



Developing Digital Competencies Among Higher Education Lecturers for the Industry 4.0: A Case Study at Tan Trao University, Vietnam

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In the context of the Fourth Industrial Revolution, digital transformation has become a key driver reshaping higher education, placing growing demands on university lecturers to effectively integrate digital tools into their teaching and professional practice. This study investigates the digital competencies of lecturers at Tan Trao University, Vietnam, using the DigCompEdu framework and the model proposed by Uerz et al. (2021). A structured questionnaire was administered to 154 full-time lecturers across diverse disciplines. Quantitative analysis, including descriptive statistics, T-tests, and ANOVA, was applied to assess competency levels and differences across demographic groups. The findings reveal generally high levels of self-perceived digital competence among lecturers, with significant variations by gender, age, academic qualification, field of teaching, and working position. Female lecturers scored higher in instructional design, while mid-career lecturers and PhD holders exhibited greater confidence in digital education design and professional engagement. Leadership positions were associated with higher digital literacy. The study underscores the need for stratified digital training, targeted policies, and supportive infrastructure to bridge competency gaps and enhance faculty readiness for digital transformation. These findings offer empirical insights and practical recommendations for policymakers, higher education institutions (HEIs) and individual lecturers aiming to strengthen digital competencies in Vietnam and similar contexts.

Keywords: Digital competencies, Lecturers, Higher education, Industry 4.0, Tan Trao University

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INTRODUCTION

The Industry 4.0, characterized by the fusion of advanced technologies such as artificial intelligence, big data, the Internet of Things, and cloud computing, is fundamentally transforming the landscape of higher education worldwide (Schwab, 2016). Recently, the number and quality of university lecturers in Vietnam have been steadily increasing. In 2015, there were approximately 69,591 lecturers nationwide; by 2021, this number had risen to 85,000. The academic qualifications of university lecturers have also improved across different levels, with an increasing proportion meeting higher qualification standards. Specifically, in 2015, 78.52% of lecturers held postgraduate degrees, while 21.41% held only undergraduate degrees. By 2021, the percentage of lecturers with

postgraduate qualifications had increased to 92.64%, and those with only undergraduate degrees had decreased to 7.36% (General Statistics Office of Vietnam, 2021). In Vietnam, as the country strives to integrate more deeply into the global knowledge economy, the imperative to equip university lecturers with robust digital competencies has never been more urgent.

First and foremost, digital transformation is redefining the roles and responsibilities of university lecturers. Digital technology is not merely a supportive tool but a decisive factor in enhancing the quality of teaching and learning. Lecturers play a key role in adopting and leveraging digital technology in their instructional practices; at the same time, they serve as guides and facilitators for students in accessing and utilizing technology. The integration of information technology into teaching promotes interaction between instructors and learners, making lectures more dynamic and flexible. It also enables both lecturers and students to search for and share information, thereby enhancing students' self-study abilities and problem-solving skills (Nguyen Thi Ngoc Anh, 2023). In the era of digital transformation, higher education is becoming "lecturer-centered," meaning that lecturers are positioned to take advantage of opportunities to innovate educational processes, improve teaching techniques, and strengthen their professional competencies (Phan, T. M. T., & Tieu, B. S., 2023). Traditional teaching methods—primarily based on face-to-face instruction and printed textbooks—can no longer meet the rapidly changing learning demands of students in the digital age. To adapt, lecturers must adopt blended and online teaching models, utilize Learning Management Systems (LMS), and design interactive, technology-enhanced learning experiences (Nguyen et al., 2021). A lack of digital skills may cause lecturers to fall behind, rendering their teaching approaches outdated and negatively affecting the quality of education.

Second, digital competencies are essential for fostering innovation in teaching, research, and academic administration. Lecturers with advanced digital skills can leverage data analytics to personalize learning, integrate virtual and augmented reality tools into classrooms, and collaborate with international peers through digital platforms (Redecker, 2017). Furthermore, in an era where research increasingly depends on digital tools for data collection, analysis, and dissemination, lacking digital fluency hinders lecturers' ability to engage in cutting-edge research and publish in international journals (Pham, T. V., 2021; Uoc, T. M., 2023).

Third, the Vietnamese government has placed strong emphasis on digital transformation in higher education. Policies such as the National Digital Transformation Program to 2025, with a vision to 2030 (Prime Minister of Vietnam, 2020), underscore the centrality of digital capabilities in achieving educational reform and innovation. However, the successful implementation of such policies depends heavily on the digital readiness of academic staff. Thus, HEIs must urgently invest in professional development programs, infrastructure, and institutional support systems to build digital capacity among lecturers (MOET, 2020).

Fourth, the Vietnamese government has recently issued the master plan for the network of Higher education and teacher training institutions for the period 2021–2030, with a vision to 2050, which sets increasingly high standards for university lecturers in terms of academic qualifications, teaching competencies, and research capabilities (Prime Minister of Vietnam, 2025). Therefore, enhancing digital competencies is a key enabler for university lecturers to pursue advanced training programs such as doctoral, postdoctoral, and internationally standardized courses to meet professional job requirements.

Finally, as students themselves are increasingly digital natives, a disconnect between their expectations and the digital preparedness of lecturers can create disengagement and reduce learning effectiveness. Ensuring that university educators can confidently use digital tools not only enhances instructional quality but also models the competencies that students themselves need in the future workforce (OECD, 2018).

