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Developing and Validating a Digital Competence Framework for Pre-service STEM Teachers: Evidence at a Public University in Vietnam

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Abstract

The higher education system in Vietnam has many opportunities and challenges brought about by digital transformation, especially in building excellent human resources. The primary responsibility for building a teaching staff with high moral qualities and meeting the criteria for required competence and adaptability to the needs of the social environment lies with the key pedagogical universities. There are two research objectives that this study aims to resolve: (1) What are the standards and definitions proposed for a framework of digital competency for pre-service Science, Technology, Engineering, and Mathematics (STEM) teachers? (2) What are the basic guidelines that can lead to the assessment of digital competency for STEM students at pedagogical universities? The data was collected from a survey of 945 students from STEM Faculties at a public university in Vietnam using a mixed methods approach, and the reliability index of the measuring scale was determined to be satisfactory. To standardize the scale and integrate it into the learning objectives of teacher education programs at pedagogical universities, this study offers recommendations for future studies.

Keywords: Framework of Digital Competence, Digital Literacy, STEM Teacher Students, Training Curriculum, Viet Nam

INTRODUCTION

The world is rapidly entering a new era called "digital transformation," where digital technology is deeply embedded in all aspects of life. The human resources of organizations are undergoing a dramatic change, and physical resources are being rapidly converted into digital forms. The nature of jobs is constantly evolving, knowledge management and expertise are becoming more crucial in decision-making, and social networks and mobile devices are profoundly affecting the way organization function. With enhanced digital skills, this revolution presents an endless number of opportunities for business market development and transformation.

The National Digital Transformation project was initiated by the Vietnamese government in 2020, and it had a very ambitious plan for the digital transformation of the country by 2030. As per the plan, 90% of ministry and provincial level dossiers would be completely digitalized, 80% of Level 4 public services would be delivered online, and all government reporting would be conducted through these digital platforms. With almost 70% of the labor force in basic occupations experiencing possible changes, Vietnam is the ASEAN country most affected by job transformations because of digitization, as per the International Labor Organization (Hoang, 2024).

The pressing task for Vietnamese higher education in this rapidly changing context is to develop a workforce that can make use of and adapt to new technology. But very little is known about digital competency among students, particularly with regard to the issue of how college students perceive their own skills, challenges, and readiness in the digital era. The term "digital competence" and its importance in teaching and practice remain a disputed issue. Based on the above data, every country needs a clear plan for recognizing, measuring, and improving the digital competence of its citizens, especially the youth, including college and university students. The first step in this direction is to develop a framework for digital competence that is appropriately tailored to the special context and environment of the country.

Some components of digital competency have already been included in the pedagogical training programs at a public university in Vietnam in this study, which is recognized as a national vital institution for teacher education. However, there are no clear signs at present to measure digital competency as an output, no common understanding of what digital competency is in this case, and no recognized output standard for pre-service teachers.

The quality of education in the twenty-first century is directly linked to the importance of teacher education in a digital environment. In the opinion of the European Commission, "one of the most crucial skills that people must have in order to participate in today's society is digital competency" (Europaea, 2018). The project of research on pre-service teachers' digital competency is described in the following article. It discusses the components of digital competency as well as the approaches and factors influencing its development.

Moreover, research shows that there is no consensus on what digital competence is. The use of technology effectively while displaying good attitudes, empathy, critical thinking, problem-solving skills, and creativity is referred to as digital competence. Digital competence is recognized as a key success factor in professional development, research, and education. Technological literacy is now a prerequisite in almost all sectors because most jobs are becoming increasingly technology-driven. The advancement of the world today is dependent on the digital economy, and learning institutions are transforming into digital ecosystems. In this case, it is expected that both teachers and students should employ technology to create better communities, foster creativity in the next generation, and facilitate innovation (Killen, 2018).

Digital literacy is a major factor that enhances learning outcomes, as indicated by research conducted by Sneed (2016). According to the revised taxonomy of Bloom, as explained by Sneed, creative activities such as the creation of infographics, presentations, photographs, animations, or videos require higher-order thinking skills than mere memory or comprehension tasks. Students achieve a deeper level of comprehension of the subject matter, retain it for a longer period of time, and communicate their ideas more effectively as they engage with such digital creation activities. Such approaches encourage creativity and inquiry, which often leads to students exceeding the expectations of the conventional classroom.

