		Able to combine different digital content	DCC3
		Use programming languages to create working programs	DCC4
		Aware of and pay attention to copyright and licensing when developing digital content	DCC5
Safety	"Protect devices, personal data and privacy in the digital environment; Protect health and spirit;	Protect data on digital platforms	S1
		Detect risks when accessing digital platforms	S2
		Distinguish appropriate content when sharing to protect privacy	S3

Digital Competence of UNESCO	Definition	Measurement Scale	Encode
	Understand the impact of digital technology on social welfare; Understand the impact of digital technology on the environment"	Establish settings to protect information before sharing it on digital platforms	S4
		Uses environmentally friendly platforms	S5
Problem solving	"Identify needs and issues that need to be solved in the digital environment; Apply digital tools to innovate processes and products; Update the development of digital technology"	Identify and differentiate most technical errors when using digital platforms	PS1
		Be patient when solving a digital problem	PS2
		Fix technical errors when using digital platforms	PS3
		Uses different digital technologies to create innovative solutions	PS4
Career-related competences	"Operate specific digital technologies; Observe, inspect and evaluate information, data and digital content specific to a given field"	Identify digital tools and technologies specific to the field of study	CRC1
		Proficient in operating and using digital devices and specialized software to handle work related to the field of study	CRC2
		Collect and analyze industry-specific data using digital tools	CRC3
		Exploit open data sources to serve the field of study	CRC4

Litina and Miltuze (2023) identified various factors affecting students' digital competence, such as gender, geographic location, technological education, and diverse academic groups. However, the research lacked empirical validation to substantiate the influence of these factors on students' digital competence.

Consequently, this study proposes the following hypotheses:

H1: Digital competence does not significantly differ between male and female students.

H2: Digital competence does not significantly differ between students from rural and urban areas.

H3: Students with information technology training exhibit significantly higher digital competence than those without such training.

H4: Digital competence significantly varies across different academic years.

3. Methods

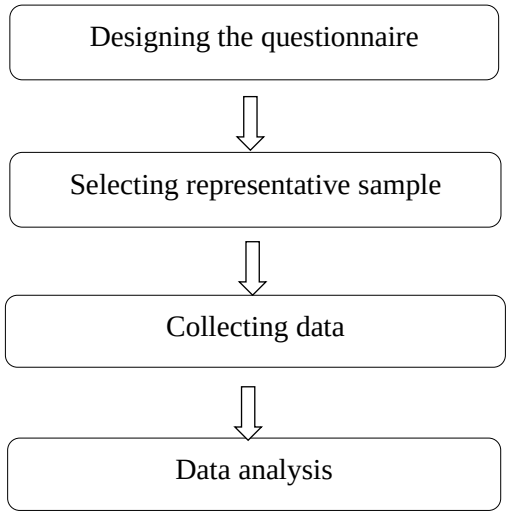

Figure 2: Data Collection Process for Research

The research conducted in-depth interviews with 20 lecturers who are experts in their field from different universities such as National Economics University, Thuongmai University, University of Economics Ho Chi Minh City and several other education institutes in Vietnam. The opinions obtained are the basis for the authors to propose a DC framework for university students from UNESCO's DLGF DC framework. From a theoretical basis, observed variables are built on a 5-level Likert scale for students to evaluate on DC aspects (from 1: very weak to 5: very good).

The authors conducted a preliminary survey of 135 questionnaires for students of three universities. Following the survey, focused interviews were conducted with 32 experts, including 18 lecturers from faculties/institutes of several universities and 14 directors from technology enterprises in Vietnam. From there, the authors combined

collected opinions and proposed an appropriate DC framework as well as built a scale corresponding to the proficiency level of each competence group according to the selected DC framework standards. Data were collected from October 2024 to November 2024. Part 1 included three questions on perceptions of digital transformation, the digital competency framework, and digital competence. Part 2 included 31 questions organized into the seven competency groups (Table 1). Part 3 consisted of four questions on gender, geographical region, information technology training status, and academic year.

Step 2 was selecting a representative sample. Survey participants were selected based on criteria including gender, geographical region, academic year, and whether they had received information technology training, to ensure the representativeness of the study sample. The research had a sample size of 2,658 economics students from typical universities in Vietnam (from the first to fourth years) to ensure the representativeness of the sample (Hair et al., 2019). The survey questionnaires were sent to economics universities across Vietnam: Northern region (National Economics University, Foreign Trade University, Thuongmai University, Banking Academy); Central region (University of Economics – Da Nang, University of Economics – Hue); Southern region (University of Economics Ho Chi Minh City, Academy of Finance, and several other universities). The sample included both male and female students from urban and rural areas to ensure the representativeness of the research.

