

A Systematic Review: On the Comparative Study of Teacher Digital Literacy Frameworks in Europe, the UK, and China

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Abstract: This study provides a systematic review and comparative analysis of teacher digital literacy frameworks from the European Union (EU), the United Kingdom (UK), China, and UNESCO. Seven frameworks are examined: DigCompEdu, the Jisc Digital Capabilities Framework, the Digital Teaching Professional Framework (DTPF), the Professional Standards Framework (PSF), China's Digital Literacy Framework for Teachers (2022), UNESCO's ICT Competency Framework for Teachers (ICT-CFT), and UNESCO's AI Competency Framework for Teachers (2024). The seven frameworks were examined from six aspects: content coverage, applicability, integrability, implementation support, innovation and future orientation, and impact and effectiveness. Several elements appear repeatedly across the frameworks, particularly the use of technology in teaching, information and data literacy, ethical practice, digital pedagogy, professional development, and learner empowerment. However, the frameworks do not give the same weight to these areas. They also differ in whom they are designed for, how they are intended to be used, and how far they address newer technologies. Some of these differences can be understood from the educational and policy backgrounds in which the frameworks were developed. Another point emerging from the comparison is that teacher digital literacy is no longer concerned mainly with the ability to use technology. Pedagogy, ethics, professional practice, and more recently AI have become increasingly visible in these frameworks. This study therefore provides a basis for understanding how teacher digital literacy has been approached in different contexts and what needs to be considered when existing frameworks are used elsewhere.

Keywords: Teacher digital literacy; Digital competence; Comparative analysis; Competency frameworks; Systematic review; Digital education

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1. Introduction

1.1. Background

Digital technologies have become an increasingly important part of teaching and learning, and teachers are

now expected to work confidently and responsibly in technology-rich educational environments. Digital competence is widely recognized as an important set of skills for participation in education, work, and society^[1]. For teachers, this involves more than the ability to operate digital tools. It also includes the capacity to use technology for teaching, communication, assessment, professional development, and the ethical management of digital information.

The terms digital literacy, digital competence, and digital competency are often used in related ways in the literature. Although their meanings are not identical, they generally refer to a combination of knowledge, skills, attitudes, and practices that enable individuals to use digital technologies effectively, critically, and responsibly. In educational settings, these concepts have increasingly been applied to the professional roles and responsibilities of teachers.

Digital technologies are now part of everyday teaching and learning, and teachers are expected to work with them in increasingly varied ways. In response, different countries and organizations have developed frameworks to describe what teachers need to know and what they should be able to do with digital technologies. Among them are DigCompEdu in the European Union, the Jisc Digital Capabilities Framework and the Digital Teaching Professional Framework in the UK, China's Digital Literacy Framework for Teachers, and UNESCO's ICT and AI competency frameworks. They deal with many similar issues, but they were developed for different purposes and groups of educators. Their structures and priorities therefore vary.

The context in which a framework was developed can be seen in what it gives particular attention to. Not all frameworks approach teacher digital competence in the same way. In some, the main concern is how technology can be used in teaching and to support learners. Others pay more attention to teachers' professional practice, institutional requirements, responsible technology use, or newer forms of technology. The UNESCO AI Competency Framework for Teachers (2024) is a recent example. Unlike many earlier frameworks, it deals directly with what teachers need to know about AI, how AI may be used in teaching, and the ethical questions that come with its use.

A considerable amount has now been written about teacher digital literacy and competence, but the frameworks are often discussed separately. Much of the existing research has been carried out within a single national, institutional, or framework setting. This makes cross-framework comparison less straightforward. Differences are found not only in the competencies listed, but also in the way a framework is intended to be used. Some come with detailed guidance and resources, while others leave more room for institutions to decide how they should be implemented. Their treatment of recent technological developments also varies. These aspects are worth examining alongside the competency domains themselves, particularly when a framework developed in one setting is considered for use elsewhere.

Seven frameworks from the European Union, the United Kingdom, China, and UNESCO are examined in this study. Three questions are addressed:

RQ1. What are the core components of the selected teacher digital literacy frameworks?

RQ2. What similarities and differences exist among these frameworks in terms of their competency domains, structures, and priorities?

