MINISTRY OF EDUCATION AND TRAINING

HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY AND EDUCATION

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DEVELOPING DIGITAL COMPETENCE FOR UNIVERSITY STUDENTS

By

Mai Anh Tho

DISSERTATION SUMMARY

Field of study: Education

Code: 9140101

HO CHI MINH CITY - 2023

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This research is conducted and completed at **Ho Chi Minh City, University of Technology and Education.**

Instructor: **Associate Professor Ngô Anh Tuấn**

Reviewer 1:

Reviewer 2:

Reviewer 3:

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HO CHI MINH CITY - 2023

INTRODUCTION

1. Statement of the problem

In today's educational landscape, digital competence is the most significant aspect to ensure effective learning as well as student learning outcomes (Martin, Spamer & Flowers, 2020; Yu, 2018). Digital competence is regarded as a critical prerequisite for students in the twenty-first century (Sánchez-Caballé, Gisbert-Cervera & Esteve-Mon, 2020). Therefore, developing digital competence among students is one of the priority goals of education (Slavova & Garov, 2019). Educational institutions must prioritize the development of digital competence to facilitate not only students' learning success, but also their prompt adaptation the world's emerging demands for the high quality of human resources (Martin et al., 2020).

However, research on digital competence possessed university students and the development of digital competence for students in Vietnam has been scarce. As a result of the pressing need for acquiring digital competence in the higher education space, as well as the existing research gap in the area of digital competence development, the research topic *"Developing digital competence for university students"* was chosen as the topic of this PhD dissertation.

2. Research purpose

Based on the theoretical foundations, the dissertation analyzes and evaluates the current levels of digital competence development of university students in Ho Chi Minh City (HCMC). With the findings generated, the dissertation proposes a measure to help students at universities in HCMC develop digital competence through the integration of digital competence-related content into existing courses of particular training programs.

3. Research objectives

The dissertation aims to complete the following objectives:

- Research the theoretical foundations concerning digital competence of university students and competence development
- Study university students' levels of digital competence and the current attempts to develop digital competence for students at universities in HCMC
- Propose a measure for developing digital competence for students at universities in HCMC by incorporate digital competence topics into existing courses at universities
- Conduct experiments on the proposed measure

4. Research object and subject

Research object: Developing digital competence for university students

Research subject: Activities of digital competence development among university students

5. Research hypotheses

The current levels of digital competence of university students are basic. Besides, activities to develop such competence for students lacks clarity in terms of objectives, content, methods, and assessments, and the influence of factors on digital competence development for students has not been adequately evaluated. By considering the theoretical basis and using reliable competence assessments, appropriate measures to be proposed can enhance students' digital competence. Additionally, students' competence is expected to improve if there are digital competence-integrated courses.

6. Scope of the study

6.1 Research design

When designing a tool for assessments of students' digital competence, the study focuses on 20 component skills inherited from the ERAMUS+ 2016 project and did not have questions related to Programming abilities (3.4) in its research design.

Regarding the pedagogical intervention, the study only conducts two initial experiments for integrating digital competence topics into university-level courses to develop students' competence in the domains of Information and Data Literacy and Digital Content Creation.

6.2 Research context

Due to time and resource constraints, the study focuses on examining the current levels of students' digital competence and competence development attempts at three universities in HCMC, representing three different groups of higher education institutions in Vietnam. They are (1) Ho Chi Minh City University of Technology and Education (HCMUTE) as a public, autonomous university, (2) Nong Lam University, Ho Chi Minh City (HCMNLU) as a public, unautonomous university, and (3) Ho Chi Minh City University of Foreign Languages - Information Technology (HUFLIT) as a private university.

6.3 Research population

To achieve the research purpose, the study conducts the following activities:

- Surveying 3,467 students, including 1,336 students from HCMUTE, 1,021 students from HCMNLU, and 1,110 students from HUFLIT with regard to their levels of digital competence;
- Surveying 256 teachers, with 90 from HCMUTE, 86 from HCMNLU, and 80 from HUFLIT with regard to their levels of competence and activities to develop digital competence for students;
- Conducting in-depth interviews with 24 students (8 students per university) to further explore their digital competence and the development of digital competence at their institutions.

6.4 Time frame

The study conducts an overview of theoretical foundations during the 2019-2020 academic year. In the following academic year, 2020-2021, it develops an assessment tool and studied student's proficiency levels as well as the three universities' development of such competence. Based on the study results, the research project proposes a measure for developing digital competence for students and carries out pedagogical interventions during the 2021-2022 academic year.

7. Research approach and method

The study adopts the positivism research paradigm, with the employment of the deductive approach and mixed methods. It utilizes theoretical and practical research methods, including questionnaire surveys, interviews, analysis of educational products, and pedagogical experiments.

8. Signification of the study

8.1 Theoretical contributions

The study systemizes and clarifies the theoretical foundations concerning developing digital competence for university students. Specifically, it inherits research findings of the ERAMUS+ project to develop a performance-based assessment tool, allowing more accurate results compared to existing assessment tools. The project also identifies ways to develop students' digital competence from the theoretical perspective.

8.2 Practical contributions

The study develops MATPlatform, a web-based digital competence assessment platform that facilitates comprehensive, objective, and reliable assessments of students' digital competence through performance-oriented questions.

Additionally, it surveys, interviews, and analyzes data to understand the current status of student's digital competence and developmental activities. A measure for increasing students' digital competence was proposed by incorporating relevant content into university courses, based on the correlation between theoretical foundations and research findings. Teaching contents related to the competence areas of Information and Data Literacy and Digital Content Creation are also designed and implemented in two faculties at HCMUTE to evaluate the improvement in students' digital competence.

Furthermore, the study contributes valuable learning resources to support the development of digital competence among university students. These resources include a handbook of digital competence development and a book on digital competence.

The research findings of this study serve as a reference for higher education institutions in Vietnam, providing guidance for building and implementing solutions to enhance their students' digital competence.

9. Outline of the study

In addition to the introduction, conclusion, recommendations, list of published works, references, and appendices, the dissertation consists of four chapters as follows.

Chapter 1: Overview of research on developing digital competence for university students

Chapter 2: Theoretical foundations for the development of university students' digital competence

Chapter 3: Current state of digital competence development for students at universities in Ho Chi Minh City

Chapter 4: Measure for developing digital competence for students at universities in HCMC by integrating digital competence content into university courses

CHAPTER 1. OVERVIEW OF RESEARCH ON DEVELOPING DIGITAL COMPETENCE FOR UNIVERSITY STUDENTS

1.1 Research on university students' digital competence

In the higher education context, research on students' digital competence focuses on the following main directions.

1.1.1 Research on indicators of digital competence

This direction has received significant research attention, particularly in the discussion of what constitutes digital competence. Studies in this line of research indicate that indicators of digital competence primarily derive from the contextual approach, drawing on digital competence research and related policy documents (Sánchez-Caballé & cộng sự, 2020; Spante, Hashemi, Lundin & Algers, 2018; Zhao, Pinto Llorente & Sánchez Gómez, 2021). While there are various perspectives to examine digital competence, there is substantial convergence in its underlying content, with Ferrari (2012) concept of digital competence being considered by UNESCO as the most comprehensive, encompassing different indicators.

1.1.2 Research on components of digital competence

Following discussions on digital competence indicators, researchers have also focused on identifying the component competences and the relationships between them. This serves as the basis for the development of tools to assess digital competence of university students. The components described in the comprehensive framework of DigComp include most of the components found in other frameworks (Sánchez-Caballé et al., 2020).