Step 3 was collecting data. The research used Google Forms to conduct the questionnaire and send it to students through MS Teams, Facebook, and Group Mail. The authors received 2,379 valid answer sheets that met the standards for evaluation and analysis (89.05%). Step 4 was analyzing data. The research sample was selected and refined to be representative of economics students in Vietnam (see Figure 4).

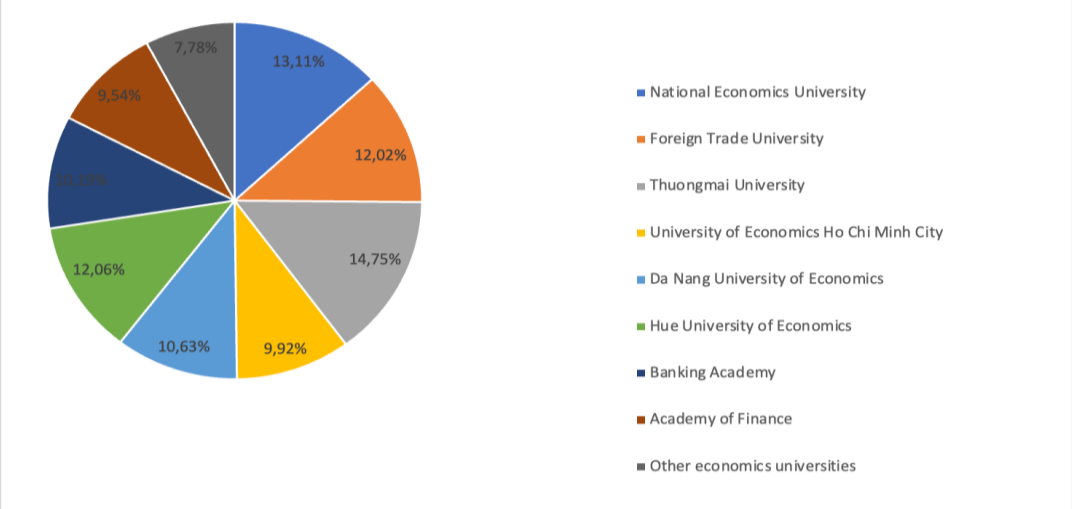

Figure 4: Results of University Students Participating in the Survey in Vietnam

Research results show that Thuongmai University has the highest number of votes with 351 votes, accounting for 14.75%, the National Economics University with 312 votes, accounting for 13.11%, Hue University of Economics with 287 votes accounting for 12.06%, Foreign Trade University with 286 votes accounting for 12.02%, Da Nang University of Economics with 253 votes accounting for 10.63%, University of Economics Ho Chi Minh City, with 253 votes, accounting for 9.92%, Banking Academy with 242 votes, accounting for 10.19%, Academy of Finance with 227 votes accounting for 9.54% and other economic universities with 185 votes accounting for 7.78%.

The gathered data were systematically coded and analyzed utilizing SPSS 26 software to assess seven categories of digital competencies based on their mean values and standard deviations. The Mann-Whitney U test was utilized to ascertain any differences in perceptions between male and female students, as well as between those from rural and urban backgrounds. This test facilitated the comparison of differences between two independent groups concerning their digital competence. Additionally, the Kruskal-Wallis H test was employed to investigate whether statistically significant differences existed in perceptions of DC among students from various academic years or faculties.

4. Results and Discussion

Out of the 2,379 participants surveyed regarding economics students' awareness of digital transformation, an impressive 93.99% demonstrated understanding of its importance. Specifically, 99.20% recognized its significance. However, only 29.63% affirmed familiarity with the digital competency framework. This highlights the need for greater attention to this aspect in its current state.