RQ3. How do the selected frameworks differ in content coverage, applicability, integrability, implementation support, innovation and future orientation, and impact and effectiveness?

The comparison does not assume that one framework should work better than the others in every setting. Each was developed for particular purposes and under particular educational conditions. For this reason,

attention is given both to what the frameworks contain and to the settings in which their features may be more or less useful.

1.2. Teacher digital literacy and digital competence

Digital literacy has not always carried the broad meaning it has today. Gilster (1997) associated it with understanding and using information in digital form and gave critical thinking an important place in the concept ^[2]. Martin and Grudziecki (2006) later described a wider set of abilities and dispositions, including awareness, attitudes, and the capacity to access, evaluate, integrate, create, and communicate digital information. Their work also distinguished three stages—digital competence, digital usage, and digital transformation ^[3].

The concept became broader as digital technologies entered more areas of everyday life. In UNESCO's (2018) account, digital literacy covers the accessing, managing, understanding, evaluating, creating, and communicating of information through digital technologies, with attention also given to safe and appropriate use ^[4]. This definition brings together activities that earlier discussions sometimes treated separately. Working with digital information, communicating and creating content, making judgments, and using technology responsibly all become part of digital literacy.

Digital competence covers much of the same ground, but is commonly framed somewhat differently. The Council of the European Union (2018), for example, describes it through knowledge, skills, and attitudes associated with confident, critical, and responsible engagement with digital technologies ^[5]. The emphasis is on using digital technologies confidently, critically, and responsibly in learning, work, and participation in society. Information and data literacy, communication and collaboration, digital content creation, safety, and problem solving are among its main areas. The distinction between digital literacy and digital competence is therefore not always clear in the literature. For the purpose of this study, both are treated as broader concepts than technical ability alone, while their different terminology is retained when individual frameworks are discussed.

For teachers, the educational use of technology is particularly important. Being familiar with a digital tool is not enough; teachers also need to consider how it fits their teaching and how it can help with assessment, communication, or learner support. Falloon (2020) includes knowledge, skills, attitudes, safety, and ethical practice in his discussion of teacher digital competence ^[6]. Fernández-Batanero et al. (2021), from a higher education perspective, also connect digital competence with the use of technology in teaching and learning ^[7]. This link with teaching practice can also be seen in national policy. China's Digital Literacy Framework for Teachers (2022) includes digital awareness, competence, and responsibility ^[8]. Teachers are expected not only to work with digital information but also to use technology when identifying and dealing with problems that arise in education and teaching. The framework therefore connects digital literacy with the improvement of teachers' everyday practice. Teacher digital literacy, as used in this study, therefore includes several related areas: the use of digital technologies, pedagogy, information and data use, ethical responsibility, and professional development. These areas provide a starting point for the comparison of the seven frameworks in the following sections.

2. Research objectives and questions

This review looks at seven frameworks developed in different educational and policy settings in the EU, the UK, China, and by UNESCO. The comparison focuses first on what each framework includes and how its

main areas are organized. It then considers where the frameworks are similar, where they differ, and what particular priorities can be seen in each of them. A further part of the analysis considers the frameworks from six perspectives: content coverage, applicability, integrability, implementation support, innovation and future orientation, and impact and effectiveness.

2.1. Objectives

Three objectives guide the review. The first is to identify the main components covered by the selected frameworks. The second is to compare how the frameworks organize and prioritize teacher digital literacy and digital competence. The third is to consider their relative strengths and limitations using the six dimensions adopted for the analysis.

2.2. Research questions

Based on these objectives, the review considers three questions:

RQ1. What components are included in the selected teacher digital literacy and digital competence frameworks?

RQ2. In what ways are the frameworks similar or different in their competency areas, structure, and main priorities?

RQ3. What differences can be found when the frameworks are considered in terms of content coverage, applicability, integrability, implementation support, innovation and future orientation, and impact and effectiveness?

3. Methods

3.1. Search strategy

A structured search strategy was used to identify relevant literature on teacher digital literacy and digital competence frameworks. The search covered academic publications, policy documents, institutional reports, and other relevant sources concerning teacher digital literacy, digital competence, competency frameworks, and professional development. Particular attention was given to frameworks developed in the European Union (EU), the United Kingdom (UK), China, and by UNESCO.