1.1.3 Research on measurement of digital competence

Another important line of research is concerned with ways to measure digital competence of university students, as such assessments are the starting point for the development of digital competence when aiming to design comprehensive and systematic approaches (Sillat, Tammets & Laanpere, 2021). Various models and tools have been developed by countries, regions, international organizations, and commercial entities for measuring and diagnosing digital competence (Çebi & Reisoglu, 2020; Jashari et al., 2021). The three most common methods are self-assessment, knowledge-based assessment, and performance assessment. Among these methods, performance assessment allows for the most accurate measurement (Saltos-Rivas et al., 2021; Zhao et al., 2021).

1.2 Research on developing digital competence for university students

1.2.1 Research on preconditions for developing digital competence

- Educational policies for digital competence: They need to be clearly defined and specified at each educational level, serving as a basis for change to meet the requirements of current digital institutions (Instefjord & Munthe, 2016; Krumsvik, 2014; Wastiau, Blamire, Kearney, Quittre, Van de Gaer & Monseur, 2013).
- Awareness of strategic leadership in institutions regarding digital competence: Leadership plays an important role in interpreting and implementing policies into practical goals and providing specific support (Dexter, 2008; Edvard Hatlevik & Christian Arnseth, 2012; Petersen, 2014). Also, the levels of digital competence of leaders are seen as a barrier (Afshari, Bakar, Luan, Samah & Fooi, 2009; Dexter, 2008; Petersen, 2014; Stuart, Mills & Remus, 2009).
- Infrastructure to support the development of digital competence: It is important to integrate digital technology into teaching, as outdated infrastructure hinders change (Newland & Handley, 2016; Somekh, 2008; Vanderlinde & Van Braak, 2011).
- Professional development of teachers concerning digital competence: It is a crucial task because teachers' digital competence influences the development of students' digital competence (Sipilä, 2014; Wastiau et al., 2013).

1.2.2 Research on strategies for developing university students' digital competence

Studies addressing strategies for developing digital competence among university students approach the issue on two levels: macro-level and micro-level (Sánchez-Caballé et al., 2020).

At the macro-level, research focuses on solutions for developing digital competence for university students at the institutional level. This includes (1) translating national-level policies for developing digital competence into specific objectives and activities at the institutional level (Newland & Handley, 2016; Petersen, 2014; Soby, 2015); (2) addressing the infrastructure of institutions and the role of strategic leadership in fostering digital competence among staff members (Newland & Handley, 2016; Petersen, 2014); and (3) implementing systematic innovation strategies regarding curricula and the incorporation of digital competence content ((Røkenes & Krumsvik, 2016; Sánchez-Caballé et al., 2021; Starčič, Cotic, Solomonides & Volk, 2016)

At the micro-level, research focuses on sharing specific measures that teachers can apply to develop digital competence among students. Strategies for integrating technology into teaching are shared through various methods and practices, increasing students' technological access and helping them develop digital competence (Guzmán-Simón et al., 2017). Some notable studies in this area include:

- Teachers helping students develop digital competence through the use of e-learning systems in combination with digital tools to implement classroom learning activities (Kim, Hong & Song, 2019; Kühn, 2017; Tomczyk, Potyrała, Włoch, Wnęk-Gozdek & Demeshkant, 2020; Tretinjak & Andelic, 2016);
- Implementing active teaching methods supported by technological tools in the classroom to develop students' digital competence (Elphick, 2018; Romero-García, Buzón-García & de Paz-Lugo, 2020);
- Designing specialized training modules to develop students' digital competence (Ata & Yıldırım, 2019; Campbell & Kapp, 2020; Gabriele, Bertacchini, Tavernise, Vaca-Cárdenas, Pantano & Bilotta, 2019; Hamutoğlu, Savaşçi & Sezen-Gültekin, 2019; Lerdpornkulrat, Poondej, Koul, Khiawrod & Prasertsirikul, 2019; Romero-Tena, Barragán-Sánchez, Llorente-Cejudo & Palacios-Rodríguez, 2020; Vinikurova, Mazurenko, Prikhodchenko & Ulanova, 2021), (Botturi, 2019; Reisoğlu & Çebi, 2020);
- Designing learning resources, particularly digital resources, to aid students' development of digital competence (Carl & Strydom, 2017; Gordillo, Barra, López-Pernas & Quemada, 2021; Paige, Dobson & Bentley, 2016; Sharp, 2018; Starčič et al., 2016).

In the Vietnamese context, there have been no publications specifically discussing measures for developing digital competence among university students.

1.3 Some observations of the literature review

Based on the analysis of local and international studies on digital competence of university students and the development of students' competence, the following observations are made.

Firstly, it is important to identify the indicators and components of digital competence, as well as the relationships between these components, in order to develop assessment tools that can accurately assess students' current digital competence. Europe's DigComp 2.1, which describes digital competence in five areas with corresponding indicators, has been recognized by UNESCO as the most updated and comprehensive framework. It encompasses almost all the competence components of other frameworks developed worldwide, and has been used by many higher education institutions not only in Europe but also in other parts of the world to design assessment tools for students' digital competence. Therefore, Vietnam can consider adopting the DigComp framework to develop an assessment tool for the digital competence of Vietnamese students that is suitable for their cognitive characteristics and Vietnam's cultural and social contexts.

Secondly, nearly 80% of studies that assess students' digital competence use the self-assessment method, which often leads to less accurate results. Therefore, to gain a full understanding of the actual state of digital competence among university students, it is necessary to develop practical assessment tools that reflect the essence of digital competence. Validating the validity and reliability of such tools is also crucial. Among the three assessment methods currently used, the method of performance assessment yields the most accurate results, although it is more technically complex and costly to implement.

Additionally, conducting research with a mixed-methods design, combining both quantitative and qualitative analysis, is believed to generate more comprehensive results regarding digital competence of university students, compared to studies that employ only one method.

Finally, previous studies on developing digital competence for university students from a micro-level approach are more suitable and feasible for countries that are in the early stages of digital education transformation, where national policies and solutions from government bodies may not yet be clear. As a result, it is essential to provide support for teachers in developing students' digital competence through teaching activities. Furthermore, higher education institutions can consider designing specialized training courses or incorporating digital competence content into existing courses, using digital technologies in teaching design and organization, depending on the conditions and practical circumstances of the institutions, as well as developing other activities aimed at developing digital competence for students.

Chapter 1 summary

Chapter 1 provides an overview of research on the development of digital competence for university students, synthesizing studies related to two main issues: the digital competence of university students and the development of digital competence for university students.

Regarding the first issue, the dissertation compiles studies related to the indicators of digital competence, the components of digital competence, the relationships between these components, and the assessment methods. These findings serve as important foundations for shaping and building the theoretical basis of students' digital competence.

Regarding the second issue, the chapter reviews research on the prerequisites for developing digital competence among students and explores measures to develop their digital competence.

Based on the findings from the literature review, the chapter provides some preliminary observations, which lay the groundwork for the subsequent theoretical research on the development of digital competence for university students in Chapter 2.

CHAPTER 2. THEORETICAL FOUNDATIONS FOR THE DEVELOPMENT OF UNIVERSITY STUDENTS' DIGITAL COMPETENCE

2.1 Basic concepts

2.1.1 Competence

In this dissertation, competence is defined as a set of knowledge, skills, and attitudes that students need to perform an activity, and solve problems in specific contexts to achieve learning and professional goals.