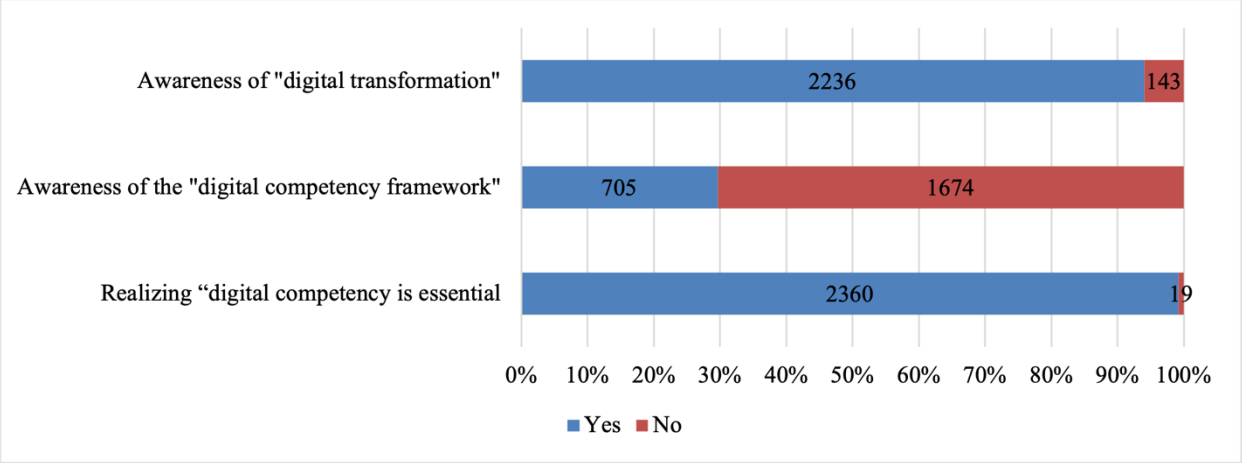

Figure 4: Awareness of the Digital Competency Framework of University Students Majoring in Economics in Vietnam

The thresholds for reliability were established based on Cronbach's alpha values, where a coefficient greater than 0.8 indicates a good scale, and values between 0.7 and 0.8 denote an acceptable scale (Peterson, 1994). Additionally, item-total correlation coefficients were required to exceed 0.3. The DC scales—ESO, IDC, CCC, DCC, CSC, PSC, and PC—met the criteria for both Cronbach's alpha and item-total correlation coefficients, thereby confirming their reliability (see Table 2).

Table 2: Scale Reliability Testing

Variable	Number of Items	Cronbach's Alpha (Final)	Corrected Itefm - Total Correlation
ESO	4	0.808	0.495
IDC	4	0.796	0.513
CCC	5	0.791	0.409
DCC	5	0.757	0.531
CSC	5	0.825	0.568
PSC	4	0.763	0.552
PC	4	0.812	0.585

(Source: Result from SPSS 26)

4.1 Results

4.1.1. Devices and software operations

At economics universities in Vietnam, students' proficiency in devices and software operations garners an average score of 3.55 out of 4.0 points (see Table 3**)**. Notably, students who feel adept at using browsers and digital software/tools for academic purposes achieve the highest score of 3.71 points, with a standard deviation of 0.885, and 61% perceive their proficiency as good or better. Conversely, setting up settings and updating applications/software/digital devices received the lowest rating of 3.32 points among information and data capacity aspects. Specifically, 57.2% of students rate their ability in this area as average or lower. The remaining competencies include an overall understanding of computer components and connectivity to other devices, scoring 3.57 points, and proficiency in manipulating electronic devices and logging into components, peripherals, and smart card readers, scoring 3.59 points. The smaller standard deviation in the assessment of equipment and software proficiency indicates a relatively high level of consistency among students' perceptions. Additionally, most students demonstrate a very high usage rate of basic office software, with approximately 96.1% utilizing programs such as Microsoft Office for academic purposes. However, the usage rates for specialized academic software (31.3%), antivirus software (21.8%), and graphic processing software (20.5%) are significantly lower (Mai et al., 2021). These findings indicate that

devices and software serve as the primary tools supporting students in their daily learning activities.

Table 3: Students' Assessment of Their Devices and Software Operations

Encode	The scale	Evaluation rate (%)					Medium	Standard deviation
		1	2	3	4	5		
DSO1	Comprehensive understanding of the components of a computer and how it is connected to other devices	1.2	7.0	40.7	41.2	9.9	3.57	0.812
DSO2	Well-implementing the operations on electronic devices, login of software, peripheral devices, smart card readers	1.6	7.4	37.4	40.7	12.8	3.59	0.871
DSO3	Proficient in using browsers and digital software/tools for learning	0.8	6.2	32.1	41.2	19.8	3.71	0.885
DSO4	Capable of opening settings and updating applications/software/digital devices	2.1	14.4	40.7	34.2	8.6	3.32	0.896