3.2. Databases and sources

The literature search was conducted using ERIC, Scopus, Google Scholar, and SpringerLink to identify peer-reviewed journal articles, conference papers, and other relevant academic publications. In addition, official policy documents, institutional reports, and grey literature published by established organizations and public authorities, including the European Commission, relevant UK organizations, the Ministry of Education of China, and UNESCO, were examined. Official sources were particularly important because several of the frameworks included in this review were developed and published by government agencies or international organizations rather than through academic journals.

3.3. Search terms and keywords

The search strategy combined terms related to digital literacy, teachers, geographical or organizational context, and competency frameworks. The main search terms included:

Digital literacy: “digital literacy” OR “digital competence” OR “digital skills” OR “digital ability”
Teacher development: “teacher education” OR “teacher training” OR “educator competencies” OR “professional development” OR “faculty development”
Context: “China” OR “European Union” OR “EU” OR “United Kingdom” OR “UK” OR “UNESCO”
Framework: “framework” OR “model” OR “standards” OR “guidelines”
These terms were combined using Boolean operators and adapted where necessary to the search functions of individual databases.

Two main filters were applied. First, the search focused primarily on publications from 2018 to 2024 in order to capture recent developments in teacher digital literacy and competence, particularly those associated with digital transformation and emerging technologies. Second, publications in both English and Chinese were considered.

The date range was used to maintain a focus on recent developments. However, several influential frameworks developed before 2018, such as the Jisc Digital Capabilities Framework (2015) and DigCompEdu (2017), were included through purposeful selection because they remain widely referenced and continue to influence subsequent research, policy, and framework development. This approach allowed the review to balance current developments with established frameworks that remain relevant to the field.

3.4. Inclusion and exclusion criteria

Specific inclusion and exclusion criteria were applied to maintain the relevance and comparability of the selected literature. Studies and documents were considered for inclusion when they addressed digital literacy or digital competence in relation to teachers or educators and provided a framework, model, standard, or set of guidelines relevant to the research questions. Publications unrelated to teacher digital competence or without a relevant framework component were excluded. **Table 1** summarizes the criteria used in the selection process.

Table 1. Inclusion and exclusion criteria for literature selection

Inclusion Criteria	Exclusion Criteria
Subject terms include digital literacy, digital competence, digital skills, or digital ability	Not related to digital literacy, digital competence, digital skills, or digital ability
Abstract includes teacher education, teacher training, educator competencies, professional development, or faculty development	Does not involve teacher education, teacher training, educator competencies, professional development, or faculty development
Focus on China, the European Union (EU), the United Kingdom (UK), or relevant UNESCO frameworks	Outside the geographical or organizational scope of the review
Includes framework, model, standards, or guidelines	Does not include framework, model, standards, or guidelines
Written in English or Chinese	In other languages

The selection process was conducted in stages, beginning with the identification of potentially relevant records, followed by screening and eligibility assessment. Duplicate and clearly irrelevant records were removed, and the remaining publications and documents were assessed against the inclusion and exclusion criteria. The final selection provided the evidence base for identifying and comparing the seven frameworks

examined in this study. **Figure 1** (PRISMA Diagram) below illustrates the process of literature selection, showing the flow of studies included and excluded during the review process.