2.1.2 Digital competence of university students

This dissertation adopts DigComp 2.1 as the framework of reference. Accordingly, the concept of digital competence of university students is understood as a set of knowledge, skills, and attitudes that students need to effectively use digital tools for problem solving, communication, information management, collaboration, content creation, sharing, and knowledge construction in an efficient, selective, comprehensive, flexible, creative, ethical, and rational manner to conduct learning and research tasks at the university level, as well as for entertainment and social participation.

2.1.3 Development of digital competence for students

The development of digital competence for university students in this dissertation involves the implementation of teaching and other activities with the support of technologies to enhance their awareness and improve their levels of digital competence within the learning and working environments of universities.

2.2 Theories of digital competence of university students

2.2.1 Characteristics of digital competence of university students

Digital competence of university students exhibits the following characteristics. It is closely linked to their learning, research, and work within the university context, and students' possession of digital competence enhances the quality of their learning. The dynamic nature of digital competence of students is evident in two aspects: their level of proficiency and ability to adjust and supplement component competences.

2.2.2 Roles of digital competence to university students

Digital competence is one of the eight core competences required for lifelong learning (European Commission, 2018). It is a top priority for students to maintain and achieve learning outcomes in today's learning environments (Martin et al., 2020; Yu, 2018).

Having a high level of digital competence enables students to improve their readiness to use digital technologies for learning (Kim et al., 2018), and enhances their ability to interpret, comprehend, and perform in online learning (López-Meneses et al., 2020; Mosa, Naz'ri bin Mahrin & Ibrrahim, 2016), thereby leading to greater academic and professional success in an increasingly technology-driven learning environment (Bergdahl, Nouri & Fors, 2020; He, Zhu & Questier, 2018).

As a result, possessing digital competence is regarded as a fundamental requirement for students in the 21st century (Sánchez-Caballé et al., 2020).

2.2.3 Structure and proficiency levels of digital competence for university students

This study adopts the DigComp model of digital competence, and thus the structure and levels of digital competence for university students are based on this reference framework.

Table 1: Structure of the DigComp framework

Areas	**Desription**	**Competences**
1. Information and data literacy	To articulate information needs, to locate and retrieve digital data, information and content. To judge the relevance of the source and its content. To store, manage, and organise digital data, information and content.	1.1 Browsing, searching and filtering data, information and digital content 1.2 Evaluating data, information and digital content 1.3 Managing data, information and digital content

2. Communicaition and collaboration	To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity. To participate in society through public and private digital services and participatory citizenship. To manage one's digital presence, identity and reputation.	2.1 Interacting through digital technologies 2.2 Sharing through digital technologies 2.3 Engaging in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette 2.6 Managing digital identity
3. Digital content creation	To create and edit digital content To improve and integrate information and content into an existing body of knowledge while understanding how copyright and licences are to be applied. To know how to give understandable instructions for a computer system.	3.1 Developing digital content 3.2 Integrating and re-elaborating digital content 3.3 Copyright and licences 3.4 Programming
4. Safety	To protect devices, content, personal data and privacy in digital environments. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion. To be aware of the environmental impact of digital technologies and their use.	4.1 Protecting devices 4.2 Protecting personal data and privacy 4.3 Protecting health and well-being 4.4 Protecting the environment
5. Problem solving	To identify needs and problems, and to resolve conceptual problems and problem situations in digital environments. To use digital tools to innovate processes and products. To keep up-to-date with the digital evolution.	5.1 Solving technical problems 5.2 Identifying needs and technological responses 5.3 Creatively using digital technologies 5.4 Identifying digital competence gaps

The proficiency levels of the DigComp framework for digital competence initially comprised three levels: foundation, intermediate, and advanced (Table 2). In the DigComp 2.1 version, the proficiency levels have been further elaborated into eight levels to facilitate the development of learning materials and training programs for digital competence. Each proficiency level is defined based on learning outcomes, and is assessed using verbs aligning with the Bloom's taxonomy scale (Carretero et al., 2017).

Table 2: Proficiency levels of DigComp (Carretero et al., 2017)

Proficiency levels (DigComp 1.0, 2,0)	Proficiency levels (DigComp 2.1)	Complexity of tasks	Autonomy	Cognitive domains
Foundation	1	Simple tasks	With guidance	Remembering
	2	Simple tasks	Autonomy and with guidance where needed	Remembering
Intermediate	3	Well-defined and routine tasks, and straightforward problems	On my own	Understanding
	4	Tasks, and well-defined and non-routine problems	Independent and according to my needs	Understanding
Advanced	5	Different tasks and problems	Guiding others	Applying
	6	Most appropriate tasks	Able to adapt to others in a complex context	Evaluating
Highly specialized	7	Resolve complex problems with limited solutions	Integrate to contribute to the professional practice and to guide others	Creating
	8	Resolve complex problems with many interacting factors	Propose new ideas and processes to the field	Creating

2.2.4 Assessment of digital competence of university students

The literature review identifies three common approaches to designing assessment tools for students' digital competence, including (1) self-assessment, (2) knowledge-based assessment, and (3) performance-based assessment, with the latter being considered the most reliable measure (Saltos-Rivas et al., 2021; Zhao et al., 2021). For this reason, the study developed the MATPlatform assessment tool to measure digital competence of university students. MATPlatform is constructed using a performance-based approach, drawing upon research findings from the ERASMUS+ project, and placing strong emphasis on the validity and reliability of the tool.

2.3 Theoretical frameworks for development of university students' digital competence

2.3.1 Importance of developing digital competence for university students

Students in the current digital generation have easy access to and frequently use digital tools, but often lack necessary competencies to meet the learning demands of the present educational context (Aesaert, Voogt, Kuiper & van Braak, 2017; Cabezas & Casillas, 2017; Johnson, Adams Becker, Cummins, Estrada, Freeman & Hall, 2016; Mesároš & Mesároš, 2010; Ng, 2012; Verhoeven, Heerwegh & De Wit, 2016).

Recent studies indicate that without teachers' support in using digital technologies for learning, students tend to utilize them in their own ways, which may have limited benefits or even result in detrimental effects (Aesaert et al., 2017; Bergdahl, Fors, Hernwall & Knutsson, 2018; Goldhammer, Gniewosz & Zylka, 2016; Hatlevik, Guomundsdóttir & Loi, 2015; Hietajärvi, Salmela-Aro, Tuominen, Hakkarainen & Lonka, 2019).

In the 2016 Horizon report, Johnson et al. (2016) emphasize that digital competence remains a challenge in higher education, and projects aimed at developing students' digital competence are crucial for enhancing learning motivation (Bergdahl et al., 2020) in today's digitally enhanced educational environments.

2.3.2 Objectives of developing digital competence for students

According to the research group led by Đỗ Văn Hùng (2022), the objective of developing digital competence is to equip students with essential skills to actively, positively, and safely live, learn, work, and engage in social communication in the digital environment.

Falloon (2020) states that the development of digital competence for students aims to support their learning process at the university level. Specifically, digital competence enhances students' skills in utilizing tools that support learning, increases their access to digital resources, and enables them to integrate digital tools and resources into the learning process, thereby fostering the quality of learning.

The report by Redecker (2017) emphasizes the objectives of developing digital competence that teachers should strive for in order to help students develop the five areas of digital competence. These areas include (1) information and data literacy, (2) communication and collaboration, (3) digital content creation, (4) safety, and (5) problem solving, which align with the component competences of the DigComp framework. Developing these competences can strengthen students' ability to apply these skills in their learning, thereby improving educational effectiveness and quality.