Tan Trao University is a multidisciplinary university established in 2013 with nearly 160 lecturers working across a wide range of teaching and research fields such as education, educational psychology, economics, accounting, information technology, healthcare, and more. The selection of Tan Trao University as the research

site was intentional and contextually grounded. Currently, the university has been actively implementing strategic digital transformation initiatives aligned with national digital education policies, particularly the National digital transformation program to 2025, with a vision to 2030 (Prime Minister of Vietnam, 2020; Tan Trao University, 2023). Administratively governed by the Tuyen Quang Provincial People's Committee, the university has made substantial investments in digital infrastructure, adopted Learning management systems, and introduced blended learning models, making it a relevant and illustrative case for studying faculty digital readiness. In order to meet the required standards of a higher education institution, Tan Trao University has been focusing on developing a comprehensive digital transformation in its university governance system. Among its priorities, enhancing digital competencies for lecturers is considered a particularly urgent and essential task. Developing digital competencies for university lecturers in Vietnam and for Tan Trao University's lecturers particularly, is a strategic necessity in the context of Industry 4.0. It is not merely a matter of technological adoption but a broader transformation of higher education toward agility, inclusivity, and innovation.

LITERATURE REVIEW

The development of digital competencies among university lecturers has become an increasingly critical focus in contemporary educational research, particularly against the backdrop of rapid technological change and the widespread adoption of digital tools in higher education. The transition to digitally enhanced teaching and learning environments has reshaped the role of lecturers, requiring them not only to master technological tools but also to integrate these effectively into pedagogical practices.

A comprehensive review by Basilotta-Gómez-Pablos et al. (2022), which examined research published between 2000 and 2021 from the Web of Science and Scopus databases, documented the growing interest in digital competencies in academia. The review identified a gradual evolution in research themes, from basic ICT literacy to more integrated and pedagogically oriented frameworks, and emphasized the ongoing need for continuous professional development in digital skills for educators. Similarly, a meta-analysis conducted by Liesa-Orus et al. (2023) found significant variations in self-perceived digital competence across academic disciplines, reinforcing the importance of targeted and context-specific training programs to support faculty development.

To provide a coherent framework for assessing and guiding the development of digital competence, several internationally recognized models have been introduced. One of the most widely adopted is the Digital Competence Framework for Educators (DigCompEdu) developed by the European Commission. This framework defines 22 competencies organized into six key areas: professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence (Redecker, 2017). Studies such as Esteve-Mon et al. (2020) have demonstrated the applicability of DigCompEdu in higher education settings, particularly in aligning professional development initiatives with pedagogical transformation goals. Another foundational model is UNESCO's ICT Competency Framework for Teachers (ICT-CFT), which links educators' digital skills with broader educational objectives such as equity, quality, and inclusion (UNESCO, 2018). Unlike frameworks that focus solely on technical proficiency, ICT-CFT highlights the integration of digital tools into curriculum design, instructional practice, and teacher professional learning, thereby offering a scalable approach for national-level implementation. In addition to these frameworks, the Technological pedagogical content knowledge (TPACK) model proposed by Mishra and Koehler (2006) has significantly contributed to the understanding of how educators combine content expertise, pedagogical strategies, and technological tools. This integrative model provides a theoretical lens for exploring the complexities of technology-enhanced teaching and has been widely referenced in faculty development and digital transformation initiatives. Beyond theoretical considerations, empirical evidence underscores the impact of digital competence on teaching effectiveness and student outcomes.

For instance, García-Peñalvo et al. (2021) reported a positive correlation between lecturers' digital skills and students' perceived learning value, suggesting that enhanced digital competence among faculty can directly improve the quality of education delivered.

Despite these advances, challenges persist. Many educators face barriers such as unequal access to digital infrastructure, insufficient institutional support, and differing levels of digital literacy. Addressing these challenges requires a systemic approach that includes ongoing professional development opportunities, investment in digital infrastructure, and the cultivation of institutional cultures that encourage innovation in digital pedagogy (Cabero-Almenara et al., 2020; Basilotta-Gómez-Pablos et al., 2022; UNESCO, 2018).

Building on this body of literature, the present study adopts DigCompEdu as a primary theoretical framework and draws upon a context-specific adaptation by Uerz et al. (2021) tailored to higher education lecturers. By operationalizing this model within a Vietnamese university setting, the study contributes to the limited yet growing body of empirical research in Vietnam and in Southeast Asia that applies international frameworks to local educational contexts. Furthermore, while prior studies have often relied on generalized or self-reported measures of ICT proficiency, this study provides a multi-dimensional analysis of digital competence through four domains: Digital literacy, Competences in Designing, implementing and evaluating education, Student empowerment, and Professional digital competence. It also investigates how these competencies differ by gender, age, discipline, teaching experience, and job position. In doing so, the study not only adds empirical depth to global discussions on faculty digital readiness but also offers policy-relevant insights for developing targeted strategies to advance digital transformation in Vietnamese HEIs.

RESEARCH MODEL AND METHODOLOGY

Research model

The digital transformation in higher education has significantly reshaped the content, methods, and delivery modes of university instruction, steering them toward greater internationalization. Consequently, university lecturers are compelled to adapt their teaching approaches to align with these changes. In this context, lecturers' subject-matter expertise within digital education environments emerges as a critical component of their professional competencies in universities (Guillén Gámez, F. D et al., 2024). Digital competence stands out as a pivotal factor for lifelong learning and is essential for active participation in today's increasingly digitized society (Wesselink & Giaffredo, 2015).

Digital competence is broadly defined as an individual's ability to use information and communication technologies effectively within specific contexts (Nguyen, et al., 2024). It encompasses a combination of knowledge, skills, attitudes, strategies, and awareness necessary when utilizing information technology and digital media. Thus, digital competence involves deploying one's knowledge, skills, and attitudes in particular situations, supported by digital resources and tools (Nguyen et al., 2024). Digital competencies encompass a combination of knowledge, skills, and attitudes that enable individuals to use digital technologies effectively, critically, and responsibly across various contexts. According to the European Commission's DigComp framework, digital competence involves the confident, critical, and responsible use of digital technologies for learning, work, and participation in society (European Commission, n.d.).