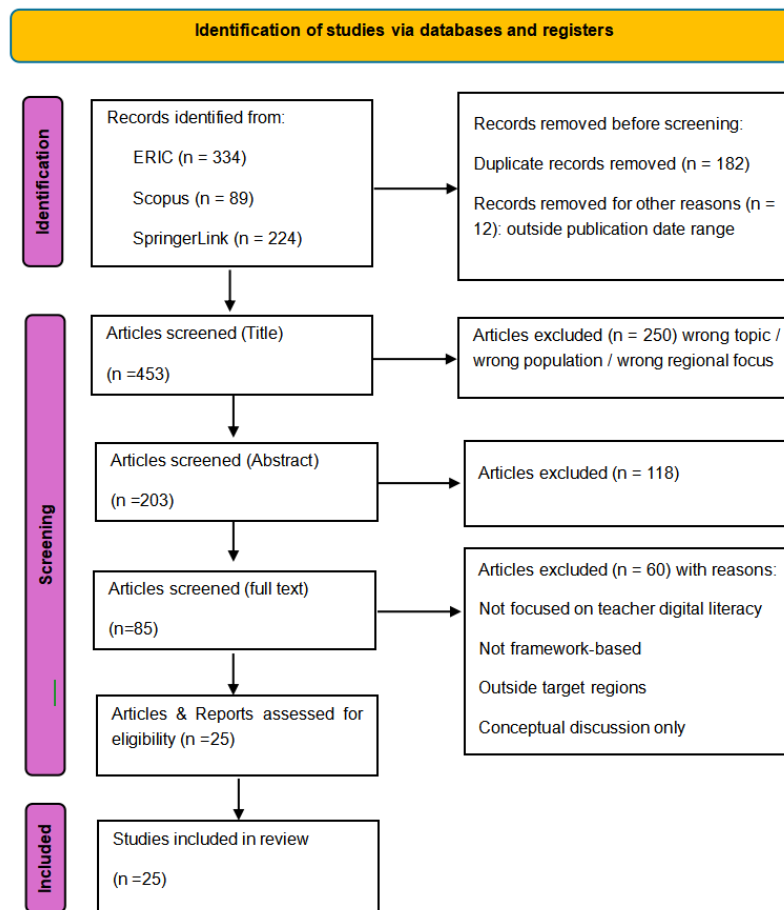


Figure 1. PRISMA diagram

3.5. Article selection process

Article selection followed the PRISMA guidelines and involved identification, screening, eligibility assessment, and final inclusion.

The searches produced 647 records in total, including 334 from ERIC, 89 from Scopus, and 224 from SpringerLink. Duplicate checking removed 182 records. A further 12 were removed before screening, mainly because they did not fall within the review period of 2018–2024. The remaining 453 records entered title screening.

Title screening reduced this number considerably. Of the 453 records, 250 were removed because their topics, target populations, or overall focus did not fit the review. Abstracts were then read for the remaining 203 records. After 118 more records were excluded, 85 articles were taken forward for full-text assessment.

At the full-text stage, each article was considered against the inclusion and exclusion criteria. Sixty were removed for one or more reasons: the study was not concerned with teacher digital literacy, no relevant framework was examined, the study fell outside the geographical or organizational scope, or digital literacy was discussed only in general terms without a clearly identified framework. This process resulted in 25

studies for the final review. The analysis also drew on the official documents of the seven frameworks and related materials published by the organizations responsible for them.

3.6. Evaluation framework

Once the studies and framework documents had been identified, the next step was to decide how the seven frameworks would be compared. Six dimensions were chosen: content coverage, applicability, integrability, implementation support, innovation and future orientation, and impact and effectiveness. Previous research and established digital competence frameworks helped inform this choice. The intention was to look at the frameworks from more than one angle, including both their content and their possible use in practice.

Each dimension asks a somewhat different question. Content coverage looks at how much of teacher digital competence is represented in a framework. Applicability asks whether the framework can be used beyond the setting for which it was originally developed. For integrability, the concern is how readily it can work with existing policies, curricula, and teacher development arrangements. Implementation support is more practical and looks at whether users are given guidance, tools, or other resources. Innovation and future orientation considers the attention paid to technological change and emerging needs. Impact and effectiveness, finally, draws on the available evidence of how a framework has been adopted, used, or reflected in educational practice.

The frameworks were rated on a five-point scale. **Table 2** sets out what scores of 1, 3, and 5 mean for each dimension. Where the evidence placed a framework between two of these reference points, a score of 2 or 4 was used. Ratings were made after reading the framework documents together with relevant policy and supporting materials.

The same criteria were applied to all seven frameworks so that the scores could be compared on a common basis.