2.3.3 Content of developing university students' digital competence

Content is an indispensable part of every educational activity (Trần Thị Hương & Nguyễn Đức Danh, 2017), serving as the material for interactions between teachers and students.

Based on the aforementioned objectives of developing digital competence for university students, the development process should focus on the following main areas.

2.3.4.1 Developing competence in Information and Data Literacy area

In this domain of digital competence, it is important to guide students to obtain essential skills to become informed citizens in a digital society. Students need to explore how to use the Internet as a source of information and data to make learning engaging and meaningful (Howland et al., 2014).

To develop competence in this area, teachers need to design learning activities that support students in acquiring necessary knowledge and skills related to the following issues: articulating information needs clearly, developing and implementing strategies for information searching in digital environments, comparing and evaluating the reliability and sources of information, identifying misinformation and ambiguity, and organizing, storing, retrieving, processing, analyzing, and interpreting information.

For example, Botturi's (2019) study guides students to understand how the Internet and information networks work and teaches them to critically assess information online and recognize fake news. In another study, Reisoğlu and Çebi (2020) guide students through a training course that combines theory and practice. They instruct students to use search tools, databases, and strategies for information search, filtering and selection using online libraries, evaluate the validity and reliability of information, and use browser extensions, as well as store and organize information using digital technologies such as cloud platforms like Drive and Dropbox.

2.3.4.2 Developing competence in Communication and Collaboration area

What is important in this competence area is that students are guided to develop essential skills to interact and communicate through digital technologies, practice digital citizenship, manage their digital identity and reputation, and utilize digital tools and technologies for collaboration, design, and creation of information and knowledge (Đỗ Văn Hùng et al., 2022).

To achieve this, teachers need to organize learning activities to guide students in acquiring necessary knowledge and skills related to the following issues: interacting through digital technologies; using information

and communication technologies to communicate, engage, share information and digital data appropriately in specific contexts; participating in digital citizenship by using digital technologies and services; organizing, managing, and collaborating in work tasks by using digital solutions; creating and managing digital identity, protecting personal privacy and privacy of others in digital environments.

Botturi (2019) provides guidance on topics such as social media and safety, instructing students to use videos in the classroom to convey messages concerning online safety. Reisoğlu and Çebi (2020) also guide students to manage their digital identities created on different social media platforms and manifest such identities in their real-life communication and interaction through platforms such as Google Hangout, Skype, and Gmail. They also focus on instructing students to work collaboratively via Google Docs, Google Presentation, and Google Sheets, share information and content through educational social networks, adhere to rules and regulations in the digital environment, and properly cite sources.

2.3.4.3 Developing competence in Digital Content Creation area

In this area, students need to develop essential skills to create and edit digital content, transform and integrate information and digital content into their existing knowledge base, and have a clear understanding of licensing and copyright issues related to the process of creating digital content (Đỗ Văn Hùng et al., 2022).

Therefore, teachers need to organize learning activities to guide students in acquiring necessary knowledge and skills related to the following issues: developing digital content in different formats, integrating and modifying digital content; applying copyright and licences to digital content; planning and developing a series of user-friendly instructions for computer systems to solve specific problems.

In Botturi's (2019) research, students are instructed on topics such as using and creating audio, music, and video files; digital storytelling; educational robotics, visual literacy, and programming (with guest speakers presenting the Scratch programming language). Meanwhile, Reisoğlu and Çebi (2020) provide instructions on copyright and licences, designing animated presentations using web 2.0 tools, creating educational videos, digital storytelling, and concept mapping; integrating and recreating digital content, principles of message design; logic algorithms and information programming, introduction to Scratch and Alice programming languages; and monitoring student progress through assessments on educational platforms such as Google Classroom, Edmodo, or web 2.0 tools like Kahoot.

2.3.4.4 Developing competence in Safety area

With regard to safety, it is important for students to be instructed in developing essential skills to protect devices, content, personal data, and privacy in digital environments. Students should also be aware of protecting their health and well-being, the impact of digital technologies on social well-being and social integration, and the impact of technologies and their usage on the environment (Đỗ Văn Hùng et al., 2022).

As a result, teachers need to organize learning activities to guide students in acquiring the necessary knowledge and skills related to the following issues: measures to protect digital devices; safe use and sharing of information; understanding of risks and threats to health and well-being in the digital environment; awareness of the environmental impact of digital technologies, and safe and responsible use of digital technologies.

In Botturi's (2019) study, students discussed typical research related to social media and safety, media addiction, and cyberbullying (with guest experts being ones working on prevention programs). Research by Reisoğlu and Çebi (2020) instructed students on topics such as delivering presentations on threats from technologies and digital tools, protection methods, privacy threats and protection methods, and issues of technology and Internet addiction. Gordillo and colleagues (2021) designed an educational video game to instruct students about online safety.

2.3.4.5 Developing competence in Problem Solving area

Regarding problem solving, students need to be instructed to develop essential skills to operate digital technologies in specific professional contexts, understand, analyze, and evaluate data, information, and digital content relevant to their professional activities. Students should also possess the ability to practice innovation and entrepreneurship in digital environments (Đỗ Văn Hùng et al., 2022).

This can be achieved by designing learning activities that guide students to acquire essential knowledge and skills related to the following issues: identifying technical issues and solving problems when operating devices and using digital environments; determining, evaluating, and selecting appropriate digital tools and technologies to address problems; using digital technologies creatively to generate knowledge; pinpointing digital competence gaps, and finding ways to develop one's competence while supporting the development of others.

In Botturi's (2019) study, students were instructed to use mobile phones and digital technologies of movie studios for storytelling by creating visual content with only one frame. Research by Reisoğlu and Çebi (2020) guided students to work out solutions to technical issues encountered in digital environments.

In summary, to develop digital competence for students, teachers need to organize related learning activities. Previous research suggests that students' digital competence can be developed through designing specific training modules (Botturi, 2019; Reisoğlu & Çebi, 2020) or integrating digital competence content into particular courses of training programs, combining various teaching activities with technological support (From, 2017; Hatlevik, 2017; Tondeur et al., 2017).

The first approach involves designing modules dedicated to digital competence, often implemented at the institutional or faculty level as either a compulsory course for all training programs or an elective course, depending on the institution's digital competence development policies. This approach requires guidance, coordination, and collaboration among relevant stakeholders in the educational system for successful implementation (Sánchez-Caballé et al., 2021).

The second approach, based on the current integrative teaching perspective, allows teachers to implement it individually, particularly in the initial stages when digital competence policies and strategies in educational institutions may not be clearly defined. This approach provides a basis for incorporating digital competence topics into training programs. It also enables teachers to integrate appropriate digital competence content into their lectures and teaching activities using suitable methods and resources, through which teachers can monitor students' competence improvement. The feasibility and effectiveness of such integrated courses serve as the basis for integrating the content into training programs, gradually supporting students in developing individual component competences.

Regardless of the chosen approach, the implementation of digital competence teaching activities needs to ensure necessary steps of the competence development teaching process (Dương Thị Kim Oanh, 2022). These steps include (1) analyzing competence development goals for students; (2) identifying content for competence development; (3) determining formats, methods, and means of teaching to develop students' competence; and (4) establishing assessment methods to measure students' competence development.