Digital literacy provides an individual with a competitive advantage in the corporate world beyond the classroom. It assists employees in performing critical tasks more effectively and enables corporations to derive maximum benefit from their technological investments. This was evident during the Covid-19 pandemic, when telecommuting became the norm and the digital revolution gained momentum across the globe. Consequently, digital literacy has a direct impact on the functioning of corporations and influences how they can enhance digital competency in the workplace (Muncaster, 2025).

Meta is in support of the implementation of the “We Think Digital” program in the Asia-Pacific region. We Think Digital provides resources for the development of a global community of responsible digital citizens with the necessary skills for the digital age by collaborating with professionals from across the region. The six modules of digital competency courses provided and delivered by this program, namely Internet, Digital Footprint, Digital Identity Protection, Digital Citizenship, Positive Connectivity, and Critical Thinking, are intended to promote responsible digital citizenship. This collaborative effort focuses on self-awareness and understanding others in digital spaces, highlighting the value of empathy, exercising rights, and critical thinking. This program does not aim to develop a comprehensive framework for digital competency.

More recent studies have given valuable insight into the Vietnamese use of digital devices. For instance, 37% of users have projected material from their phones onto a TV, 37% of users have accessed and utilized QR codes, 15% of users have accessed online purchases including tickets for vacation or music and movie streaming, and 46% of users have transferred digital money. All of these activities reflect a growing comfort level with digital devices and platforms. In particular, e-commerce is rapidly developing and is an essential indicator of digital literacy. Among Vietnamese respondents surveyed, 21% had paid bills or made purchases online, 84% searched for product information on the Internet, 59% engaged

in mobile shopping, and the use of e-wallets rose from 11% in 2019 to 14% in 2020 (Hootsuite, 2020).

In response to this digital evolution, Meta (formerly Facebook) partnered with the University of Social Sciences and Humanities under Vietnam National University to design the country's first digital competence framework for students. This framework, currently piloted by the Faculty of Information and Library Science, has gained notable attention and support from both educators and the broader academic community. The proposed framework outlines seven competence groups with 26 criteria to develop students' digital competence. A survey assessing the digital competence of students in the social sciences and humanities across seven basic skill groups revealed that students' digital competence is at an average level (Hùng, 2021).

UNESCO's Digital Competence Framework

UNESCO has introduced a version of the digital competence framework by supplementing the existing content of the European DigComp 2.0 framework. The competence groups are described as follows (UNESCO, 2018):

Group 1 – Operating Devices and Software

Group 2 – Information and Data Literacy

Group 3 – Communication and Collaboration

Group 4 – Digital Content Creation

Group 5 – Safety

Group 6 – Problem-Solving

Group 7 – Competences Related to Employment

The Digital Competence Framework of the Council of Australian University Librarians

The Council of Australian University Librarians (CAUL) has defined digital competence and developed a framework based on that of the Joint Information Systems Committee. They consider digital competence a crucial component for success in a digital society, encompassing the cognitive and social skills required to use media, information, and technology in unique and creative ways to optimize value for individuals, organizations, and businesses. The CAUL digital competence framework is described as follows (Johnston, 2020).

Policies Promoting Online Training and the Development of Digital Competence

The National Digital Transformation Program (2020) set a goal of developing comprehensive digital competence for the population, with 70% of the population possessing basic digital competence by 2030. Integrating digital literacy into the curriculum is a key element of education from the earliest levels.

Circular No. 09/2021/TT-BGDĐT, issued on March 30, 2021, regulates the management and organization of online teaching in primary and secondary schools and continuing education centers (Moet, 2021)

Circular No. 08/2021/TT-BGDĐT, dated March 18, 2021, regarding regulations for undergraduate training, specifies the proportion of online instruction for a given program. According to this, for full-time and work-study programs, up to 30% of the total course load may be delivered through online classes (Moet, 2021)

Circular No. 02/2025/TT-BGDĐT on the Digital Competence Framework for learners applies to educational institutions, training programs, and learners within the national education system (Moet, 2025).

These policies have a great effect on the development of training and education. They promote innovative approaches to teaching and the effective use of information technology in education management, teaching, and testing. They therefore move us one step further towards the goal of ensuring that all individuals have access to technological learning opportunities. Improving the digital skills of students and lecturers is still important in realizing a major revolution in education.

In conclusion, information about digital competency among Vietnamese university students has not been widely shared because there is limited research on this subject. The first step in every university's plan to determine and improve digital competency among students is to construct a digital competence framework that meets the training output criteria and is appropriate for the socioeconomic environment.