4.1.2 Information and data literacy

The evaluation of students' information and data literacy yields an average score of 3.45 out of 5.0 points (see Table 4). Within this competency group, students' highest-rated competency lies in assessing the reliability of websites and information updates, reaching a peak score of 3.79 points, with a standard deviation of 0.873. Notably, 65.4% of students perceive their ability in this aspect as good or better. Conversely, the ability to back up and restore data across digital devices received a lower score of 2.83 points, with 58.7% of students rating their proficiency as average or below. Similarly, constructing a search plan to find information and digital content is also rated relatively low, with 34.6% of students considering it average and 2.5% rating it as weak. Additionally, systematically managing and storing information and data online scored 3.65 points, with 41.5% of students rating it as average or below. Document storage software is used by approximately 46.9% of students. However, only about 14.5% to 27% of students can utilize digital technology skills at a more

advanced level, such as specialized academic software or systematic management of complex data (Mai et al., 2021).

Table 4: Students' Assessment of Information and Data Literacy

Encode	The scale	Evaluation rate (%)					Medium	Standard deviation
		1	2	3	4	5		
IDL1	Build personal search plan to find information and digital content	2.5	8.2	34.6	43.2	11.5	3.53	0.892
IDL2	Consider the website's reliability and the currentness of the information	1.2	4.9	28.4	44.4	21.0	3.79	0.873
IDL3	Manage and store information and data online systematically	1.6	5.3	34.6	42.8	15.6	3.65	0.865
IDL4	Backup and restore data on all relevant digital devices	2.6	26.2	29.9	32.5	8.8	2.83	0.898

4.1.3 Communication and collaboration

The evaluation of students' communication and collaboration abilities reveals an average score of 3.45 out of 5.0 points (see Table 5). Among the criteria within this competency group are students excel in attending to the content of communication across various digital platforms, such as SMS, email, Facebook, Zalo, Ms. Team, and Google Meet, achieving an average score of 3.82, with a standard deviation of 0.856. Impressively, 68.3% of students consider themselves proficient or better in this area. These findings are consistent with Phú (2023), who reported that online learning platforms like Zoom and Google Meet are extensively utilized, with high levels of user satisfaction (65.7% for Zoom and 67.3% for Google Meet).

Adhering to behavioral standards during online interactions is another strong suit, with students rating this competency at 3.73 points, and 65.5% of them believe they meet the competency level adequately. Additionally, students express confidence in their ability to utilize different tools for data sharing. Conversely, their ability to collaborate with others using digital technology garnered a rating of 3.32 points, with 57.2% of students considering this ability as average or lower. Similarly, the skill of selecting appropriate digital tools for collaborative processes received a relatively

low rating, averaging 3.52 points, with 45.3% of students rating it at an average level or lower.

Table 5: Students' Assessment of Communication and Collaboration

Encode	The scale	Evaluation rate (%)					Medium	Standard deviation
		1	2	3	4	5		
CC1	Communicate with people through various digital applications	1.2	4.5	25.9	47.3	21.0	3.82	0.856
CC2	Comply with behavioral standards when interacting online	0.8	7.0	26.7	48.6	16.9	3.73	0.902
CC3	Use different tools to share data	1.6	4.5	34.6	44.0	15.2	3.67	0.848
CC4	Collaborate with people using digital technology	4.9	12.8	39.5	32.1	10.7	3.32	0.991
CC5	Choose the right digital tools for collaborative processes	2.5	8.2	34.6	43.2	11.5	3.53	0.892

4.1.4 Digital content creation

The assessment of students' information and data capacity, with an average score of 3.38 out of 5.0 points (see Table 6), reflects the lowest level among the seven competency groups. This indicates that creating digital content with innovative flair is not a strong suit for economics students. The two most highly rated aspects within this group are designing images, publications, and short videos using tools and software such as Canva, Camtasia, MS PowerPoint, Photoshop, and Capcut, along with proficiency in these capabilities. Updating and editing digital content received relatively good ratings, with 43.6% and 41.6% of students rating them at a good level, scoring an average of 3.49 and 3.48 points, respectively. The results are consistent with the study by Phú (2023), which indicated that Quizzi (62.6%), Padlet (57.8%), and Canva (71.1%) were also highly rated by students for their effectiveness in supporting learning activities and report presentations. Conversely, the skill of using programming languages to develop functional programs was rated as average or below average by approximately 54.3% of students. Awareness and consideration of copyright and licenses when creating digital content received the lowest rating, averaging 3.23 points, with 21.4% of students rating it as weak or very weak. However, the high standard deviation values indicate significant variance in students' perceptions of these competency aspects.

