



Comparative Analysis on post-Covid Digital Competency Frameworks and Digital Skill Gap Studies

Myat Min Thu*, Thanatip Chankong

Department of Computer Engineering, Chiang Mai University, Chiang Mai, Thailand

*Correspondence: myatminthu_1@cmu.ac.th

SUBMITTED: 30 April 2026; REVISED: 28 May 2026; ACCEPTED: 30 May 2026

ABSTRACT: As regarded as the age of Industry 4.0, digital skills have emerged as a more significant aspect of daily life. Equipping oneself with adequate digital skills has become increasingly essential across domains such as employment, education, and business. Especially in the wake of the COVID-19 pandemic, the need for digital skills stands out as an even more prominent asset, as remote work and online learning have become the new norm. Various entities such as governments, non-governmental organizations, academic institutions, and corporations are adapting to this advancing era by conducting new studies and designing new frameworks for digital literacy to address existing skill gaps. This paper conducts a comparative analysis of these frameworks and studies to identify commonalities and differences between them. This review also explores best practices, advantages, challenges, and limitations of existing studies and frameworks to propose potential improvements or new approaches to tackle digital skill gap issues and address evolving digital skill requirements more efficiently in a post-COVID-19 world.

KEYWORDS: Digital skill gap; digital divide; digital literacy; frameworks; comparative review

1. Introduction

In recent years, with significant advancements in Information and Communication Technology (ICT), including artificial intelligence, the world has witnessed a rapid acceleration of digitization across many sectors, thereby driving the development and enhancement of digital skills [1, 2]. According to [3], digital competency is closely linked to professional development for all 21st-century workers. Since the COVID-19 pandemic, the importance of digital skills has further increased due to the widespread adoption of remote work, which has become the new norm across various domains, including work, education, and healthcare [4]. In response to this growing demand, a variety of digital skill gap-bridging frameworks have been developed by different entities, including government bodies [5] and educational institutions [1]. These frameworks employ diverse methodologies and focus areas, aiming to equip individuals with the necessary digital literacy and competencies required to adapt to and succeed in the digital age.

However, existing studies [1, 6, 7] indicate that despite increasing attention to this issue, a significant digital skill gap still persists across different populations. Furthermore, limitations remain in addressing the issue in a comprehensive and inclusive manner. Due to differences in perspectives, methodologies, and target groups, the effectiveness and suitability of these frameworks vary. Therefore, it is essential to critically analyze and compare existing digital skill gap-bridging frameworks to identify their strengths, weaknesses, commonalities, and differences, as well as to explore the challenges and limitations in addressing digital skill gaps effectively. By synthesizing findings from existing literature, this study also aims to propose potential improvements and more adaptive approaches that better align with evolving digital skill requirements in the post-COVID-19 era, thereby providing valuable insights for policymakers, educators, and other stakeholders in enhancing digital literacy and competency development.

2. Methodology

Reviewing and analyzing existing issues related to the digital skill gap required a focus on multiple disciplines [6]. The study adopted a multidisciplinary approach, carefully examining and integrating both technological and social perspectives to ensure a comprehensive analysis of digital competency frameworks and studies. To ensure that all relevant study areas were covered, a multi-faceted methodology was used, comprising the following steps:

3.1. Literature searching and selection.

The literature search and selection were conducted using a systematic approach. Relevant studies were sourced from publication databases such as IEEE Xplore, Google Scholar, and Scopus. The inclusion criteria were: (1) technical relevance and timeliness, (2) scope of the study, and (3) diversity considerations. This process ensured that the selected literature was both relevant and comprehensive, covering a wide range of perspectives.

3.2. Data extraction.

Key information and insights were extracted from each selected study, including research questions, objectives, methodologies, findings, and limitations. Data extraction was performed using a structured and standardized template to ensure consistency and uniformity across all selected studies.

3.3. Comparative analysis.

Comparative analysis of digital competency frameworks and their integration into education is critical for evaluating the effectiveness and limitations of existing approaches and for identifying future research and practical directions [3]. In this study, a structured comparative method was used to compare selected digital literacy frameworks and studies. The extracted data were analyzed from a comparative perspective. Comparison matrices were developed to systematically identify key commonalities and highlight differences across frameworks. This included a micro-level thematic analysis, where different dimensions of digital literacy frameworks were broken down and comparatively examined.