Digital Competence Framework for Pre-service Teachers

According to Secker & Morrison (2022), the concept of “digital competence” has developed over more than 20 years and is often used interchangeably with related notions such as digital literacy, information literacy, media literacy, or computer literacy

UNESCO defines digital competence as the ability to use and engage with digital technologies confidently, critically, and responsibly for learning, working, and participating in society. Digital skills are critical for jobs and social inclusion (UNESCO, 2018).

The Vietnamese Ministry of Education and Training (MoET), in Circular No. 02/2025/TT-BGDĐT on the Digital Competence Framework, defines digital competence as the ability to use digital technology to complete specific tasks or solve practical problems.

Research by Esteve-Mon et al. (2016) and Lázaro Cantabrana et al. (2019) has proposed a digital competence framework for pre-service teachers.

Table 1. Teacher Digital Competence Frameworks and Models

Model Framework	Institution	Reference	Areas or Dimensions of Teacher Digital Competence
ICT standards for FID	Ministry of Education, Chile	Del Prete & Huerta (2015); Enlaces (2008)	Pedagogical, technical, school management, social, ethical and legal aspects of development.
NETS-T	ISTE	ISTE (2008)	Learning and creativity of the students, learning and evaluation experiences, work, citizenship and professional growth.
Teacher ICT competence standards	UNESCO	UNESCO (2008)	Policy and vision, curriculum and evaluation, pedagogy, ICT, organization and administration, professional teacher training.
Teacher ICT competencies	Ministry of Education, Chile	Enlaces (2011)	Pedagogical, technical, management, social, ethical and legal, and professional development.
DigiLit Leicester	Leicester City Council	Fraser, Atkins & Richard (2013)	Search, evaluation and organization, create and share, evaluation and feedback, communication, collaboration, and participation, security, identity, development.
ICT competences for professional teacher development	Ministry of National Education, Colombia	Ministerio Educación Nacional (2013)	Technological, communicative, pedagogical, management and research.
Common Framework for Teacher digital competence	Ministry of Education, Government of Spain	INTEF (2014 - 2017)	Information, communication, content creation, security, problem solving
Teacher digital competence Rubric	ARGET, Universitat Rovira i Virgili	Lázaro & Gisbert (2015)	Didactic, curricular and methodological; planning, organization and management of digital technological resources and spaces; relational, ethical and security; personal and professional
Teacher digital competence definition	Generalitat de Catalunya	Departament d'Ensenyament (2016)	Design, planning and didactic implementation; management of digital technological resources and spaces; communication and collaboration; ethics and digital citizenship; professional development
DIGCOMP-EDU	European Commission	Redecker & Punie (2017)	Social and professional commitment; digital resources; digital pedagogy; evaluation and feedback; empowerment of students; facilitate students' digital competence

(Esteve-Mon et al., 2016; Lázaro Cantabrana et al., 2019)

This study aims to address two research questions:

1) What criteria and descriptions are proposed for a digital competence framework for pre-service STEM teachers?
2) What foundational recommendations can guide the assessment of digital competence for STEM pedagogical university students?

METHOD

The study was designed using a mixed-method approach, integrating both qualitative and quantitative methodologies. A questionnaire was developed for participants to complete through self-assessment, aiming to measure digital competence by having them evaluate their levels of knowledge, skills, confidence, and usage of digital media and information technology. Pre-defined rating scales such as the Likert scale, multiple-choice questions, or true/false questions were used to a large extent in the questions. In addition, questions that test procedural and factual knowledge were incorporated in knowledge-based tests to assess digital competency.

In Hanoi, Vietnam, a total of 945 pre-service STEM teachers took part in the research. Of these, 82.54% were female students, and 17.46% were male students. The higher percentage of female students reflects the fact that most pre-service STEM teachers and educators in Vietnam are female. Over 41% of the respondents were first-year students, followed by second-year students (20.9%), and third- and fourth-year students. Geographically, 54% of the students came from rural areas, 34.3% from urban areas, and over 10% from remote, mountainous, or island areas. 36.9% of the respondents rated their academic performance as "good," and 39.8% as "excellent."

The respondents verbally agreed to participate in the research before any data was gathered, ensuring that the answers would not be used for other purposes and that the names of the respondents would remain anonymous. SPSS Statistics 20.0 was used in the analysis of the data.