Table 6: Students' Assessment of Digital Content Creation

Encode	The scale	Evaluation rate (%)					Medium	Standard deviation
		1	2	3	4	5		
DCC1	Design images, publications, short videos	4.1	8.2	32.9	43.6	11.1	3.49	0.942
DCC2	Proficient in updating and editing digital content	1.6	10.3	35.8	41.6	10.7	3.48	0.878
DCC3	Ability to combine different digital content	2.1	11.5	37.4	39.9	9.1	3.42	0.885
DCC4	Use programming languages to create working programs	4.1	14.4	35.8	35.4	10.3	3.33	0.983
DCC5	Be aware of and pay attention to copyright and licensing when developing digital content	4.5	16.9	38.7	30.5	9.5	3.23	1.01

4.1.5 Safety

The assessment of students' safety competencies resulted in an average score of 3.60 out of 5.0 points (see Table 7). In assessing their capacity for data protection on digital platforms, 63.8% of students rated it at a good level or higher, achieving a score of 3.77 points, the highest within this competency group. Concerning the risk associated with accessing digital platforms, the rating stands at 3.67 points, with a standard deviation of 0.838. Students also displayed significant interest in utilizing platforms beneficial to the environment, garnering a score of 3.76, with 63% rating it as good or better. However, the ability to configure settings to safeguard information before sharing it on digital platforms scored only 3.22 points, indicating the lowest level. The high standard deviation values suggest considerable variation in students' perceptions of these competency aspects. The interview with Mr. Nguyen Son Hai, Director General of the Department of Information Technology (2023), also revealed: "Most students today frequently access the Internet and social media; however, the majority lack adequate knowledge of cybersecurity and personal data protection. This situation creates opportunities for cybercriminals to attack and steal students' personal information."

Table 7: Students' Assessment of Safety

Encode	The scale	Evaluation rate (%)					Medium	Standard deviation
		1	2	3	4	5		
S1	Protect data on digital platforms	0.4	4.5	31.3	45.7	18.1	3.77	0.812
S2	Detect risks when accessing digital platforms	0.4	7.0	33.7	43.2	15.6	3.67	0.838
S3	Distinguish appropriate content when sharing to protect privacy	0.8	4.9	30.9	44.9	18.5	3.75	0.841
S4	Establish settings to protect information before sharing it on digital platforms	6.6	14.0	39.5	30.5	9.5	3.22	1.02
S5	Use environmentally friendly platforms	0.4	4.9	31.7	41.2	21.8	3.76	0.991

4.1.6. Problem solving

The assessment of students' problem-solving ability yielded an average score of 3.59 out of 5.0 points (see Table 8). Data pertaining to this competency indicate that 61.7% of students rated their skills to recognize and distinguish most technical errors when using digital platforms as good or better, marking it as the highest-rated competency. Furthermore, when faced with a problem, students displayed confidence in their ability to patiently resolve digital issues, achieving a score of 3.69 points, with a standard deviation of 0.901. Conversely, overcoming technical errors when using digital platforms scored 3.58 points, with 45.3% rating it as average or below average. The ability to utilize different digital technologies to devise creative solutions was deemed the least confident, scoring 3.39 points, with 56.6% of students rating it as average or below average. Mr. Nguyen Son Hai confirmed that while students can recognize technical errors when using digital platforms, they demonstrate a restricted advancement in critical thinking, creativity, and problem-solving abilities as influenced by digital technologies. The creation of innovative solutions using digital tools remains constrained due to the lack of practical environments and real-world project experiences.