Table 2. Evaluation dimensions and rating criteria for digital literacy frameworks

Dimension	Description	Rating Criteria (1–5)	Supporting References
Content Coverage	Extent to which a framework covers key digital literacy elements, including technical, pedagogical, ethical, and innovation-related competencies	1 = very limited coverage; 3 = partial coverage; 5 = comprehensive and systematic coverage	DigComp (2017) ^[9] , UNESCO ICT-CFT (2018)
Applicability	Degree to which the framework can be applied across diverse educational contexts and systems	1 = highly context-specific; 3 = moderately transferable; 5 = highly adaptable across contexts	Jisc(2015) ^[10] , ISTE (2017) ^[11]
Integrability	Compatibility with existing policies, curricula, and teacher training systems	1 = difficult to integrate; 3 = partially compatible; 5 = highly compatible and flexible	Mishra & Koehler (TPACK) ^[12] , UNESCO (2018)
Implementation Support	Availability of tools, resources, and guidance for implementation	1 = minimal support; 3 = some support; 5 = comprehensive support resources	ISTE Coaches (2017) ^[13] , UNESCO ICT-CFT (2018)
Innovation & Future Orientation	Ability to address emerging technologies and future educational needs	1 = limited future focus; 3 = moderate attention; 5 = strong focus on innovation and emerging technologies	OECD (2021) ^[14] , DTPF (2019) ^[15]
Impact & Effectiveness	Indicative influence on teaching practices and digital competence development	1 = limited indication; 3 = moderate indication; 5 = widely adopted with indicative influence	UNESCO (2017) ^[16] , policy and adoption reports

The same five-point scale was used for all six dimensions. Scores of 1, 3, and 5 served as the main reference points, and scores of 2 or 4 were used when a framework fell between two levels. As the six dimensions examine different aspects of a framework, the meaning of each score was adjusted to fit the dimension being assessed. The specific criteria are shown in **Table 2**.

The scores are intended mainly to support comparison among the seven frameworks. In particular, the score for “impact and effectiveness” does not represent an experimental measure of effectiveness. It draws on available evidence of framework use, policy influence, and reported applications in education. For this reason, the scores are used to show relative differences among the frameworks rather than to provide precise quantitative measures of their effectiveness.

4. Results

4.1. Overview of digital literacy framework

To provide a comparative analysis of teacher digital literacy and digital competence, this study focuses on seven frameworks developed by major national, regional, and international organizations: Digital Competence for Educators (DigCompEdu), the Jisc Digital Capabilities Framework, the Digital Teaching Professional Framework (DTPF), the Professional Standards Framework (PSF), China’s Digital Literacy Framework for Teachers, UNESCO’s ICT Competency Framework for Teachers (ICT-CFT), and UNESCO’s AI Competency Framework for Teachers (2024). The seven frameworks come from different educational and policy settings and do not place the same emphasis on teacher digital competence. Comparing them makes it possible to see where they overlap and where their priorities differ, including how newer developments are addressed. **Table 3** gives an overview of the seven frameworks.

Table 3. Overview of the selected frameworks

	Year	Institution	Areas or dimensions of teachers’ digital literacy	Purpose
Digital Competence for Educators (DigCompEdu)	2017	European Commission’s Joint Research Centre (JRC)	6 Dimensions ▪ Professional Engagement. ▪ Digital resources. ▪ Teaching and learning. ▪ Assessment. ▪ Empowering Learners. ▪ Facilitating learners’ digital competence.	Describes the digital competences educators need in their professional work and in teaching and learning. It also considers how teachers can use digital technologies to support learners and develop learners’ own digital competence.
Digital Capabilities Framework	2015	Jisc (Joint Information Systems Committee) a UK-based not-for-profit organization	6 Areas ▪ Digital proficiency and productivity. ▪ Digital creation, problem-solving and innovation. ▪ Digital learning and development. ▪ Digital identity and wellbeing. ▪ Media literacies. ▪ Digital communication, collaboration and participation.	Takes a broad view of digital capability. It was developed to help individuals and institutions understand the different capabilities involved in studying and working in a digital environment.