2.3.4 Methods for developing university students' digital competence

Among the methods used today, practical teaching, visual teaching, and project-based teaching are commonly employed to develop digital competence for university students (Howard et al., 2021).

Regarding instructional formats, such as whole class, group, and individual instructions, group instructions have been used to help students develop digital competence through a range of activities both inside and outside the classroom. These activities include presentations, hands-on practice, exercises, and real-world tasks in businesses and communities (Botturi, 2019; Gordillo et al., 2021; Reisoğlu & Çebi, 2020). In addition, self-study outside the classroom, with indirect guidance from teachers, allows for personalized teaching, addressing the knowledge gaps of weaker students and promoting the creative skills of high-achieving students (Trần Thị Hương & Nguyễn Đức Danh, 2017). This approach is also used to develop students' digital competence.

Regarding instructional methods, the use of technology plays a crucial role in the development of digital competence (Bravo, Lecca-Orrego & Alarcón, 2023). Therefore, teachers can combine digital competence teaching with teaching tools and technologies to encourage active and experiential learning. They can emphasize group-based learning with a variety of activities both inside and outside the classroom, such as practical exercises, practice, and reference materials, enabling students to expand their knowledge and enhance their competences.

2.3.5 Assessments of university students' digital competence development

There are various methods to assess the development of students' digital competence. Reisoğlu and Çebi (2020) obtained data from journal entries and focus group interviews to evaluate the effectiveness of the training process. Campbell and Kapp (2020) analyzed data regarding students' backgrounds, perceptions, and experiences with technologies, as well as their technological use in learning, and narratives of difficulties they encountered. They then conducted semi-structured, video-recorded focus group interviews, focusing on students' perceptions of digital competence and their decisions regarding the use of digital technologies in the classroom. Observational methods were also applied to assess the development of students' digital competence. Other studies have used tools to assess students' competence before and after interventions and employed statistical methods to analyze and evaluate the effectiveness of such activities (Çebi & Reisoğlu, 2019).

2.3.6 Factors influencing development of university students' digital competence

There are six main factors that influence the development of digital competence in university students, including infrastructure, human resources, students' awareness, university policies, academic management, and external environment.

Chapter 2 summary

Reviewing local and international research, the dissertation clarifies the theoretical basis for the development of digital competence among university students, focusing on the following issues.

- Identifying the conceptual framework: This involves defining the concepts of competence, digital competence of university students, and the development of digital competence for university students.
- Elucidating the theoretical basis of digital competence in university students by clarifying the characteristics, roles, and component competences of digital competence, along with their corresponding indicators. This provides a foundation for building an assessment tool to measure students' digital competence.
- Clarifying the theoretical basis for the development of digital competence in university students by presenting the foundational learning theories relevant to the development of digital competence, the importance of developing digital competence for university students, objectives and content, methods for competence development, competence assessments, and subjective and objective factors that influence the development of students' digital competence. These insights form the basis for constructing a survey toolkit to assess the current development of digital competence for university students.

CHAPTER 3. CURRENT STATE OF DIGITAL COMPETENCE DEVELOPMENT FOR STUDENTS AT UNIVERSITIES IN HO CHI MINH CITY

3.1 Research on students' digital competence

3.1.1 Research purpose

The research aimed to investigate the current levels of digital competence among university students and the development of digital competence for university students to understand the current situation and propose practical solutions accordingly.

3.1.2 Research design

The research employed a mixed-methods explanatory sequential design, also known as a two-phase model (Creswell & Clark, 2018b). The data collection process involved first gathering quantitative data through a survey questionnaire, followed by conducting interviews to gather qualitative data and gain further insights into the research issues.

3.1.3 Participants, context and sampling

Due to time and resource constraints, the study was conducted at three universities in HCMC. To ensure the representativeness and reliability of the research, the minimum sample size was calculated using Yamane Taro's formula (1967).

Table 3: Minimum sampling size

Universities	**Total number of students**	**Minimum student sample size**(e=0.05)	**Total number of teachers**	**Minimun teacher sample size** (e=0.1)
HCMUTE	**24367**	394	**587**	85
HCMNLU	**23680**	393	**571**	85
HUFLIT	**10476**	386	**453**	81
Total	58523	**1173**	1611	**251**

For student interviews, the study interviewed students from different faculties at each university, with a total of eight students per university (n=24), meeting the sampling guidelines (Creswell & Clark, 2018b). The participants were encoded S1-S24, with S1-S8 from HCMUTE, S9-S16 from HCMNLU, and S17-S24 from HUFLIT.

3.1.4 Research tools

To assess the proficiency levels of students, the study utilized the MATPlatform, an online assessment tool developed based on the performance assessment method and aligned with the DigComp framework (see section 2.2.4).

In addition, to further examine the quantitative data collected from the survey of students and teachers, the study developed a set of questions for direct interviews with students regarding competence development activities at their respective universities.

3.1.5 Data collection

Quantitative data was collected during the academic year 2020-2021, whereas qualitative data was gathered from the end of August 2021 to September 2021, following the analysis of the quantitative data. The researcher conducted online interviews with students from different faculties in each university who had participated in the competence assessment survey, with each interview lasting about 30 minutes, after obtaining their consent. Prior to the interviews, the students were provided with relevant information, including the purpose of the interviews, guidance, interview questions, and assurances regarding data confidentiality.

3.1.6 Rating scale

The research project use 5-point Likert scale as show in this table.

Mean score	Awareness	Frequency	Influence
$4.2 \leq TB \leq 5$	Extremely aware	Very often	Extremely influential
$3.4 \leq TB < 4.2$	Moderately aware	Often	Very influential
$2.6 \leq TB < 3.4$	Somewhat aware	Sometimes	Somewhat influential
$1.8 \leq TB < 2.6$	Slightly aware	Rarely	Slightly influential
$1 \leq TB < 1.8$	Not at all aware	Never	Not at all influential

3.2 Findings

3.2.1 Current digital competence of university students

The findings reveal that the overall level of digital competence among students from all three universities is intermediate (4.62). The highest scoring competence is 5.1 (Solving technical problems, 6.50), while the lowest scoring competence is 3.3 (Copyright and licenses, 2.69). Additionally, seven competences where students are found to be at the foundation level are 1.2 (3.77), 2.4 (3.56), 2.6 (3.34), 3.1 (3.49), 3.2 (3.56), 3.3 (2.69), and 5.4 (3.57). It is evident that Digital Content Creation is the area where students exhibit the weakest performance, followed by Information and Data Literacy and Communication and Collaboration. The identification of students' competence gaps is limited in the study.

3.2.2 Current development of university students' digital competence

Overall awareness: The knowledge of digital competence is relatively new for both teachers and students. Many students mentioned that they were introduced to this kind of competence for the first time when participating in the survey. Furthermore, the majority of teachers are not aware of the significance of developing digital competence for students or the objectives associated with its development.

Content of digital competence development: In most areas of competence, students have not received instructions at the university level. The research findings indicate that students tend to demonstrate higher levels of proficiency in competences where they have received instructions from teachers. This finding aligns with previous studies that highlight the importance of teacher support for effective development of digital competence. Regarding the approaches to competence development, none of the participating teachers design dedicated training modules specifically focused on digital competence development, and more than 75% of teachers rarely or never integrate digital competence content into their courses.

Methods of digital competence development: Most teachers have not prioritized specific teaching methods for developing digital competence among students. However, more than half of them report frequently using digital teaching strategies and new pedagogical methods to enhance teaching effectiveness. Additionally, over 75% of teachers often or very often use teaching aids.