3. Findings

3.1. Comparison between two comprehensive digital competence frameworks developed with different focuses.

Different digital literacy frameworks vary significantly in their dimensional focus, with each framework emphasizing distinct aspects of digital competence. As shown in Table 1, the two selected frameworks illustrate different structural and conceptual approaches to digital literacy. The European Union’s Digital Competence Framework for Citizens (DigComp 2022) [5] adopts a holistic approach in which digital competencies are categorized into five dimensions: (1) information and data literacy, (2) communication and collaboration, (3) digital content creation, (4) safety, and (5) problem-solving. In contrast, the South Pacific Digital Literacy Framework (SPDLF 2023) [1] consists of two main components: the SPDLF digital literacy framework and an interactive digital literacy tool. The framework focuses on six literacy dimensions: (1) media literacy, (2) visual literacy, (3) information literacy, (4) communication literacy, and (5) computer literacy. Table 1 presents a comparative summary of the two frameworks.

Table 1. Comparison of digital competence frameworks.

No	Framework	Key Dimensions Focused On
1	EU Digital Competence Framework for Citizens (DigComp 2022)	Information and data literacy; Communication and collaboration; Digital content creation; Safety; Problem-solving
2	South Pacific Digital Literacy Framework (SPDLF 2023)	Media literacy; Visual literacy; Information literacy; Communication literacy; Computer literacy

Both frameworks encompass broad dimensions of digital competencies, although each differs in emphasis and structure. The DigComp framework offers a more holistic and integrated approach by incorporating safety and problem-solving alongside core digital skills. In contrast, the SPDLF framework adopts a more applied and task-oriented classification, emphasizing media, visual, and computer literacy. Each framework has distinct strengths, making them complementary in addressing digital literacy challenges from different perspectives.

3.2. Comparison between two hybrid digital competence learning models.

Some frameworks assess digital competence and address digital literacy through hybrid approaches that integrate digital competence frameworks into traditional pedagogical models. As shown in Table 2, two representative hybrid learning models are compared to highlight their structural integration of conventional and digital competencies. The Partnership for 21st Century Learning (P21) Framework [8] integrates traditional Life and Career Skills (e.g., leadership and social skills) and Learning and Innovation Skills, commonly known as the 4Cs (Creativity, Critical Thinking, Communication, and Collaboration), with digital competencies such as information, media, and technology literacy. The E3 Learning Model (Education, Employability, Entrepreneurship) [9] is a project-based learning model developed in South Africa that promotes innovation and entrepreneurship in education. Its learning process is structured into phases: (1) inspiration, (2) tools and implementation, (3) reflection, (4) mindset change, and (5) competencies. In the final phase, competencies are defined in alignment with UNESCO’s competency-based framework, including knowledge, skills, values, attitudes,

information, data, and technology. The emergence of these hybrid models highlights the adaptive and integrative nature of modern educational frameworks, where digital competencies are embedded within traditional learning systems.

Table 2. Comparison of hybrid digital competence learning models.

No	Model	Conventional Competences	Digital / Added Competences
1	Partnership for 21st Century Learning (P21) Framework	Life & Career Skills; Learning & Innovation Skills (4Cs)	Information literacy; Media literacy; Technology skills
2	E3 Learning Model (Education, Employability, Entrepreneurship)	Knowledge; Skills; Values; Attitudes	Information; Data; Technology competencies (UNESCO-based framework)

3.3. *Delving into the tools and methodologies utilized to evaluate digital competencies.*

Various frameworks and studies have utilized different technologies and methodologies in developing digital competency and literacy assessment tools. Some of the commonly used methods are summarized below after a thorough analysis of the selected frameworks and studies.

3.3.1. *Statistical methods.*

Mixed-method approaches combining qualitative and quantitative techniques are commonly used by integrating interviews and surveys with statistical tests and models during data collection. In most studies, statistical methods play a significant role in analyzing large datasets and ensuring model reliability and consistency. For example, [10] conducted a Fleiss' Kappa test to validate the statistical consistency of developed rubrics. Using null and alternative hypothesis testing, [11] concluded that digital technology and artificial intelligence alone are not sufficient to bridge the digital skill gap, and that more strategic interventions are required. Other commonly used statistical techniques such as Cohen's *d*, *t*-tests, and confirmatory factor analysis are applied depending on the study design and objectives. Due to the subjective nature of self-assessments, statistical methods enhance data reliability and improve the robustness of digital competency frameworks.