Numerous digital competence frameworks have been proposed and applied to enhance the digital skills of educators. For instance, the Norwegian Centre for ICT in Education developed a professional digital competence framework for teachers, encompassing six key areas: understanding ICT in education; curriculum and assessment; pedagogical methods; application of digital competence; organization and management; and professional development. Digital competencies refer to the confident, critical, and responsible use of digital technologies for

learning, work, and participation in society. The European Commission's DigCompEdu framework outlines 22 specific competencies organized into six areas, including: Professional engagement, Digital resources, Teaching and learning, Assessment, Empowering learners, and Facilitating learners' digital competence. Similarly, the UK's framework for teachers and trainers in the education and training sector outlines twelve competency elements, including operating devices and software; information and data literacy; communication and collaboration in digital environments; digital safety and well-being; digital content creation; digital learning and development; professional digital practices; digital learning design; digital delivery; digital assessment; digital facilitation; and digital engagement with stakeholders. These frameworks provide structured guidance for educators to integrate digital technologies effectively into their teaching practices, ensuring they meet the evolving demands of modern education.

This study applied the framework for digital competences of lecturers developed by Uerz et al. (2021). This framework offers a comprehensive model tailored specifically for higher education. This framework was created as part of the Acceleration Plan for Educational Innovation with IT in the Netherlands, aiming to support lecturers in integrating digital technologies into their teaching practices effectively. The framework comprises four interrelated dimensions, each encompassing specific competencies essential for modern educators (Figure 1).

Research methodology

Data collection

The study employed a quantitative research design, utilizing a structured survey questionnaire as the primary instrument for data collection. The questionnaire was developed based on the Digital Competence Framework for Educators proposed by the European Commission, which outlines a comprehensive model of digital competence for educators (Redecker, 2017), and was further adapted to the higher education context using the framework