Assessment of digital competence development outcomes: Assessment activities to evaluate the outcomes of competence development have been rarely implemented.

Factors influencing digital competence development: The factors believed to have the greatest influence on competence development have not been supported or addressed in the study.

3.3 Overall assessment of current development of university students' digital comptetence

3.3.1 Strengths

The overall level of digital competence among students from all three universities is intermediate, with students from HCMUTE demonstrating advanced proficiency in certain component competences. Additionally, teachers have also shown intermediate proficiency in three component competences. The universities have implemented e-learning environments, and the majority of teachers have utilized digital platforms for searching and sharing digital resources with students, as well as for communication and interaction.

3.3.2 Limitations

Students are still at a basic level in many important competences. Furthermore, both teachers and students have limited awareness of digital competence development, and there is a lack of clear and specific plans for developing this competence among students in the universities. The implementation of teaching activities for the development of digital competence has been minimal, and many digital competence-related contents have not received sufficient support from teachers.

3.3.3 Causes of limitations

Research in this field is still in its early stages in Vietnam. While there are national-level policies regarding digital transformation in education, the actual implementation of these policies has been slow. Based on literature reviews, discussions with university leadership, and the researcher's practical experience, there are no specific policies addressing digital competence and its development for stakeholders in the educational system.

In addition, there is very little proactive research on digital competence for stakeholders on the part of universities, with only three studies focusing on digital competence of students (Vietnam National University, Hanoi) and two studies on digital competence of teachers (Vietnam National University, Ho Chi Minh City).

These factors contribute to the limited development of digital competence among university students today. The absence of specific roadmaps and policies to promote the development of digital competence for stakeholders in higher education institutions, along with insufficient understanding of digital competence and its importance for students, incomplete comprehension of the objectives and methods to support students among teachers, and certain limitations in teachers' own digital competence, have led to minimal implementation of activities to develop digital competence among students. Consequently, students have only achieved a basic level in many important competences.

Based on these research findings, Chapter 4 will present a measure to enhance students' digital competence through teaching activities.

Chapter 3 summary

Chapter 3 presents the research plan for examining the current development of students' digital competence, including the research objectives, research design, participants and contexts, sampling, research tools, data collection, and scaling.

The obtained results are analyzed to clarify the levels of proficiency among students and the current development of digital competence in universities in HCMC. The analysis focuses on several aspects: (1) the overall awareness of teachers regarding the development of students' digital competence, (2) the teaching contents related to digital competence, (3) the approaches to competence development for students, (4) the assessment methods for competence development, and (5) the factors influencing competence development.

The study also evaluates the strengths and limitations of the research findings and analyzes the reasons behind these limitations, serving as a basis for proposing measures to develop digital competence for students in the next chapter.

CHAPTER 4. MEASURE FOR DEVELOPING DIGITAL COMPETENCE FOR STUDENTS AT UNIVERSITIES IN HO CHI MINH CITY BY INTEGRATING DIGITAL COMPETENCE CONTENT INTO UNIVERSITY COURSES

4.1 Proposed solution

As the examination of digital competence development activities at the three types of universities in HCMC reveals, students have not reached a high level of digital proficiency and require support from universities in this regard.

However, the existing activities aimed at developing digital competence for university students lack clear and specific plans regarding the objectives, content, methods, and assessments of students' competence development. Moreover, the awareness of both teachers and students about the role and importance of digital competence is still limited. Therefore, it is crucial to implement specific activities that assist teachers in developing students' digital competence, especially in the absence of specific regulations and guidelines from the governing ministry and higher education institutions.

This chapter aims to present a strategy called "Developing digital competence for university students through the integration of digital competence content into university courses." The strategy provides guidance for teachers on the necessary steps to support students in developing digital competence through the courses they teach. The proposed strategy can be implemented immediately at universities.

4.2 Strategy for developing digital competence for students at universities in HCMC

4.2.1 Objective

The objective is to enhance the digital competence of university students by integrating digital competence-related content into the courses taught at the university level.

4.2.2 Content and implementation plan

In this study, integration refers to incorporating digital competence-related content into existing courses after analyzing their learning objectives and content. Following the guidelines for competence development for students in higher education by Duong Thi Kim Oanh (2022), the following steps should be taken to integrate digital competence content into existing courses.

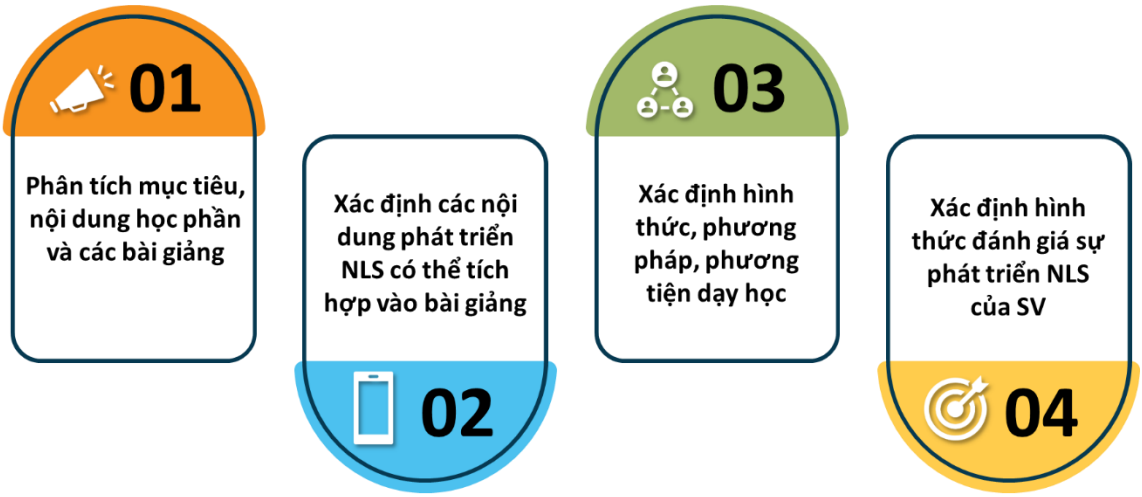

Figure 1: Steps to integrate digital competence

Step 1: Analyze the learning objectives, content and lectures of the course

Step 2: Identify digital competence content that can be integrated into courses

Step 3: Select appropriate teaching formats, methods and activities

Step 4: Identify digital competence assessment methods

4.2.3 Implementation requirements

Teachers must first have a clear understanding of the importance, objectives, and content related to developing digital competence for students. It is essential that they themselves possess sufficient digital competence to design and organize effective teaching activities. Furthermore, support policies and recognition from the university, faculty, and department play a significant role in motivating teachers to actively support students in their digital competence development.

In addition, ensuring the availability of necessary infrastructure requirements, such as reliable internet connections, digital devices, and resources that support the teaching process, is crucial for the successful implementation of the proposed strategy.

4.3 Applying the strategy for digital competence development at HCMUTE

4.3.1 Developing digital competence for Information Technology students through Web programming course

The review of the Web development course' materials has identified the relevant digital competence content that can be integrated into the course, specifically the domain of Information and Data Literacy. The teacher can guide students on techniques for searching, evaluating, and selecting appropriate information to be used in their final reports for the course. To incorporate the Information and Data Literacy component, the teacher uploads three topics with corresponding activities on the learning management system (LMS), including (1) browsing, searching, and filtering data, information, and digital content; (2) evaluating data, information, and digital content; and (3) managing data, information, and digital content. The teacher conducts online teaching sessions and provides demonstrations to students using Google Meet and other supportive tools. Students then practice and apply their knowledge to meet the course requirements and present their activities and results in the final reports.