RESULTS AND DISCUSSION

Based on UNESCO’s digital competence framework, existing research findings, and the Vietnamese Ministry of Education and Training’s (MoET) Circular No. 02/2025/TT-BGDĐT on the digital competence framework, we propose the following digital competence framework for pre-service teachers:

Group 1: Operating Devices and Software

Group 2: Information and Data

Group 3: Communication and Collaboration

Group 4: Digital Content Creation

Group 5: Digital Safety

In this study, we rely on UNESCO's Digital Competency Framework and the Digital Competency Framework of the Vietnamese Ministry of Education and Training (MOET) to propose a digital competency framework for pre-service teachers, consisting of six categories:

Group 1: Operating devices and software (VH)

Group 2: Information and data (TTDL)

Group 3: Communication and collaboration (GTHT)

Group 4: Digital content creation (STNDS)

Group 5: Digital safety (ATS)

Group 6: Problem-solving (GQVD)

Table 2. Criteria for Evaluating Digital Competence for Pre-service Teachers

Level of Proficiency in Digital Competence	Level	Task Complexity	Autonomy	Cognitive Domain
Basic 1	1	Simple tasks	Requires guidance	Remember
	2	Simple tasks	Self-managed with guidance when needed	Remember
Intermediate	3	Routine and clearly defined tasks	My own responsibility	Understand
	4	Tasks and issues that are clearly defined but not routine	Independently and tailored to myself	Understand
Advanced	5	Various tasks and issues	Guiding others	Apply
	6	The most appropriate tasks	Capable of adapting to others in complex contexts	Evaluate
Expert	7	Solving complex problems with limited solutions	Integrating contributions into professional practice and guiding others	Create
	8	Solving complex problems with multiple interacting factors	Proposing new ideas and processes for the field	Create

Reliability Testing of the Scale

The reliability test results of the scale indicate that most variables within the digital competence measures have a Cronbach's Alpha coefficient of 0.88, and the item-total correlation coefficients are greater than 0.4.

Exploratory Factor Analysis (EFA)

An initial EFA was conducted for the factor groups. The results showed that the KMO measure, Bartlett's test, and the total extracted variance all met the required criteria (Table 4). However, the observed variables VH5, GTHT4, GTHT8, STNDS6, ATS7, ATS8, GQVD8, and GQVD9 did not meet the factor loading criteria (Table 3). Therefore, these observed variables were removed from the model.

Table 3. Rotated Matrix – Round 1

	Component							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
VH1		.622						
VH2		.705						
VH3		.705						
VH4		.627						
VH5								
VH6		.510						
VH7		.702						
VH8		.725						
VH9		.689						
VH10		.585						
VH11		.582						
TTDL1							.651	
TTDL2							.551	
TTDL3			.552					
TTDL4			.609					
TTDL5			.696					
TTDL6			.705					
TTDL7			.776					
TTDL8			.686					
TTDL9			.653					
TTDL10			.527					
TTDL11			.534					
TTDL12			.571					
GTHT1	.664							
GTHT2	.711							
GTHT3	.539							
GTHT4								
GTHT5	.681							
GTHT6	.720							
GTHT7	.569							
GTHT8								
GTHT9	.688							
GTHT10	.742							
GTHT11	.671							
STNDS1					.629			
STNDS2					.720			

	Component							
	1	2	3	4	5	6	7	8
STNDS3					.715			
STNDS4					.728			
STNDS5					.672			
STNDS6								
STNDS7					.586			
ATS1						.522		
ATS2						.613		
ATS3						.703		
ATS4						.663		
ATS5						.571		
ATS6						.544		
ATS7								
ATS8								
GQVD1				.598				
GQVD2				.648				
GQVD3				.725				
GQVD4				.702				
GQVD5				.702				
GQVD6				.625				
GQVD7				.560				
GQVD8								
GQVD9								

Table 4. Combined KMO Results from Two EFA Runs

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.967	.967
Bartlett's Test of Sphericity	Approx. Chi-Square	27638.67	24791.35
	df	1653	1225
	Sig.	.000	.000

A second round of EFA was then conducted for this factor group. The results for the KMO measure, Bartlett's test, and the total extracted variance all met the required criteria. In the rotated matrix, all factor loadings were greater than 0.5. The analysis indicated that 8 factors were extracted, with all observed variables meeting the loading criteria. Since there was no cross-loading among the factors, most of the original factor names were retained.