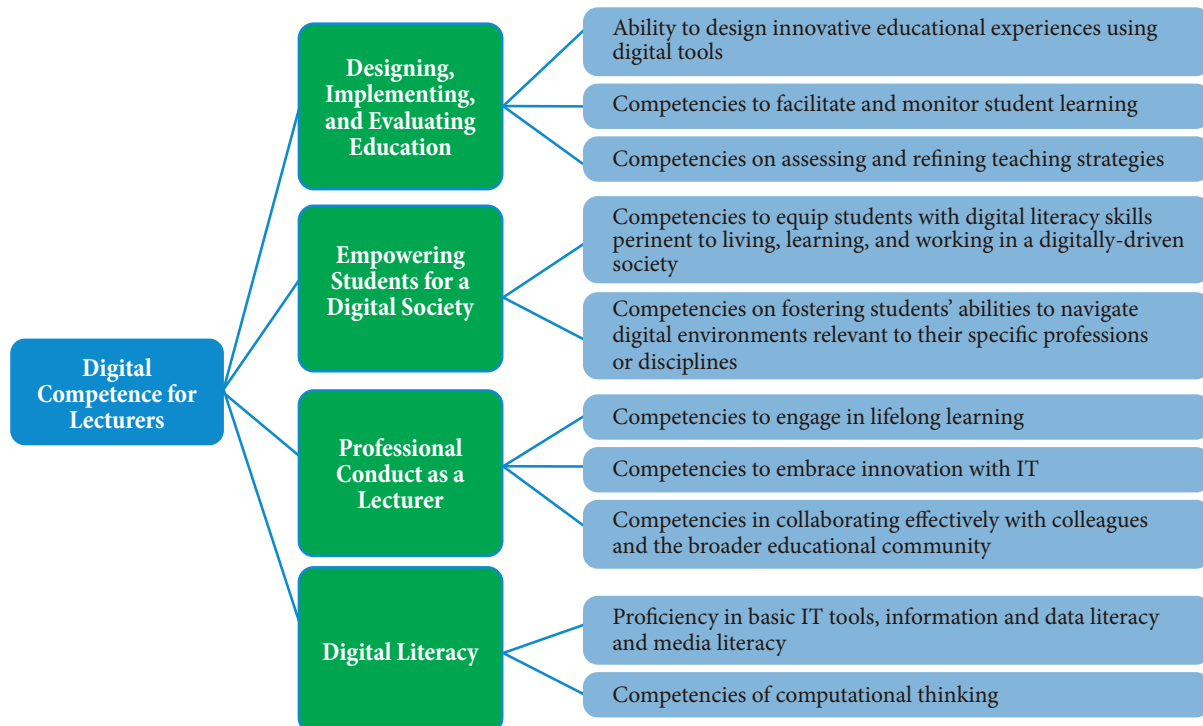


Fig. 1. Framework for digital competences of lecturers

Table 1. Measured Items for digital competencies

Competency Area	Sub-Competency	Survey Statements
Digital Literacy (DT)	Proficiency in basic IT tools, information and data literacy and media literacy	1. I can effectively implement digital technology and understand digital data positively and creatively in teaching. 2. I can use available digital tools in specific teaching contexts and recognize their impact on teaching and learning outcomes. 3. I can quickly adapt to and adopt new digital tools in the teaching process. 4. I actively stay updated with technological developments and am willing to experiment with new digital tools in teaching. 5. I can independently search, analyze, interpret, and evaluate the reliability of digital resources. 6. I can effectively access and use the Internet and social networks in teaching. 7. I understand copyright regulations and always properly cite digital resources used in teaching. 8. I can critically manage and protect student personal data in the teaching process.
	Computational thinking	1. I can present a problem involving digital technology in my teaching profession. 2. I can apply digital technology solutions to my academic discipline or research field. 3. I can develop digital solutions for teaching-related issues.
Designing, Implementing, and Evaluating Education (DE)	Designing innovative educational experiences using digital tools	1. I can use technology to creatively design teaching activities aligned with my discipline and institutional goals. 2. I can use digital technology to design and implement activities tailored to individual student needs. 3. I can organize teaching and support student learning across different learning environments (face-to-face, online, blended). 4. I can select, adapt, organize, and create digital teaching materials for instructional purposes.
	Facilitating and monitoring student learning	1. I can monitor and support student learning using formative and summative digital assessments. 2. I can collect, analyze, and report student data using digital technology. 3. I can use digital technologies to organize personalized learning for each student.
	Assessing and refining teaching strategies	1. I can apply digital tools to design and conduct student assessments. 2. I can use digital tools to gather feedback and process student performance data. 3. I can conduct assessments in various learning environments (in-person, online, etc.). 4. I can use digital tools to design online assessment systems suitable for students' disciplines. 5. I can use digital tools to assess and provide feedback in various formats aligned with learning objectives.
Empowering Students for a Digital Society (ES)	Equipping students with digital literacy skills pertinent to living, learning, and working in a digitally-driven society	1. I can guide students to use digital tools to support their learning. 2. I can guide students to use the Internet and social media responsibly in life, learning, and work. 3. I can teach students how to manage and protect personal and learning analytics data effectively with digital tools. 4. I can guide students to use digital tools to monitor and regulate their own learning process.
	Fostering students' abilities to navigate digital environments relevant to their specific professions or disciplines.	1. I can guide students to explore and apply digital tools relevant to their training disciplines. 2. I can encourage students to research and contribute to the development of digital tools in their field of study. 3. I can organize activities to develop students' digital communication skills.
Professional Digital Competence (PC)	Lifelong learning with digital tools	1. I actively seek online learning opportunities to update professional knowledge and skills. 2. I can identify the digital skills needed for my professional growth. 3. I can evaluate and adjust my personal learning activities when necessary.
	Embracing innovation with IT	1. I actively explore new digital tools or technologies that could enhance teaching, learning, or research activities. 2. I regularly experiment with new approaches to integrate technology into my instructional or professional practices. 3. I am confident in adapting to emerging educational technologies and promoting digital innovation within my institution.
	Collaborating in digital environments	1. I can participate in professional educator networks to co-create and develop digital education. 2. I can collaborate in designing and evaluating innovative digital education. 3. I can use digital tools to communicate with students and colleagues around the world.

developed by Uerz et al. (2021), which aligns with the roles and responsibilities of university lecturers. The questionnaire measured digital competence across four core dimensions: Digital Literacy; Designing, Implementing and Evaluating Education; Empowering Students; and Professional Digital Competence. Its structure comprised two main sections: (1) 38 closed-ended items (see Table 1) rated on a five-point Likert scale (1 = Strongly disagree to 5 = Strongly agree), and (2) five demographic questions related to gender, age, academic discipline, teaching experience, and job position.

The study was conducted with full-time lecturers currently working at Tan Trao University. These participants are directly involved in teaching and academic research across a wide range of disciplines, including Education, Educational Psychology, Natural and Social Sciences, Economics, Accounting, Information Technology, and Health Sciences. This disciplinary diversity ensures a comprehensive assessment of digital competence across various fields of knowledge, aligning with previous research that has highlighted differences in digital skill development across academic disciplines (Liesa-Orus et al., 2023). A pilot test was conducted with 12 lecturers to assess the clarity and reliability of the instrument. After revising some of the unclear items, the finalized version of the questionnaire (see Table 1) was distributed in both online and printed formats to optimize the response rate. Data collection was carried out over a four-week period in early 2025, and a total of 154 valid responses were obtained from full-time lecturers at Tan Trao University, approximately 98.7% of the institution's teaching staff.

Data processing and analysis

All data were coded and processed using SPSS version 26.0, following a systematic procedure that included data validation and cleaning; reliability testing of each subscale using Cronbach's Alpha, with all four domains achieving coefficients above 0.80—indicating strong internal consistency (Field, 2018); descriptive statistics; and inferential statistics using independent samples T-tests, one-way ANOVA, and Levene's test for homogeneity of variance. All statistical tests were performed at a significance level of $\alpha = 0.05$. The goal of the analysis was to provide an overview of lecturers' digital competence levels and identify significant differences across demographic groups, thereby informing policy recommendations and practical strategies for professional development aligned with institutional and national digital transformation efforts.

RESULTS AND DISCUSSION

The survey collected 154 valid responses from full-time lecturers working at Tan Trao University. The sample characteristics are described in Table 2 below.

To provide an overview of the key research constructs in the model, including: Digital Literacy (DT), Designing, Implementing, and Evaluating Education (DE), Empowering students for a digital society (ES) and Professional Digital Competence (PC), the study conducted descriptive statistics for the composite variables representing each construct. Table 3 presents a descriptive analysis of these composite variables, based on data from 154 valid observations.

Table 3 showed that the surveyed lecturers demonstrate high levels of digital competence in instructional design and implementation, while digital literacy and the ability to empower students reveal more variability. These findings suggest the need for targeted professional development, especially for groups with lower self-perceived digital skills, to ensure equitable and effective integration of technology in higher education. Fostering peer learning, mentoring, and lifelong digital learning pathways will further support a balanced competency profile across the academic workforce. Digital Literacy (DT) component recorded a mean score of 4.159 (on a 5-point scale), with values ranging from 3.49 to 4.62. The standard deviation was about 0.180, indicating a relatively low dispersion of responses around the mean. This suggests that the lecturers generally perceived themselves to possess

Table 2. Sample description

	Count	%	DT	DE	ES	PC
Gender						
Female	76	49.35	4.17	4.22	4.21	4.31
Male	78	50.65	4.19	4.16	4.24	4.25
Age						
Under 30	39	25.32	4.14	4.28	4.22	4.23
30-39	56	36.36	4.20	4.32	4.24	4.24
40-49	32	20.78	4.18	4.34	4.23	4.22
Over 50	27	17.53	4.15	4.26	4.20	4.18
Academic Title/Degree						
Professor	0	0.00	3.49	4.41	3.65	3.75
Associate Professor	1	0.65	4.18	4.43	4.24	4.28
PhD	41	26.62	4.18	4.34	4.20	4.24
Master's Degree	110	71.43	4.19	4.32	4.24	4.21
Others	2	1.30	4.11	4.32	4.19	4.18
Field of Teaching and Research						
Natural Sciences and Health Sciences	38	24.68	4.20	4.26	4.22	4.26
Social Sciences and Humanities	58	37.66	4.19	4.32	4.24	4.23
Engineering and Technology	35	22.73	4.02	4.33	4.22	4.26
Interdisciplinary Sciences and Arts	23	14.94	4.13	4.30	4.21	4.08
Experience in Higher Education						
<3 years	11	7.14	4.12	4.29	4.13	4.21
3-5 years	45	29.22	4.25	4.34	4.32	4.26
5-10 years	34	22.08	4.19	4.34	4.26	4.26
>10 years	64	41.56	4.17	4.33	4.21	4.22
Position						
University Leadership	2	1.30	4.62	4.62	4.40	4.17
Department/Faculty/Center/Institute Manager	26	16.88	4.14	4.32	4.18	4.17
Lecturer	123	79.87	4.20	4.22	4.23	4.25
Others	3	1.95	4.25	4.41	4.05	3.97