3.3.2. *Tools to foster innovation.*

Some studies and frameworks have prioritized innovative approaches to digital competency assessment. A notable example is the South Pacific Digital Literacy Framework (SPDLF 2023) [1], which employs a game-based approach to evaluate digital literacy, offering incentives such as certificates alongside assessment outcomes. As interactive digital technologies have increasingly permeated daily life including work, education, social interaction, and entertainment [2], the need for human–human and human–machine interaction in digital literacy systems has become essential. Other innovative approaches include collaborative competency assessments between groups with different backgrounds. For instance, the learning model in [12] conducted a collaborative digital skill assessment between university students and young self-employed workers. A total of eighteen digital skills were co-developed, and results were categorized into quadrants based on perceived importance. Similarly, a gap analysis in [13] highlighted differences between university students and employers regarding the prioritization of essential digital skills.

3.3.3. Roles of AI in fostering digital competencies and technological integration.

Most studies collectively highlight the pivotal role of artificial intelligence (AI) in addressing digital competency and technological integration challenges. While emphasizing that engineering students require both technical and non-technical skills for improved employability, [13] highlights the role of AI in reshaping workforce skill demands. In [12], AI is used as a facilitating tool to identify and bridge competency gaps within collaborative learning models. Moreover, AI is also discussed in the context of lifelong learning and continuous skill development. An in-depth analysis in [11] describes AI as a backbone of the modern workforce, noting its use in monitoring and predicting skill demands, customizing training programs, and improving talent acquisition efficiency. These applications help organizations remain competitive in rapidly evolving technological environments. Overall, AI plays an increasingly significant and inevitable role in addressing the digital divide and enhancing digital competency development.

4. Discussion

4.1. Identification of digital and non-digital competence gaps across domains.

Gap analysis studies [13] comparing students and employers reveal differences between prioritized non-digital skill sets among employers and the skills highly ranked by students. Similarly, the learning model in [12] demonstrated collaborative upskilling and reskilling activities between students and local workers to bridge competency gaps. Across studies, digital skill gaps are consistently identified in multiple domains, including employment, entrepreneurship, and higher education.

4.2. Limitations in inclusivity of current digital competency frameworks.

Current digital competency frameworks lack comprehensive inclusivity. Therefore, localized adaptation and consideration of social constraints are necessary to ensure broader applicability across diverse user groups and contexts. A study in Indonesia [14] found gender-based differences in digital skills, where males performed better in technical operational skills, while females excelled in creative digital tasks. In contrast, a study on women's digital competence in India [15] highlighted that data bias, stereotypes, and algorithmic discrimination continue to limit women's opportunities in the digital era. These findings suggest the importance of integrating local and socio-cultural contexts into digital literacy frameworks. Additionally, several studies [6], [14] have shown that age, internet accessibility, economic status, and educational background are significantly correlated with digital literacy levels. Therefore, these constraints must be considered to ensure inclusivity in digital competency frameworks.

4.3. Limitations of self-assessment in digital competency evaluation.

Over the past decade, self-assessment has been widely used as a core method for measuring digital literacy among educators and students [10]. Self-assessment has supported digital education and workforce training, particularly with the rapid advancement of ICT and increasing reliance on digital technologies across industries [1, 2]. Many studies included in this review combine self-assessment with structured digital literacy frameworks. However, despite its advantages, self-assessment has limitations in accuracy, standardization, and

comprehensiveness, particularly for individuals with varying digital skill levels. Previous Studies [6, 10, 14] indicated that relying solely on self-assessment introduces limitations due to subjectivity, biased responses, and language barriers. [6] further highlights that self-reported data alone is insufficient for comprehensive evaluation of digital competencies.

5. Conclusion

This study highlights the need for more holistic approaches to evaluate and address the digital competency gap. As digital competency assessment becomes more widely adopted, innovative methods such as intervention tools, heuristic approaches, and peer-based assessments can be further explored to bridge identified skill gaps. In addition, supporting measures such as improving internet access and educational opportunities act as key enablers in enhancing digital competency levels. While strengthening technological infrastructure and algorithms remains important, it is equally essential to design localized and inclusive frameworks that consider underlying social and cultural factors. Overall, this study contributes to ongoing research and practical efforts aimed at enhancing digital competency development and bridging the digital.