			3 stages: Exploring, Adopting, Leading. 7 key areas:	
Digital Teaching Professional Framework (DTPF)	2018	Education and Training Foundation (ETF) in the United Kingdom.	▪A. Planning Your Teaching. ▪B. Approaches to Teaching. ▪C. Supporting Learners to Develop Employability Skills. ▪D. Subject-Specific and Industry-Specific Teaching. ▪E. Assessment. ▪F. Accessibility and Inclusion. ▪G. Self-Development.	Intended mainly for teachers and trainers in further education and training. Its emphasis is on the practical use of technology in teaching, with development supported through different stages of digital practice.
Professional Standards Framework (PSF) ^[17]	2023	HE (formerly Higher Education Academy)	3 Dimensions: Areas of Activity, Core Knowledge, Professional Values.	Sets out professional expectations for teaching and supporting learning in higher education. Digital practice appears within these wider expectations rather than as a separate area of competence.
Digital Literacy Framework for Teachers	2022	Ministry of Education of China	5 dimensions: Digital awareness, Knowledge and skills in digital technology, Digital application, Digital social responsibility, Professional development.	Sets out what digital literacy means for teachers in the Chinese education context. It connects teachers' knowledge and use of digital technology with teaching practice, professional development, and digital responsibility.
Information and Communication Technology --- Competency Framework for Teachers (ICT-CFT) ^[18]	2018	United Nations Educational, Scientific and Cultural Organization (UNESCO)	3 levels: Knowledge Acquisition, Knowledge Deepening, Knowledge Creation. 6 aspects of a teacher's work: Understanding ICT in Education Policy, Curriculum and Assessment, Pedagogy, Application of Digital Skills, Organization and Administration, Teacher Professional Learning.	Provides a reference for teacher development in the use of ICT. Its structure links different stages of teacher development with several areas of professional practice and allows adaptation to national and institutional settings.
AI competency framework for teachers ^[19]	2024	United Nations Educational, Scientific and Cultural Organization (UNESCO)	5 aspects of AI competency: Human-centered mindset; Ethics of AI; AI foundations and applications; AI pedagogy; AI for professional development 3 progression levels: Acquire, Deepen, Create.	Concentrates specifically on teachers' work with AI. It covers what teachers need to understand about AI, how it can be used in teaching, and the ethical and professional questions involved.

4.2. Common elements across frameworks

Despite the regional and contextual differences, the seven digital literacy frameworks share several key elements, reflecting the core competencies required for effective digital literacy in education (**Table 4**).

Table 4. Common components in educator digital literacy frameworks

Common Elements	How the Elements Appear Across Frameworks
Technological Application	DigCompEdu: Digital technologies are considered in relation to teaching, learning, and assessment. ICT-CFT: ICT use is connected with different areas of teachers' work, including pedagogy and curriculum. Jisc: Practical digital capability includes working, communicating, and creating with digital technologies. AI Competency Framework: Extends technological application to AI and its use in teaching.
Information and Data Literacy	Jisc: Information, data, and media literacies form one part of its model of digital capability. China's Digital Literacy Framework for Teachers: Includes the acquisition, management, and use of digital information and resources. DigCompEdu: Teachers are expected to select, create, modify, and manage digital resources. ICT-CFT: Work with digital information and resources appears across several aspects of teachers' professional practice.

Ethical Responsibility	PSF 2023: Professional practice is located within a set of professional values and responsibilities.
	AI Competency Framework: Ethical questions are treated as a distinct part of teachers' AI competence. Jisc: Digital identity and well-being are included within digital capability. China's Digital Literacy Framework for Teachers: Digital social responsibility is identified as one of its five dimensions.
Pedagogical Innovation	DTPF: Digital practice is considered in planning, teaching approaches, assessment, and learner support. DigCompEdu: Technology is linked directly with teaching and learning rather than treated only as a technical skill.
	AI Competency Framework: AI pedagogy is included as a separate competency area. China's Digital Literacy Framework for Teachers: Digital application includes the use of technology to support and improve educational practice.
Professional Development and Lifelong Learning	ICT-CFT: Teacher professional learning forms part of the framework. Jisc: Digital learning and development is one of its six elements.
	DTPF: Its progression from Exploring to Adopting and Leading allows digital practice to develop over time. PSF 2023: Continuing professional learning and reflective practice are part of wider expectations for higher education professionals.
Learner Empowerment	DigCompEdu: Empowering Learners is one of its six areas, alongside the development of learners' own digital competence.
	ICT-CFT: Teachers' use of ICT is linked with changes in pedagogy and the ways learners engage with knowledge. DTPF: Several areas address learner support, accessibility, assessment, and employability. AI Competency Framework: AI pedagogy considers how AI can be used in teaching and learning while retaining a human-centered approach.
Alignment with Educational Contexts	China's Digital Literacy Framework for Teachers: The framework is closely connected with China's educational digitalization and teacher development agenda.
	ICT-CFT: Designed as an international reference that can be adapted at national and institutional levels. PSF 2023: Developed around professional practice in higher education. AI Competency Framework: Offers an international reference for teacher competence as AI becomes more widely used in education.