Source: Synthesized by authors

Table 3. Descriptive analysis

	N	Minimum	Maximum	Mean	Std. Deviation
DT	154	3.49	4.62	4.15913	0.179897
DE	154	4.16	4.62	4.32517	0.089233
ES	154	3.65	4.40	4.20695	0.134753
PC	154	3.75	4.31	4.19269	0.119667
Valid N (listwise)	154				

Source: Synthesized by authors

a high and consistently distributed level of digital literacy. Designing, Implementing, and Evaluating Education (DE) had the highest mean score among the four dimensions, at 4.325, with a narrow range from 4.16 to 4.62 and a very low standard deviation of 0.089. This implies a strong consensus among lecturers regarding their competence

in designing and evaluating digitally supported educational activities. Empowering students for a digital society (ES) showed a mean of 4.207, with a slightly wider range from 3.65 to 4.40 and a standard deviation of 0.135. Although still reflecting generally high perceived competence, the greater variability suggests that some lecturers may feel less confident in this area, particularly in enabling students to navigate and engage in digital environments effectively. Last, professional digital competence (PC) has mean score at 4.193, with values spanning from 3.75 to 4.31 and a standard deviation of 0.120. This reflects a fairly high and consistent perception of professional-level digital capabilities, including the use of digital tools for collaboration, communication, and personal professional development. Overall, the results indicate that lecturers at Tan Trao University exhibit strong self-perceived digital competencies across all four measured dimensions. The relatively small standard deviations across all components suggest a high level of consistency in responses, with the greatest variation observed in the “Empowering students” dimension. The highest mean score in the “Designing, Implementing, and Evaluating Education” component highlights lecturers' confidence in using digital tools to enhance pedagogical practices.

To ensure the internal consistency of the measurement scales, the study employed Cronbach's Alpha to assess the reliability of each scale. According to Hair et al. (2010) and Nunnally & Bernstein (1994), a scale is considered reliable when Cronbach's Alpha coefficient is ≥ 0.7 . Specifically: Cronbach's Alpha ≥ 0.9 is considered excellent; $0.8 \leq$ Cronbach's Alpha < 0.9 is good; and $0.7 \leq$ Cronbach's Alpha < 0.8 is acceptable. In addition, the Corrected Item-Total Correlation for each item should be ≥ 0.3 . The reliability testing results of the scales are presented in Table 4 below.

These results confirm the reliability of the measurement scales used in this study. Each domain meets or exceeds the reliability criteria, providing a solid foundation for further analysis. Specifically: The Digital literacy scale comprised 10 items and achieved a Cronbach's Alpha of 0.889, which reflects high internal consistency. The corrected item-total correlation values ranged from 0.349 to 0.457, all exceeding the minimum threshold of 0.30. These results indicate that all items contribute adequately to the overall construct, and therefore, all were retained for further analysis. The measurement of Designing, Implementing, and Evaluating Education (DE) consisted of 12 items and yielded a Cronbach's Alpha of 0.856, indicating good reliability. The CITC values ranged between 0.418 and 0.482, confirming the satisfactory contribution of each item to the construct. As such, all items were deemed appropriate and retained. Variable “Empowering Students for a Digital Society” with 7 items, demonstrated excellent reliability, as evidenced by a Cronbach's Alpha of 0.904. The CITC values fell within the range of 0.449 to 0.495, supporting the strong internal coherence of the scale. Given these robust indicators, all items were retained without modification. Professional Digital Competence (PC) included 9 items and achieved a Cronbach's Alpha of 0.875, signifying good internal consistency. Although the CITC values ranged from 0.333 to 0.395—slightly lower compared to other constructs—they were nonetheless above the critical value of 0.30. Consequently, all items were retained for

Table 4. Reliability of measurement

Measurement	Number of Items	Cronbach's Alpha	Corrected Item-Total Correlation	
Digital Literacy (DT)	10	0.889	0.349 – 0.457	Acceptable – retained
Designing, Implementing, and Evaluating Education (DE)	12	0.856	0.418 – 0.482	Acceptable – retained
Empowering Students for a Digital Society (ES)	7	0.904	0.449 – 0.495	Excellent – retained
Professional Digital Competence (PC)	9	0.875	0.333 – 0.395	Acceptable – retained

Source: Synthesized by authors

subsequent analyses. Therefore, all four constructs demonstrated acceptable to excellent levels of internal consistency, with Cronbach's Alpha coefficients ranging from 0.856 to 0.904. The corrected item-total correlation values for all items exceeded the recommended threshold, confirming the reliability and appropriateness of the measurement scales. It means that all items were retained for further statistical analysis.

To examine whether digital competence differs significantly between male and female lecturers, independent samples T-tests were conducted for each of the four core competence domains. Prior to conducting the T-tests, Levene's test was applied to assess the assumption of homogeneity of variances. The results are mentioned in Table 5.