Author Contributions

All authors contributed equally to the conceptualization, writing, review, and editing of this manuscript. All authors have read and approved the final version of the manuscript.

Competing Interests

The authors declare no competing interests.

Data Availability

All data supporting the findings of this study are available within the article and its supplementary materials. Additional data are available from the corresponding author upon reasonable request.

References

- [1] Reddy, P.; Chaudhary, K.; Hussein, S. (2023). A digital literacy model to narrow the digital literacy skills gap. *Heliyon*, 9, e14878. <https://doi.org/10.1016/j.heliyon.2023.e14878>.
- [2] SELFIE for teachers: designing and developing a self-reflection tool for teachers' digital competence. (accessed on 1 May 2025) Available online: <https://publications.jrc.ec.europa.eu/repository/handle/JRC131282>.
- [3] Karsenti, T.; Poellhuber, B.; Parent, S.; Michelot, F. (2020). What is the Digital Competency Framework? *Revue internationale des technologies en pédagogie universitaire*, 17, 11–14. <https://doi.org/10.18162/ritpu-2020-v17n1-04>.
- [4] Digital Skills Insights 2020. (accessed on 1 May 2025) Available online: <https://academy.itu.int/itu-d/projects-activities/research-publications/digital-skills-insights/digital-skills-insights-2020>.
- [5] Vuorikari, R.; Kluzer, S.; Punie, Y. (2022). DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes, EUR 31006 EN; Publications Office of the European Union: Luxembourg. <https://doi.org/10.2760/115376>.

- [6] Thida, M.; Thazin, N. (2023). Digital Skills Gap in Developing Countries: The Case of Myanmar. TENCON 2023 - 2023 IEEE Region 10 Conference (TENCON). <https://doi.org/10.1109/TENCON58879.2023.10322424>.
- [7] Maji, S. K.; Laha, A. (2022). The role of digital skill in mitigating digital divide: evidences from Asia-Pacific region. *Rajagiri Management Journal*, 16, 260–271. <https://doi.org/10.1108/ramj-05-2021-0035>.
- [8] Partnership for 21st Century Skills (2007). Partnership for 21st Century Skills – Core Content Integration. (accessed on 1 May 2025) Available online: https://www.marietta.edu/sites/default/files/documents/21st_century_skills_standards_book_2.pdf.
- [9] E3 Learning Model Pedagogical Paradigms. (accessed on 1 May 2025) Available online: https://ecubed-dbe.org/wp-content/uploads/2020/07/E3-Learning-Model-pedagogical-content_display.01.20.pdf.
- [10] Jurāne-Brēmāne, A. (2024). Developing Pedagogical Principles for Digital Assessment. *Education Sciences*, 14, 1067. <https://doi.org/10.3390/educsci14101067>.
- [11] Baral, S. K.; Rath, R. C.; Goel, R.; Singh, T. (2022). Role of digital technology and artificial intelligence for monitoring talent strategies to bridge the skill gap. International Mobile and Embedded Technology Conference (MECON). <https://doi.org/10.1109/MECON53876.2022.9751837>.
- [12] Ratanasanguanvongs, K.; Ketsuwan, N.; Chankong, T.; Maneetien, N. (2022). Collaborative learning model for identifying competence gap of self-employed worker in local community. 7th International STEM Education Conference (iSTEM-Ed). <https://doi.org/10.1109/iSTEM-Ed55321.2022.9920874>.
- [13] Ghouse, S. M.; Chaudhary, M.; Garg, S. (2018). Importance of non-technical skills for employment opportunities: A gap analysis of students and employers perception. Eleventh International Conference on Contemporary Computing (IC3). <https://doi.org/10.1109/IC3.2018.8530663>.
- [14] Angeline, M.; Luthfia, A.; Safitri, Y.; Widyakusumastuti, M. A.; Wibowo, D. (2021). Towards digital equality: Assessing youths' digital literacy capabilities. International Conference on Information Management and Technology (ICIMTech). <https://doi.org/10.1109/ICIMTech53080.2021.9534938>.
- [15] Roy, P.; Raut, A.; Samantaray, S.; Rana, A. (2024). Women and digital networking: Digital skill gap and its challenges. International Conference on Advancements in Smart, Secure and Intelligent Computing (ASSIC). <https://doi.org/10.1109/ASSIC60049.2024.10507999>.



© 2026 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).