At the beginning of the semester, the teacher conducts a pre-assessment of students' digital competence in Information and Data Literacy, both for the control group and the experimental group, to determine their current proficiency levels.

To assess the development of this competence, the teacher supplements a detailed rating scale for evaluating students' products, analyzes and compares the results between the two groups, and measures the level of competence attained by both groups after providing instructions on the content of Information and Data Literacy.

4.3.2 Developing Digital Competence for Garment Technology students through Work clothing design course

There are discussions with the teacher of the course to determine the content that can be integrated into the Work clothing design course, taking into account the teacher's expertise and feasibility of implementation.

After that, the teacher decides to provide instructions on two competence domains, (1) Information and Data Literacy, which involves searching for, evaluating, and selecting information for students' final reports, and (2) Digital Content Creation, which focuses on planning, filming, and publishing videos to demonstrate the content creation process and promote the product.

For the first competence domain, the teacher uploads materials on Information and Data Literacy divided into three topics with corresponding activities on LMS. These topics include (1) identifying information needs and proposing search strategies, (2) evaluating digital content, and (3) storing and utilizing data (see Appendix 4). The teacher provides general instructions to students using Google Meet and other supportive tools. Students engage in practical activities related to the three topics, applying their knowledge and skills to work on exercises and course assignments in groups.

Regarding the second domain, the teacher also uploads materials for three topics, including (1) filming and publishing videos, (2) integrating and recreating digital content, and (3) copyright and licences. These materials, along with corresponding activities, are made available on the LMS. Additionally, the teacher creates an instructional video demonstrating how to complete two required videos for Exercise 7 of the course.

Video 1: Describing the entire process of completing the tasks based on the given scenario to help viewers understand how the tasks are accomplished.

Video 2: Promoting and introducing the costume designed, including information about the target user and the product composition, to showcase how the designed costume aligns with the characteristics of a particular profession it is intended for.

At the beginning of the semester, both the control group and the experimental group of students participate in an assessment of their digital competence in two areas, Information and Data Literacy and Digital Content Creation. To evaluate the development of competence through students' work, the teacher uses a detailed rating scale, analyzing and comparing the results between the two groups, and re-assessing the digital competence of the experimental group after the intervention.

4.4 Designing contents for competence development of "Information and Data Literacy" and "Digital Content Creation" area at HCMUTE

4.4.1 Content for competence development of Information and Data Literacy area

According to the theory of content development of university students' digital competence presented in section 2.3.3, in order to develop the "Information and Data Literacy" area for students, lecturers must create learning activities that support students in developing three detailed competencies: (1) Browsing, searching, and filtering data, information, and digital content; (2) Evaluating data, information, and digital content; and (3) Managing data, information, and digital content. As a result, for each skill, instructors will create appropriate learning activities to assist students in learning and achieving the goals.

Topic 1: Browsing, searching, and filtering data, information, and digital content

Activity: Identifying information needs and proposing search strategies

Topic 2: Evaluating data, information, and digital content

Activity: Evaluating digital content

Topic 3: Managing data, information, and digital content

Activity: Storing and using data

4.4.2 Content for competence development in Digital Content Creation area

According to the theory of content development of university students' digital competence presented in section 2.3.3, in order to develop the "Digital Content Creation" area for students, lecturers must create learning activities that support students in developing three detailed competencies: (1) Developing digital content; (2) Integrating and re-elaborating digital content; and (3) Copyright and licenses. As a result, for each skill, instructors will create appropriate learning activities to assist students in learning and achieving the goals.

Topic 1: Developing digital content

Activity Filming and Publishing videos

Activity 1: Filming videos

Activity 2: Publishing videos

Topic 2: Integrating and recreating digital content

Activity: Creating a story map

Topic 3: Copyright and licences

Activity: Protecting copyrights of digital content

4.5 Experiment to develop students' digital competence at HCMCUTE

4.5.1 Conducting experiment

The experimental process consists of three phases as follows.

Stage 1: Preparation

Step 1: Determine the instructional purpose and content

Step 2: Select the institution and participant for the experiment

Step 3: Design instructional materials for the participating teacher

Step 4: Instruct the participating teacher in the experiment

Stage 2: Implementation

Step 1: Assess the proficiency levels of students in both control and experimental groups in the target competence areas using the MATPlatform tool

Step 2: Conduct the pedagogical intervention: The teacher guide students on digital competence-integrated content.

Step 3: Examine the results after the experiment

Stage 3: Analysis

Step 1: Process and analyze the experimental results

Step 2: Draw conclusions from the experiment

4.5.2 Results

According to the experimental results, students from both faculties showed improvement in digital competence in the targeted areas after receiving support from their teachers through materials and instructions related to Information and Data Literacy and Digital Content Creation during their courses. Furthermore, they achieved better academic results in the content areas where teacher support was provided.

Table 4: Information and Data Literacy of Information Technology students

Paired Samples Test					
Criteria	**Number of students**	**Difference in means**	**SD**	**SE**	**Sig.(2-tailed)**
Experiment group – Before and after the treatment					
Pair 1.1	37	-1.46	1.07	0.176	**0.000**
Pair 1.2	37	-1.89	0.88	0.144	**0.000**
Pair 1.3	37	-1.81	0.97	0.159	**0.000**
Control group – Before and after the treatment					
Pair 1.1	32	-0.13	0.42	0.074	**0.103**
Pair 1.2	32	-0.09	0.30	0.052	**0.083**
Pair 1.3	32	-0.22	0.66	0.117	**0.070**

Table 5: Differences in Information and Data Literacy and Digital Content Creation of Garment Technology students

Criteria	**Number of students**	**Difference in means**	**SD**	**SE**	**Sig.(2-tailed)**
Experiment group – Before and after the treatment					
Pair 1.1	28	-1.89	1.60	0.301	0.000
Pair 1.2	28	-3.25	1.00	0.190	0.000
Pair 1.3	28	-3.36	0.87	0.164	0.000
Pair 3.1	28	-2.89	1.17	0.220	0.000
Pair 3.2	28	-3.00	0.90	0.171	0.000
Pair 3.3	28	-2.89	1.03	0.195	0.000
Control group – Before and after the treatment					
Pair 1.1	21	-0.14	0.36	0.078	0.083
Pair 1.2	21	0.48	0.49	0.101	0.666
Pair 1.3	21	-0.24	0.54	0.118	0.056
Pair 3.1	21	-0.14	0.65	0.143	0.329
Pair 3.2	21	-0.24	0.99	0.217	0.286
Pair 3.3	21	-0.19	0.51	0.112	0.104

The experimental results provide preliminary evidence that teachers can support students in developing digital competence by integrating instructional content that promotes competence enhancement in suitable courses. The successful integration of competence development content into university courses serves as an important foundation for further competence development solutions within each training program.

Chapter 4 summary

Chapter 4 presents the proposed strategy for developing digital competence for students at universities in HCMC through the integration of competence development content into specific training program courses. The integrated courses chosen for this study are Web development and Work clothing design. The instructional contents of the integrated component were designed to provide practical instructions and assess the extent of students' competence improvement. The experimental findings, including pre-tests and post-tests, are presented and analyzed.