The results indicate a statistically significant difference in Designing, Implementing and Evaluating Education (DE) between male and female lecturers ($p = 0.0009$). Although Levene's test for the Empowering Students (ES) variable indicated unequal variances ($p = 0.0331$), the T-test did not show a significant difference ($p = 0.4874$). Specifically, there is a statistically significant difference between male and female lecturers in DE domain, with female lecturers reporting higher mean scores ($M = 4.22$) compared to male lecturers ($M = 4.16$), $t(152) = 3.39$, $p < 0.01$. Levene's test for this variable confirmed the assumption of equal variances ($p = 0.87$), validating the use of the standard T-test. For the other three domains including DT, ES, and PC, the T-test results did not reveal any statistically significant differences between genders. Notably, Levene's test for ES indicated unequal variances ($p = 0.033$), but the adjusted T-test still yielded a non-significant result ($p = 0.49$), suggesting that gender does not meaningfully influence lecturers' self-perceived competence in student empowerment. These findings suggest that, while male and female lecturers generally perceive themselves to be similarly competent in most aspects of digital teaching, female lecturers may feel more confident in designing, implementing, and evaluating digital learning environments. This may reflect differences in instructional practices, pedagogical approaches, or professional development experiences between genders, an area that warrants further qualitative investigation.

To evaluate whether there are statistically significant differences in digital competence among lecturer groups based on demographic characteristics, one-way ANOVA tests were conducted on the four key components of digital competence. This analysis also aims to assess how digital competence varies among lecturers at Tan Trao University across different demographic categories, in order to propose appropriate policies and targeted support strategies to enhance digital capacity within specific faculty groups. The main results are summarized in Table 6 below.

Table 5. Results of Levene's test and T-test

Variables	Levene statistic	Levene p -value	T-test statistic	T-test p -value
DT	0.5017	0.4798	-1.1909	0.2355
DE	0.0270	0.8696	3.3922	0.0009*
ES	4.6250	0.0331*	-0.6962	0.4874
PC	0.0023	0.9619	1.0185	0.3100

Source: Synthesized by authors

Table 6. Results of ANOVA test by demographic variables

Variable	Age		Discipline		Degree		Experience		Position	
	F	p -value	F	p -value	F	p -value	F	p -value	F	p -value
DT	0.899	0.443	0.673	0.571	0.211	0.888	0.712	0.547	3.781	0.013
DE	3.214	0.028	1.882	0.135	4.548	0.004	1.254	0.292	1.254	0.292
ES	2.998	0.034	1.239	0.296	3.267	0.023	1.116	0.315	2.87	0.059
PC	3.547	0.021	3.321	0.020	1.129	0.341	1.741	0.161	1.741	0.161

Source: Synthesized by authors

The one-way ANOVA tests were conducted to examine whether significant differences exist in lecturers' digital competencies across various demographic characteristics, including age group, academic discipline, teaching experience, position, and academic degree. The four core dimensions of digital competence analyzed were Digital Literacy (DT), Designing, Implementing and Evaluating Education (DE), Empowering Students (ES), and Professional Digital Competence (PC). Specifically:

Digital Literacy (DT): Among the four domains, Digital Literacy (DT) showed no significant differences across age, discipline, experience, or academic degree. However, a significant difference was observed in DT scores across job positions ($F = 3.781, p = 0.013$), with academic leaders (faculty and university level) reporting higher levels of digital literacy than lecturers and staff in other roles. This may be explained by the broader administrative and strategic responsibilities these individuals hold, which require consistent and advanced use of digital tools for communication, planning, and institutional governance.

Designing, Implementing, and Evaluating Education (DE): Significant differences were found in DE scores across age groups ($F = 3.214, p = 0.028$) and academic degrees ($F = 4.548, p = 0.004$). Lecturers aged 30–39 reported the highest levels of confidence in designing and evaluating digital learning environments, followed by the 40–49 age group, then those under 30, with the lowest scores observed among those over 50. This trend suggests that younger mid-career faculty may be more engaged with pedagogical innovation or have received more structured training in digital curriculum design. In terms of academic qualification, PhD holders reported the highest DE scores, followed by Associate Professors, then Master's degree holders, with the lowest scores in the 'Others' group. This hierarchy reflects the potential role of advanced research training and academic exposure in strengthening skills related to digital instructional design, evaluation, and course development.

Empowering Students (ES): The Empowering Students domain also showed significant differences by age ($F = 2.998, p = 0.034$) and academic degree ($F = 3.267, p = 0.023$). Interestingly, the highest ES scores were reported by lecturers aged 40–49, followed by those over 50, then 30–39, with the lowest scores in the under-30 group. This pattern suggests that teaching experience may contribute to more mature and confident approaches to empowering students in digital contexts, such as facilitating independent learning, collaboration, and ethical engagement. By academic qualification, Associate Professors reported the highest ES scores, followed by Master's degree holders, PhD holders, and then others. While PhD holders typically demonstrate strong research competence, this result may reflect a greater emphasis among Associate Professors on student-facing instructional practices, as opposed to more research-oriented roles. In addition, job position was found to moderately influence ES ($F = 2.870, p = 0.059$), with departmental leadership roles (e.g., deans, heads of faculty) reporting the highest scores, followed by university leadership, then lecturers, and others. These findings indicate that those in academic management positions may have a broader perspective on student needs and institutional responsibilities in cultivating digital citizenship.

Professional Digital Competence (PC): Significant differences in PC were observed across age ($F = 3.547, p = 0.021$) and academic discipline ($F = 3.321, p = 0.020$). Faculty in the engineering and technology fields reported the highest levels of professional digital engagement, followed by natural sciences, social sciences, and finally interdisciplinary sciences and arts. These results are consistent with expectations that technical fields tend to involve more frequent digital collaboration, publishing, and use of advanced platforms for academic communication. The age-related trend for PC mirrored the findings in DE, with lecturers aged 30–39 and 40–49 reporting higher scores compared to their younger and older counterparts. This suggests that digital professionalization peaks in early- to mid-career phases, potentially due to a combination of digital fluency, career development needs, and institutional engagement.