Table 4 shows that the frameworks have much in common, but the same ideas are often expressed in different ways. Digital technology, for example, may appear as a separate area of competence in one framework but form part of teaching or professional practice in another. A similar pattern can be seen in ethics, information use, and professional learning. What is common across the frameworks, therefore, is not a fixed set of identical competency categories. Rather, they tend to bring technology into the wider work of teachers, including teaching, working with learners, and continuing professional development.

4.3. Key differences between frameworks

The similarities described above do not mean that the seven frameworks take the same approach. Differences can be seen in who they are intended for, how they are organized, and the areas to which they give the most attention. These differences often relate to the particular education system, sector, or policy setting behind each framework. **Table 5** compares these features and shows some of the main differences among the seven frameworks.

Table 5. Analysis of core characteristics in digital literacy frameworks

Framework	Target Group/Focus	Distinctive Feature
DigCompEdu (EU)	Educators working at different levels and in different education settings.	Organizes educators' digital competence into six areas and uses six proficiency levels to describe its development from A1 Newcomer to C2 Pioneer.

Framework	Target Group/Focus	Distinctive Feature
Digital Capabilities Framework (Jisc)	Developed mainly for staff and learners in higher education and further education, with a broad view of digital capability.	Digital capability is not confined to teaching skills. Its six elements also cover areas such as information, data and media literacies, digital creation, communication, identity, and well-being.
Digital Teaching Professional Framework (DTPF)	Teachers and trainers in the UK further education and training sector.	Connects digital teaching practice with seven areas of professional work and describes development through Exploring, Adopting, and Leading.
Professional Standards Framework (PSF)	Those who teach and support learning in higher education.	Digital practice is incorporated into the wider dimensions of Professional Values, Core Knowledge, and Areas of Activity, rather than presented as a separate digital competence framework.
Teachers' Digital Literacy Framework (China)	Teachers in China, within the wider development of educational digitalization.	Brings together five dimensions: Digital Awareness, Digital Technology Knowledge and Skills, Digital Application, Digital Social Responsibility, and Professional Development.
ICT Competency Framework for Teachers (UNESCO)	Teachers and teacher-development systems internationally.	Combines three levels of development with six aspects of teachers' professional work, allowing the framework to be adapted to different education systems.
AI Competency Framework for Teachers 2024 (UNESCO)	Teachers developing the knowledge and professional capacity needed to work with AI in education.	Gives separate attention to a human-centered mindset, ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional development, organized across three progression levels.

The frameworks take noticeably different approaches to teacher digital competence. DigCompEdu, for example, uses six proficiency levels and allows teachers to see digital competence as something that develops over time. Jisc is less centered on teaching alone. Its framework includes areas such as digital identity, well-being, information literacy, and collaboration, giving it a wider view of digital capability.

The two other UK frameworks have a different purpose. DTPF was developed mainly for further education and training and is closely connected with digital teaching practice. PSF 2023, on the other hand, is a professional standards framework for higher education. Digital practice forms part of a wider set of expectations about teaching, professional knowledge, and values rather than standing as a separate competence area.

The Chinese framework has another emphasis. It brings digital awareness, knowledge and skills, application, social responsibility, and professional development together within China's educational digitalization agenda. UNESCO's ICT-CFT was developed for a much broader international audience. Its structure connects different stages of teacher development with several areas of teachers' work, which allows it to be adapted for use in different education systems.

The UNESCO AI framework is different again. Rather than covering teacher digital competence in general, it concentrates specifically on AI. Human-centered values and AI ethics sit alongside AI knowledge, pedagogy, and professional learning. This makes the framework narrower in one sense, but it also brings issues into the comparison that were much less visible when the earlier frameworks were developed.

Looking at the seven frameworks in this way, it is difficult to identify one model that works equally well for every setting. What counts as important depends partly on the teachers for whom a framework was designed, the education sector in which it is used, and the policy and technological environment at the time of its development.