These results serve as a reference for higher education institutions to evaluate and develop measures for enhancing students' digital competence through the integration of digital competence content into training programs. In the long term, when policies regarding digital competence and competence development for all stakeholders within the educational system and higher education become more specific, more systematic and comprehensive measures for digital competence development of students can be implemented. The results also support previous findings that this integration is feasible and can help students improve their digital competence without the need for specialized courses dedicated to digital competence, thereby reducing pressure on students.

Based on the research findings in this chapter, the concluding remarks, recommendations, and directions for further research will be presented in the final section of the dissertation.

CONCLUSION AND RECOMMENDATIONS

1. Conclusion

Developing university students' digital competence is a crucial focus in today's higher education landscape to train a workforce that meet the demands of Industry 4.0 in the context of digital transformation. However, research in this area is still relatively new, with most studies focusing on the concepts and components of digital competence. Recent literature reviews have identified several research gaps. Specifically, there has been the reliance on self-assessment tools for examining students' levels of digital competence, which are considered unreliable, which points to a need for the development of better assessment tools based on knowledge and performance, with validation of their validity and reliability. Additionally, mixed-method studies are needed to yield more comprehensive results of digital competence development in higher education, as previous studies have primarily approached the topic from a single method perspective. Furthermore, there is a lack of research on specific measures to support students' digital competence development.

Therefore, this dissertation addresses these research gaps by identifying the research problem, hypotheses, and tasks, and conducting research accordingly. The research findings are summarized as follows.

Theoretical contributions: The dissertation systematizes and clarifies the theoretical basis for developing digital competence for university students, drawing on the ERAMUS+ project's results to develop a performance-based assessment tool. This tool enables more accurate evaluation compared to existing self-assessment tools. The theoretical foundations for developing digital competence for students are also identified.

Assessment of student's proficiency levels: The dissertation develops the MATPlatform, a web-based digital competence assessment platform, using the performance-based assessment method. This platform allows for a comprehensive, objective, and reliable evaluation of students' competence levels at universities in HCMC through action-oriented questions. The dissertation also surveys, interviews, and analyzes the current state of digital competence development at universities in HCMC, evaluating the strengths, limitations, and causes of these limitations. This serves as the basis for the proposed strategy to develop digital competence for university students.

Proposed solution: The dissertation proposes the integration of digital competence-related content into existing courses at universities as a means of developing students' digital competence. The strategy takes into account the correlation between theoretical foundations and the research findings on students' competence and competence development. The proposed strategy is implemented in two specific courses offered by the Faculty of Information Technology and the Faculty of Fashion and Tourism, HCMUTE, focusing on Information and Data Literacy and Digital Content Creation. The instructional contents are designed to assess the extent of improvement in students' digital competence.

Pedagogical experiments: The results of the pedagogical experiment demonstrate that students in the two faculties show improvement in the competence areas targeted by the integrated courses, Web development and Work clothing design, and achieve better academic results in the instructed contents. The experiments validate the hypotheses of the dissertation.

Furthermore, the dissertation contributes digital resources for competence development, including a "Handbook of digital competence development" and a "Monograph on Digital Competence".

2. Recommendations

Following the research findings, some recommendations with regard to the development of students' digital competence are presented below.

For universities:

- Universities should adopt the MATPlatform as an assessment tool to evaluate students' current levels of digital competence. The platform's flexibility allows universities to customize question sets based on different target groups, with diverse survey scales and scopes. MATPlatform can also facilitate the issuance of digital competence certificates to survey participants.

- Universities need to invest in ICT infrastructure to support the development of digital competence among students, ensuring at least convenient and fast Internet access.
- Universities should prioritize the training, cultivation, and development of digital competence among teachers and support staff, while allocating necessary resources and budgets to implement measures that enhance students' digital competence.
- Universities should incorporate the development of digital competence into the strategic planning of academic programs, and have plans to promote and enhance digital competence within each program to enhance graduates' competitive advantage and employment opportunities.

For faculties:

- Faculties need to proactively review and add digital competence learning outcomes to the program learning outcomes to support students' development of digital competence.

For lecturers:

- Lecturers need to proactively acquire knowledge of digital competence and actively participate in training courses and workshops on digital competence. Enhancing personal competence will enable lecturers to better support students' development of digital competence.

For students:

- Student need to take a proactive approach and actively explore digital competence by accessing existing assessment tools and referring to relevant resources and reference books to gain comprehensive knowledge. This will create favorable conditions for collaboration with course teachers and receiving support in developing digital competence.

3. Future research directions

Firstly, regarding the digital competence assessment tool, future research can consider developing a more diverse set of questions, particularly those simulating specific real-life situations and scenarios for each field of study, in order to better assess students' competence. The design of MATPlatform allows for flexibility to adjust and supplement new sets of questions, enabling it to be implemented in various research settings and scopes. Furthermore, this platform also allows for the customization of the digital competence framework and accompanying sets of questions to survey other research subjects. As a result, future studies can utilize this tool to conduct research on competence development for different research subjects.

Secondly, when examining students' proficiency levels and universities' attempts to develop competence for students, the study only surveyed one representative university from each type of university, thereby making it unable to generalize the research findings to a broader context in Vietnam. Additionally, the survey data in this study provided an overview of the current state of students' competence by analyzing the mean proficiency levels, without delving into the exploration of correlations related to gender, years of study at university, or students' competence across different fields of study. Moreover, although the study provided an overview of digital competence development for students at universities through surveying teachers and interviewing students, the analysis only focused on mean values, percentages, and students' opinions to obtain a general picture of students' proficiency levels, without examining the internal and external factors that influence their competence development. Therefore, future research can further explore these causal relationships.

Finally, regarding the solutions for students' competence development, this study only proposed a feasible measure within the research context and designed instructional contents for the pedagogical experiment in the competence areas of Information and Data Literacy and Digital Content Creation for students of HCMUTE's Faculty of Information Technology and Fashion and Tourism. Further research can explore other potential measures and experiments to help students gain higher levels of competence in other domains, gradually perfecting solutions to support students' development in all competence areas. After that, perform an in-depth examination of curriculums, supplementing interview data with lecturers on incorporating digital competence into program learning outcomes, and gradually integrating digital competence development for students into the broader curriculum.

PUBLISHED WORKS RELATED TO THE DISSERTATION

A – Conference papers

1. **Mai, A. T.,** Duong, T. K. O., & Ngo, A. T. (2022, July). Develop a Digital Competence Performance Assessment Platform for University Students Based on the DigComp Framework. In 2022 6th International Conference on Green Technology and Sustainable Development (GTSD) (pp. 91-97). ISBN 978-604-73-9622-1.
2. **Mai, A. T.,** Mai, Q. T., & Ngo, A. T. (2022, July). Digital Competence of University Students: A Comparative Study at Three Universities in Vietnam. In 2022 6th International Conference on Green Technology and Sustainable Development (GTSD) (pp 108-115). ISBN 978-604-73-9622-1.
3. **Mai, A. T.,** Mai, Q. T. (2022, July). Digital Competence of University Students: Developing Information and Data Literacy for IT Students at Ho Chi Minh City, University of Technology and Education. In 2022 6th International Conference on Green Technology and Sustainable Development (GTSD) (pp 493-498). ISBN 978-604-73-9622-1.

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1. **Mai, A. T.,** & Ngo, A. T. (2021). Phát triển năng lực số cho sinh viên đại học: Một số nghiên cứu và nhận định ban đầu. Tạp chí Giáo dục, (510, 2), 7-13.
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