Table 8: Students' Assessment of Problem Solving

Encode	The scale	Evaluation rate (%)					Medium	Standard deviation
		1	2	3	4	5		
PS1	Identify and differentiate most technical errors when using digital platforms	0.8	4.9	32.5	44.0	17.7	3.73	0.838
PS2	Be patient when solving a digital problem	0.8	7.0	35.0	37.0	20.2	3.69	0.901
PS3	Fix technical errors when using digital platforms	2.1	7.8	35.4	39.1	15.6	3.58	0.916
PS4	Use different digital technologies to create innovative solutions	2.5	11.1	43.2	31.7	11.5	3.39	0.917

4.1.7 Career-related competencies

The assessment of students' competencies related to their careers yielded an average score of 3.48 out of 5.0 points (see Table 9). The results indicate varying levels of proficiency among students in different aspects. For instance, the ability to identify specific digital tools and technologies within their field of study received the highest rating, with a score of 3.58 points, and 54.7% of students rate it as good or better. Similarly, the capacity to collect and analyze specialized data using digital tools garnered positive ratings, with 50.6% of students rating it at a good level or better, and an average score of 3.56. Conversely, proficiency in operating digital devices and specialized software related to their field of study received a lower score of 3.51 points, with 48.1% of students rating it at an average level or below. The skill with the lowest rating is the ability to exploit open data sources to serve their field of study, with 4.9% rating it at a very weak level and 13.6% rated at a weak level, resulting in an average score of 3.28%. Overall, students' assessment of career-related competencies, particularly in digital content creation, remains low. This underscores the need for further enhancement in this competency group, particularly considering the importance of digital competencies in the current economic environment. The ability to use specialized learning software is only 31.3% (Nguyen et al.,2021), and the advanced digital skills required for professions, such as big data analysis, using specialized software, information security, and AI applications, are still weak and uneven across different fields and individual students.

Table 9: Students' Assessment of Career-Related Competencies

Encode	The scale	Evaluation rate (%)					Medium	Standard deviation
		1	2	3	4	5		
CRC1	Identify digital tools and technologies specific to the field of study	2.1	6.6	36.6	40.3	14.4	3.58	0.886
CRC2	Proficient in operating and using digital devices and specialized software to handle work related to the field of study	1.6	8.6	39.1	38.7	11.9	3.51	0.874
CRC3	Collect and analyze industry-specific data using digital tools	1.2	7.8	36.6	42.8	11.5	3.56	0.843
CRC4	Exploit open data sources to serve the field of study	4.9	13.6	40.7	29.6	11.1	3.28	0.989

The survey results show that economics students in Vietnam have achieved an encouraging level of proficiency in digital skills, especially in using digital tools for learning. This result also reflects the initial positive impacts of national digital transformation policies and efforts of the education sector. However, Vietnamese economics students are still quite weak in data storage and retrieval, digital safety, security and awareness of digital copyright, because they are non-technical students. These findings align with a previous study by Černý (2021), Martzoukou et al. (2024) and Popa and Vasilescu (2025). Identifying specific weaknesses in students' digital competencies can be a basis for helping policymakers develop programs to improve students' digital competencies during the digital transformation period in Vietnam. In the education sector, Hoffmann et al. (2022) pointed out that digital transformation and digital literacy have transformed the instructional and educational approaches for students (Farrokhnia et al., 2019). Students need not only the skills to access, search and analyze information but also to use digital tools effectively for their learning.

4.2 Factors Influencing the Digital Competencies of Economics Students in Vietnam

The Mann-Whitney U test was utilized to identify possible differences in perceptions between male and female students, as well as between those from rural and urban settings. Table 10 indicates that there are no significant differences between gender groups (H1) and regions (H2), with p-values of.035 and.062, respectively. Consequently, the research findings suggest that there are no gender or regional disparities in the DC of students, given that digital technology is equally accessible

to all genders and is widely available. However, students' perceptions regarding information technology training, as indicated by $p < 0.05$, reveal a statistically significant difference between those who have received IT training and those who have not (H3).

The results demonstrate that IT training has a substantial and positive effect on the DC of university students. Students who have undergone IT training exhibit higher levels of digital competence, enhanced technology application skills, and improved career adaptability compared to their peers without IT training. Therefore, it is recommended that universities prioritize the expansion and enhancement of IT education, while incorporating digital skills into the curriculum to address gaps and improve the overall DC of students.

Table 10: Independent-Samples Mann-Whitney U Test Summary

	Sex	Region	Train
Total N	1586	1586	1586
Mann-Whitney U	24226,000	28449,000	23422,000
Wilcoxon W	119492,000	117280,000	114800,000
Test Statistics	24226,000	28449,000	23422,000
Standard Error	1461.485	1523.951	1500.018
Standardized Test Statistics	-1,174	-2,604	.159
Asymptotic Sig. (2-sided test)	.062	.035	.000

The survey data reveal that most surveyed students are concentrated in the third year, totaling 903 votes, or 37.96%, followed by first-year students with 691 votes, accounting for 29.05%. Second-year students garnered 523 votes, constituting 21.98%, while fourth-year students amassed 262 votes, representing 11.01%. Considering that the year factor includes multiple subgroups, the Kruskal-Wallis H test was employed to evaluate whether significant differences are present in students' perceptions regarding competency levels across different courses or departments (see Table 11).