The ANOVA results underscore that demographic factors such as age, academic rank, field, and job position do influence lecturers' perceived digital competence, but in distinct ways across the four domains. Some remarkable results include: Mid-career lecturers and those with higher academic qualifications are more confident in digital instructional design and professional engagement; Leadership roles and technical fields correspond to higher levels of specific digital skills; and Younger lecturers may require more support in student empowerment and professional engagement. These findings point to the importance of targeted digital training programs, which should consider lecturers' age, qualification level, and field of specialization to maximize relevance and effectiveness. HEIs should also foster a culture of digital inclusion, ensuring that all faculty, regardless of demographic background, have equal access to tools, training, and pedagogical support in the context of educational digital transformation.

CONCLUSION AND RECOMMENDATIONS

The study has explored the digital competencies of university lecturers within the context of Industry 4.0, using Tan Trao University in Vietnam as a case study. Based on the findings of this study, particularly the variations in digital competence observed across age, academic qualification, specialization, and position, the following detailed recommendations are proposed to support the long-term development of digital competencies among higher education lecturers.

For policymakers and educational authorities

Establish national digital competence standards for lecturers. It is essential to develop or adopt internationally recognized competency frameworks (e.g., DigCompEdu, ICT-CFT, TRACK) and adapt them to the Vietnamese context. These frameworks help guide effective integration of technology into teaching content and methods. Aligning with international standards ensures training quality, transferability, and opportunities for global academic collaboration.

Allocate resources for building digital capacity in universities. The central and local governments should provide targeted funding for universities to upgrade their digital infrastructure, implement digital pedagogy training, and incentivize faculty participation in digital transformation initiatives. At the same time, more proactive policies are needed to promote equity in digital transformation across different regions and institutions. This includes launching support programs for under-resourced universities, particularly in rural and mountainous areas, to narrow the digital divide. In parallel, national-scale digital literacy development programs should be developed to ensure equal access and opportunities for all lecturers.

Enhance collaboration among government, universities, and industry. Building an innovation ecosystem, and specifically, a digital ecosystem that encourages co-design of training content, sharing of best practices, and practical engagement will enable lecturers to access cutting-edge educational technologies and real-world applications.

Strengthen the monitoring and evaluation of digital education policies. The government and the education sector should establish feedback mechanisms to assess the effectiveness of digital competence training and support programs. The results of monitoring and evaluation should serve as an important and meaningful basis for policy adjustment, addressing emerging challenges, and ensuring alignment with the practical needs of lecturers in the digital era.

For higher education institutions

First, HEIs need to design and implement differentiated digital training programs tailored to specific lecturer groups. Rather than applying a one-size-fits-all approach, universities should develop stratified and specialized training programs based on the unique characteristics of each lecturer demographic. Specifically, early-career lecturers (under 30 years old or with less than three years of experience) should receive training in basic digital skills, the use of instructional technologies, and methods to enhance student engagement in online learning environments. Meanwhile, mid-career lecturers (ages 30–49) should be provided with advanced courses on digital assessment design, data-informed instruction, and innovative pedagogical methods that align with their accumulated experience. Senior lecturers (over 50 years old), who may face difficulties in adapting to new technologies, should be supported through practical training programs with user-friendly guidance, emphasizing usability and alignment with their teaching objectives. Furthermore, training content should be designed according to disciplinary specialization, with sector-specific examples (e.g., STEM, social sciences, arts, interdisciplinary fields) to ensure relevance and applicability.

Second, it is essential to institutionalize digital competence within performance evaluation and professional development systems. Digital competence should be formally integrated into performance appraisals, promotion criteria, and workload allocations. HEIs should: develop digital competence indicators in self-evaluation and peer-review forms used in annual assessments; establish reward mechanisms or priority consideration for promotion for lecturers who demonstrate excellence in digital teaching; and offer training certificates or micro-credentials for digital training programs that count toward continuous professional development. Institutionalizing digital competence not only affirms its importance but also motivates lecturers to invest more seriously in enhancing their digital skills.

Third, besides general policies regulated by Government and Local Authorities, strengthening digital infrastructure and technical support systems by internal organizational resources is critical. Reliable internet access, updated learning management systems, and responsive technical support are fundamental to supporting digital teaching and learning. Moreover, equipping faculty with access to modern platforms and tools ensures that lecturers can innovate without being constrained by technological limitations. In parallel with the development of digital infrastructure, HEIs need to formulate supportive policies and incentives to encourage lecturers to enhance their digital competencies. These policies aim to create a motivating and timely support environment for lecturers in their journey of digital capacity development. To implement this solution effectively, institutions should focus on the following key actions: (i) Develop specific policies to support lecturers in accessing and using educational technologies. These policies may include providing funding for the purchase of devices and software, offering technical support and training, and introducing incentives to participate in courses and activities related to digital competencies. (ii) Ensure transparency and fairness in institutional policies and incentives. All lecturers should have equitable access to support resources and opportunities for digital competency development, regardless of department or position. (iii) Foster partnerships with external organizations and businesses to support the digital competency development of lecturers. Collaborations with partners can provide funding, specialized training, and internship opportunities, enabling lecturers to experience the practical applications of educational technologies and gain early exposure to emerging digital tools in education. (iv) Conduct regular evaluations of the effectiveness of policies and support measures for digital competency. Feedback from assessments of lecturers' digital capabilities should inform adjustments and improvements to these policies, ensuring they meet the evolving needs of digital transformation. In addition, lecturers who demonstrate outstanding achievements in digital transformation should be promptly recognized and rewarded, thereby motivating others to strive for excellence.

Fourth, HEIs should promote digital communities of practice. Creating a culture of peer learning and sharing among lecturers is a key factor in ensuring the sustainable development of digital competence. Institutions

should implement peer-to-peer mentoring programs, encouraging knowledge exchange across generations and departments. Additionally, HEIs should establish digital teaching communities of practice to share experiences, co-develop teaching materials, test new tools, and provide feedback on results. Internal forums, publications, or showcases should also be organized to disseminate successful practices and inspire innovation. These peer networks reduce technology-related anxiety, promote experimentation, and support collaborative development.