CONCLUSION

The rotated matrix results show that the 51 observed digital competence variables were grouped into 6 factors, with all observed variables exhibiting factor loadings greater than 0.5. Digital competencies of pre-service teachers include:

Group 1: Operating devices and software (VH)

Group 2: Information and data (TTDL)

Group 3: Communication and collaboration (GTHT)

Group 4: Digital content creation (STNDS)

Group 5: Digital safety (ATS)

Group 6: Problem-solving (GQVD)

In conclusion, two exploratory factor analyses (EFAs) were conducted for the independent variables. Eight variables (VH5, GTHT4, GTHT8, STNDS6, ATS7, ATS8, GQVD8, and GQVD9) were removed because they did not meet the criteria in the first round, which included 58 observed variables. Six factors were extracted based on the convergence and differentiation of 51 observable variables in the second, or final, round.

SUGGESTIONS

A properly conducted exploratory factor analysis (EFA) was employed in the research to determine the essential elements of digital competency that must be inculcated in pre-service STEM teachers. The validated framework provides factual evidence to support improvements in institutional teacher education programs. Thus, to better prepare future teachers for the evolving digital educational landscape, it is strongly recommended a public university in Viet Nam integrate these competencies into their curriculum.

First, the curriculum must include the proven framework for digital competency. Six interrelated domains were uncovered by the study as part of the pre-service teachers' digital competency framework: Managing hardware and software, data and information, teamwork and communication, creating digital content, being secure online, and problem-solving. By incorporating these domains into teacher education courses, complete digital literacy will be encouraged and theoretical knowledge and practice will be brought into alignment.

The second is having expertise in software and hardware. By providing workshops and hands-on learning experiences, teacher education courses must provide pre-service STEM teachers with the opportunity to become familiar with a range of educational technology. Their technical proficiency with hardware and software tools will be enhanced by this real-world experience, which will enhance teaching practice in technology-based classrooms.

Thirdly, enhancing proficiency in data and information management. As a basic element of digital literacy, the importance of data literacy is highlighted by the framework. Therefore, the skill of collecting, assessing, managing, and analyzing educational data should be highlighted in training courses. By acquiring this skill, pre-service teachers will be able to apply evidence-based decision-making, personalized learning, and data-driven assessment approaches in educational contexts.

In addition, improving skills in digital communication and teamwork. The curriculum should include learning experiences in teamwork that utilize digital communication tools in order to better prepare teachers for a more networked learning environment. Such activities as

encouraging online engagement, cooperation, and teamwork will help improve teachers' skills in creating inclusive online learning communities and communication.

For the training programs, we need to improve our skills in digital content creation. The development of pre-service STEM teachers' skills in creating high-quality digital learning materials is one of the key recommendations of the framework. To better ensure that teachers can present engaging and flexible information through digital forms such as texts, audio, video, and interactive applications, teaching should focus on instructional design, multimedia, and universal accessibility.

Besides, we should seriously think about fostering competence in digital safety and ethics. The validated framework highlights digital safety as a critical component of professional digital competence. Courses must address cybersecurity awareness, ethical technology use, and data protection to ensure responsible digital citizenship. Moreover, pre-service teachers should be trained to guide their future students in maintaining secure, ethical, and respectful behavior in online environments.

Another method that can be used to solve this problem is by including digital problem-solving skills in the curriculum for teachers. Each aspect of the teacher education curriculum must systematically integrate the development of pre-service STEM teachers' digital problem-solving skills. Case studies, simulation activities, and real-world digital challenges that require students to apply technology to analyze problems, think creatively about solutions, and make data-driven educational decisions can all be used to achieve this integration. This approach ensures that problem-solving is considered a critical component of digital competency development rather than a distinct skill.

In addition to ensuring that digital competency is up-to-date, we must also ensure that professional development is an ongoing process. The university needs to ensure that professional development is an ongoing process for pre-service teachers in order to ensure that the relevance and efficacy of digital competency are not lost. This requires that workshops on advanced digital pedagogy, certification courses, and web-based training courses on the latest educational technologies be conducted on a regular basis. Pre-service teachers can align themselves with the national digital transformation agenda and international best practices in teacher education by taking advantage of these opportunities.

Developing the digital competency of pre-service STEM teachers is one of the most crucial considerations in designing a collaborative digital learning environment for them. The institution should create an academic environment that promotes cooperation, the sharing of information, and the development of digital teaching resources. A community of practice

program, group work on digital projects, and peer mentoring programs may be effective tools in promoting cooperation and constructive online participation. Pre-service STEM teachers can work on developing their social skills and technological competency simultaneously in such a learning environment.