The findings indicate a statistically significant difference between different school years, with fourth-year students exhibiting higher numerical abilities compared to first-year students, as evidenced by $p < 0.05$ (H4). The results show clear differences in students' DC across academic years, with a progressive increase from the first to the fourth year, reflecting the accumulation of experience, specialized training, and more practical application. First-year students focus on developing basic skills such as operating devices and accessing information and data. Second- and third-year students advance in communication, collaboration, information security, and problem solving

in digital environments. Students in their fourth year highlight the importance of developing skills in digital content creation and utilizing digital competencies for their professional careers, as they prepare for the digital transformation in their future employment.

Table 11: Independent-Samples Kruskal-Wallis Test Summary

	Year
Total N	1586
Test Statistics	4.196 [a,b]
Degree Of Freedom	4
Asymptotic Sig. (2-sided test)	.000

5. Implications

The digital competency framework is crucial for students to achieve academic success, advance their careers, and assimilate into society within the digital era. Based on research findings, several recommended strategies are outlined as follows. Firstly, enhancing students' proficiency in utilizing technology and software necessitates investment in technological infrastructure. Educational institutions must collaborate with telecommunications providers to improve Internet systems, ensuring students have reliable and robust network access. It is essential to acquire licenses for widely-used software such as Zoom, Padlet, Canva, and Quizzi, enabling students to utilize these tools effectively in online education. Establishing a technical support team is vital to assist students with any equipment or software-related issues. Additionally, encouraging student participation in clubs and collaborative projects will facilitate the practical application of technology, thereby enhancing their skills in knowledge application.

Secondly, it is imperative to emphasize information and data competencies among students. Incorporating information and data literacy into all subjects, particularly specialized ones, is essential. It is essential to receive training in utilizing search engines, library databases, document management software, and online resources for educational and research purposes. Investments should be made to upgrade information technology systems, electronic libraries, and digital databases, ensuring that students have access to a wide range of high-quality informational resources. Courses covering data analysis, statistics, and the application of tools such as Excel, R, and Python should be organized to bolster students' abilities to interpret and comprehend information and data.

Thirdly, it is essential to implement strategies that foster communication and collaboration skills within the digital landscape. Students should receive guidance and practice of utilizing platforms such as Google Docs, Trello, and Slack. Tools like Microsoft Teams, Zoom, and Miro, along with project management software and online learning platforms, promote the enhancement of proficient communication and virtual collaboration abilities. It is advisable to conduct training sessions focused on digital communication etiquette and to engage students in regular online group activities and projects. This serves as a crucial foundation for enabling students to thrive in the age of digital technology.

Fourthly, enhancing students' skills in digital content creation is crucial. This objective can be achieved by providing courses and workshops that focus on the skills required for the creation and editing of diverse types of digital content, including text, images, videos, and audio. Such initiatives will help students become adept with widely-used creative tools (e.g., Photoshop, Canva, Premiere, and applications for short video creation), particularly for first and second-year students. Students should be encouraged to cultivate innovative thinking, consistently seeking fresh and unique ideas to produce engaging and distinctive content through the proficient use of technological tools that aid in content creation, such as photo and video editing software, social media platforms, SEO tools, and educational platforms like Coursera, Udemy, and edX to develop professional digital creative skills.

Fifthly, it is vital to enhance students' understanding of cybersecurity. This involves training students in fundamental information security practices, such as creating robust passwords, utilizing multi-factor authentication, and recognizing and preventing cyber threats and online fraud. Students should be educated on identifying potential cyber-attack strategies and employing technical measures to protect themselves and mitigate the effects of any attacks. Additionally, third and fourth-year students should receive training on automated warning systems and the application of artificial intelligence to detect legal violations, the dissemination of false information, and harmful content, thereby enabling timely warnings and prevention measures.

Subsequently, there is a need to enhance problem-solving abilities within the digital landscape and motivate students to utilize AI tools, including chatbots, for automating information retrieval, conducting data analysis, simulating scenarios, and delivering solutions with greater speed and precision. Training should be provided on AI, chatbots, and digital skills through platforms such as Coursera, Udemy, and edX to bolster knowledge and problem-solving capabilities. Concurrently, it is important to leverage digital resources, forums, and online study groups to identify and analyze challenges, fostering creative thinking and addressing issues related to learning and expertise.