Fifth, HEIs should actively strengthen international collaboration with universities in developed countries within the region and globally. Such cooperation provides critical platforms for faculty to engage with modern pedagogical innovations and digital technologies. A particularly promising avenue is expanding participation in Living Lab educational collaborations—such as the ongoing partnership between Tan Trao University and Yonsei University (South Korea). While this collaboration has yielded positive outcomes, the number of participating lecturers remains limited. Therefore, Tan Trao University should introduce incentive mechanisms that encourage broader faculty involvement. These may include formal recognition in performance evaluations, professional development credits, or financial support for participation in international joint programs. Engaging in Living Lab educational cooperation allows lecturers to experience cross-cultural educational environments and apply advanced digital tools in real-world problem-solving contexts. This not only enhances their capacity for instructional innovation but also supports the development of advanced digital competencies aligned with the DigCompEdu and Uerz et al. (2021) frameworks. By fostering such international exchange programs, HEIs contribute to their faculty's continuous professional growth and ensure alignment with global trends in higher education transformation. Moreover, HEIs should institutionalize strategic partnerships for digital competency development by signing memoranda of understanding (MOUs) with international counterparts, establishing joint research initiatives, and co-developing short-term exchange programs focused on digital skills training for faculty members.

Last but not least, to achieve sustainable development goals, HEIs should actively promote research and innovation in digital teaching. Institutions should encourage lecturers to engage in action research and experimentation in digital pedagogy by providing research funding for innovative teaching projects using new technologies, establishing interdisciplinary research teams or digital education labs to co-develop models, share expertise, and disseminate findings, and linking digital competence development with applied research and continuous pedagogical improvement.

For individual lecturers

To proactively adapt to and effectively contribute to the digital transformation of higher education, individual lecturers are encouraged to undertake personal development efforts.

Engage in continuous digital upskilling. Lecturers should actively update their digital skills through online courses, workshops, webinars, and certification programs. Priority areas include the use of Learning Management Systems (LMS), digital content creation tools, data analytics for teaching, and collaborative learning platforms. Beyond basic technical proficiency, lecturers should integrate digital tools into their teaching practices in ways that align with learning objectives, increase student engagement, and foster interactive and inclusive learning experiences.

Participate in digital teaching communities. Lecturers should proactively join or initiate peer support networks and communities of practice, both within and outside their institutions. Sharing experiences, resources, and solutions promotes mutual learning and helps reduce the sense of isolation often felt during the transition to digital environments. Accordingly, lecturers should not hesitate to experiment with new teaching methods or technologies such as flipped classrooms, blended learning models, small-scale pilot projects, or AI-based tools to

enhance instructional quality. During teaching, lecturers should also regularly evaluate the effectiveness of their digital strategies through student feedback, peer reviews, or self-reflection. This practice helps identify areas for improvement and ensures the relevance and effectiveness of digital integration.

Update digital education trends and policies. Lecturers should keep track of institutional and national policies related to digital education, as well as emerging global trends. This awareness helps guide personal development in alignment with the strategic goals of their institutions and external expectations. At the same time, lecturers should actively seek support from instructional designers, IT staff, and academic development centers. Effective collaboration with these support units can help overcome technological barriers and enhance the quality of digital course design.

The study contributes to the growing literature on digital transformation in higher education by offering empirical insights into faculty digital readiness at a provincial public university. It emphasizes the necessity of context-specific interventions, ranging from differentiated professional development to structural investments in digital infrastructure and policy reform. Although this study was limited to a single university, it maintained internal diversity in terms of academic disciplines and demographic characteristics, while also aligning with national digital education policy directions; thereby ensuring contextual depth and relevance. However, the study acknowledges that the single-case design limits the generalizability of the findings. Therefore, future research is recommended to expand the sampling scope to include HEIs across different regions, in order to enhance the representativeness and applicability of the results for policy development.

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4차 산업혁명 시대를 위한 고등교육 교수자의 디지털 역량 개발: 베트남 탄짜오 대학교 사례 연구

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인더스트리 4.0(Industry 4.0) 시대를 맞아 디지털 역량은 고등교육 개혁의 핵심 요소로 부각되고 있다. 본 연구는 베트남 탄짜오대학교(Tan Trao University)를 사례로 하여 대학 교수들의 디지털 역량 현황을 조사하고, 이를 개발하기 위한 전략을 제안한다. Uerz 외(2021)가 제시한 교육자를 위한 디지털 역량 프레임워크를 바탕으로, 다양한 전공 분야의 교수 154명을 대상으로 설문조사를 실시하였다. 양적 자료 분석과 질적 통찰을 결합한 혼합 연구 방법이 사용되었다. 연구 결과, 탄짜오대학교 교수들은 디지털 교육을 설계하고 실행하는 역량에서는 높은 수준을 보였으나, 기본적인 디지털 문해력 및 학습자 역량 강화 측면에서는 차이가 존재하는 것으로 나타났다. 다중 회귀분석 결과, 디지털 교육 설계와 학습자 역량 강화가 디지털 역량의 가장 강력한 예측 변수로 밝혀졌다. 본 연구는 디지털 인프라에 대한 투자, 목표지향적인 직무 연수 프로그램, 제도적 지원 정책, 동료 멘토링 시스템의 필요성을 강조한다. 본 연구 결과는 고등교육의 디지털 전환 관련 문헌에 기여함과 동시에, 교수의 디지털 역량 강화를 모색하는 대학들에게 실질적인 시사점을 제공한다. 이 연구는 교육 혁신을 주도하고 베트남 고등교육의 디지털 격차를 해소하기 위해 교육자들에게 필요한 역량과 지원의 전략적 중요성을 부각시킨다.

주제어: 디지털 역량, 교수자, 고등교육, 인더스트리 4.0, 탄짜오대학교

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