Meanwhile, the implementation of comprehensive assessment and feedback mechanisms for digital competency is also carefully considered. The digital competency framework for pre-service STEM teachers must be validated through systematic assessment and useful feedback. There is a need to develop assessment tools and rubrics for competency in the six characteristics of digital competence by the university. Continuous feedback, formative, and summative assessments will help pre-service STEM teachers to identify their strengths, fill in the gaps in their weaknesses, and enhance their digital practices. The training approach ensures that the outcome of digital competency is measurable, clear, and sustainable through continuous monitoring and reflective assessment.

Finally, it is important to ensure the effective provision of institutional support and resources for the development of digital competence. In order for digital competency frameworks to be successfully implemented, institutional support is imperative. The institution should ensure that teachers and students are given equal opportunities to make use of modern instructional software, digital infrastructure, and technology. Furthermore, establishing a specialized Digital Competence Support Unit with qualified personnel offering pedagogical consulting and technical support will ensure continuous guidance and optimization of resources. These aspects demonstrate the university's commitment to ensuring digital transformation in teacher education as well as enhancing teaching and learning processes.

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REFERENCES

Del Prete, A. C., & Huerta, L. Z. (2015). Initial training of teachers of basic education in Chile: Reflections and analysis of the ict curriculum guidelines. In *EDULEARN15 Proceedings* (pp. 6824-6830). IATED.

Europaea, S. (2018). Key competences for lifelong learning in the European schools. *Office of the secretary-general of the European schools, pedagogical development unit: Brussels, Belgium*, *72*.

Esteve-Mon, F. M., Cela-Ranilla, J. M., & Gisbert-Cervera, M. (2016). ETeach3D: Designing a 3D virtual environment for evaluating the digital competence of preservice teachers. *Journal of educational computing research*, *54*(6), 816-839.

Hoang, N. H. (2024). Exploring digital competence among Vietnamese EFL preservice teachers: the role of ICT self-efficacy, collegial collaboration, and infrastructural support. *Journal of Digital Learning in Teacher Education*, *40*(4), 217-237.

Hootsuite, W. A. S. Y. (2020). Digital 2020. Global digital overview. *The latest insights into how people around the world use the internet, social media, mobile devices, and ecommerce*.

Hùng, Đ. V. (2021). *Report on the Survey of Digital Competence Among Students at the University of Social Sciences and Humanities, Vietnam National University*. https://sim.ussh.vnu.edu.vn/vi/news/nang-luc-so/bao-cao-trinh-bay-khung-nang-luc-so-danh-cho-sinh-vien-94.html

Johnston, N. (2020). The shift towards digital literacy in Australian university libraries: Developing a digital literacy framework. *Journal of the Australian Library and Information Association*, *69*(1), 93-101.

Killen, C. (2018). Collaboration and coaching: Powerful strategies for developing digital capabilities. *Digital literacy unpacked*, *18*, 29-44.

Lázaro Cantabrana, J. L., Usart Rodríguez, M., & Gisbert Cervera, M. (2019). Assessing teacher digital competence: The construction of an instrument for measuring the knowledge of pre-service teachers. *Journal of new approaches in educational research*, *8*(1), 73-78.

Moet. (2021). *Regarding regulations for undergraduate training, specifies the proportion of online instruction for a given program*. Hà Nội Retrieved from https://vanban.chinhphu.vn/default.aspx?pageid=27160&docid=203159

Moet, V. M. o. E. (2021). *Regulates the management and organization of online teaching in primary and secondary schools and continuing education centers*. Hà Nội Retrieved from https://vanban.chinhphu.vn/default.aspx?pageid=27160&docid=203106

Moet. (2025). The Digital Competence Framework for learners applies to educational institutions, training programs, and learners within the national education system. https://moet.gov.vn/tintuc/Pages/tin-tong-hop.aspx?ItemID=10269

Muncaster, P. (2025). Digital literacy in the workplace: What it is and Why it matters. Retrieved in 15th December 2025, from Verizon: Digital Literacy in the Workplace: What it is & Why it Matters | Verizon Business

Secker, J., & Morrison, C. (2022). Copyright education and information literacy. *Navigating copyright for libraries: Purpose and scope*, 285-318.

Sneed, O. (2016). Integrating technology with Bloom's Taxonomy. *Arizona State University Teach Online*.

UNESCO. (2018). Digital skills critical for jobs and social inclusion. *UNESCO*.