Furthermore, career-oriented skills within the digital realm should be emphasized and instruction given in specific digital technology competencies relevant to each specialized field (such as Jira Software, Smart Pro, King Marketing, and Viindoo HRM) to equip students with the necessary software and digital tools for their respective professions. It is recommended to implement online learning management systems, digital simulations, and specialized software to establish a learning and practice environment that mirrors contemporary workplaces. It is essential for universities to collaborate with businesses to generate possibilities for students to engage in internships and gain experience in authentic digital environments, thereby enhancing their professional capabilities and specialized digital skills. The strategy for employing the digital competency framework for students in Vietnam entails the completion and dissemination of a national standard digital competency framework. This will be piloted and implemented at universities, beginning with leading universities such as the University of Economics, Thuongmai University, and Foreign Trade University.

Additionally, it involves the development of training programs, documentation, and assessment criteria for digital competencies at various levels, ensuring equitable access and fostering lifelong digital competencies for students. The integration of the digital competency framework with the national digital transformation strategy and emerging technology trends is also crucial. Countries in ASEAN, including Malaysia, Cambodia, and Brunei, have established and implemented digital competency frameworks for higher education institutions. These frameworks emphasize the cultivation of a range of digital skills, from fundamental to advanced levels, encompassing areas such as digital literacy, design, computer science, online safety, and the application of technology in professional settings. Additionally, there is a connection between national qualification frameworks and the ASEAN Reference Framework to facilitate the acknowledgment of competencies and qualifications across member nations, thereby fostering lifelong learning and enhancing labor mobility within the region.

6. Conclusion

6.1 Theoretical Contributions

The research has expanded upon and enhanced the UNESCO digital competency framework, tailoring it to the specific characteristics and practical needs of Vietnam's digital economy. The categories of digital competency include the use of equipment and software, the administration of information and data, effective communication and collaboration in a digital setting, the development of digital content, safeguarding information, problem-solving capabilities, and professional competencies. The findings indicate no significant disparity in digital competency between male and female students, nor among students from various geographical regions. This suggests a growing equality in the access and dissemination of digital technology among student demographics, indicating that initiatives aimed at promoting technology and training in digital skills have been somewhat effective in bridging the digital divide related to gender and region.

Furthermore, students who have undergone information technology training assess their digital competencies more favorably compared to those who have not received such training. This underscores the critical importance of information technology training programs in enhancing digital skills for students in economics. Additionally, there are notable differences in digital competencies based on academic year, with students in higher years (third and fourth) exhibiting superior digital competencies compared to those in lower years (first and second). This variation can be attributed to the accumulation of experience, practice, and the utilization of digital technology in educational and practical endeavors throughout the years.

6.2 Practical Contributions

The digital competency framework established in this research serves as a foundation for universities to create training programs and establish output standards for digital skills, thereby enhancing the quality of education to align with the demands of digital transformation and the modern employment landscape. In terms of policies for developing digital human resources, accurately identifying the factors that influence and do not influence digital competencies enables educational administrators and policymakers to formulate effective training and dissemination strategies for digital skills, ensuring that resources are allocated appropriately. For students, this research aids in recognizing the significance of information technology training and accumulating experience throughout their academic journey to enhance their digital competencies, thereby enabling them to assume responsibility for their own growth.

This research investigates the perceptions of students regarding their digital skills within higher education, specifically examining a case study involving economics students in Vietnam. The findings indicate that students generally possess a favorable view of their digital abilities. However, it was observed that as the complexity of tasks and the skills required increased, students' perceptions of their DC tended to diminish. No notable differences were identified between gender or regional demographics. Importantly, a significant distinction was noted in students' evaluations of their IT training, with those who had undergone such training reporting a more optimistic perspective on their digital skills. Furthermore, students in higher academic years exhibited greater levels of DC compared to those in earlier years. The study recognizes its limitations, as the sample was restricted to economics students in Vietnam. Future investigations should broaden the scope of the survey to include a wider range of disciplines and assess the impact of digital literacy on learning outcomes, employability, and the development of student competencies across various fields of study. To improve resilience and agility in crises, it is essential to leverage digital technologies and digital communication (Alanzi & Ratten, 2023).

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