4.4. Framework evaluation results

The evaluation results of the selected frameworks, based on the six predefined dimensions and rating criteria described in Section 3.6, are presented in **Table 6**. The scoring was conducted through a structured qualitative assessment of framework documents, policy reports, and supporting materials. The ratings should be interpreted as comparative and indicative rather than definitive measurements.

The evaluation was carried out by the researchers following a consistent set of criteria. To enhance the reliability of the assessment, all frameworks were evaluated using the same analytical framework and scoring standards, and the results were cross-checked to ensure internal consistency. While no formal statistical inter-rater reliability test was applied, the structured evaluation procedure and clearly defined criteria help improve the transparency and consistency of the results.

Table 6. Comparative evaluation of digital literacy frameworks across key dimensions

Framework Name	Content Coverage	Applicability	Integrability	Implementation Support	Innovation & Future Orientation	Impact & Effectiveness
DigCompEdu (EU)	5	4	4	5	4	5
Digital Capabilities Framework (Jisc)	4	4	4	4	4	4
Digital Teaching Professional Framework (DTPF)	4	3	3	5	3	3
Professional Standards Framework (PSF)	3	4	4	3	3	4
Teachers' Digital Literacy Framework (China)	4	3	4	3	4	4
ICT Competency Framework for Teachers (UNESCO)	5	5	5	4	4	5
AI Competency Framework for Teachers (2024) (UNESCO)	3	4	4	4	5	4

Content Coverage: DigCompEdu and the UNESCO ICT Competency Framework for Teachers (ICT-CFT) both scored 5 for content coverage. They cover a wide range of areas in teachers' digital practice, including technological, pedagogical, and professional competencies. The AI Competency Framework received a score of 3. This difference is largely a matter of scope: the framework was developed specifically around AI rather than teacher digital competence as a whole. The score should therefore not be read as indicating that the AI framework is less developed for its intended purpose.

Applicability: The ICT-CFT received a score of 5. As an international framework, it is intended to be adapted to different national and educational settings. China's Digital Literacy Framework for Teachers and the DTPF each scored 3. Both are more closely tied to the settings for which they were developed. Their specificity can be useful within those settings, although using them elsewhere may involve more adjustment.

Integrability: A score of 5 was given to the ICT-CFT because it can be connected with different policies, teacher development programs, and institutional arrangements. The DTPF received 3. Its design is closely linked to further education and training in the UK, so some parts of the framework may not transfer directly to other sectors.

Implementation Support: DigCompEdu and the DTPF each scored 5 in this area. Both go beyond describing competencies by providing materials that can help teachers put the frameworks into practice.

DigCompEdu includes resources for reflection and competence development, while the DTPF is accompanied by training and guidance for digital teaching. PSF received a score of 3. Since it is concerned with professional standards in higher education more generally, support for developing digital competence is less direct.

Innovation and Future Orientation: The AI Competency Framework stands out on this dimension and received a score of 5. AI is the central concern of the framework, with attention given to ethics, teaching applications, AI knowledge, and professional learning. DTPF and PSF each scored 3. Emerging technologies are less visible in these two frameworks, where the main emphasis remains on wider teaching and professional practice.

Impact and Effectiveness: DigCompEdu and the ICT-CFT both received a score of 5. They have gained recognition in policy and institutional settings and have been used in different educational contexts. As explained earlier, these scores do not mean that their effectiveness has been established through direct measurement of student or teacher outcomes. They reflect the available evidence of adoption, policy use, and reported educational application. DTPF received a lower score of 3 because evidence of its use and influence beyond its main sector is less extensive.

5. Discussion

5.1. Strengths and weaknesses of each framework

The strengths and limitations of the seven frameworks were considered in relation to their design, scope, target groups, and practical use. As summarized in **Table 7**, no single framework performs equally strongly across all areas. Rather, their strengths tend to reflect the purposes and educational contexts for which they were developed.

Table 7. Strengths and limitations of key digital literacy frameworks

Framework	Strengths	Weaknesses
DigCompEdu (EU)	Comprehensive coverage of digital competence, including technology integration, ethics, and learner empowerment. Progression model with six levels supports ongoing professional development. Widely referenced and applied in European education and teacher development initiatives.	Developed primarily within the European policy context and may require adaptation when applied in other educational systems.
Jisc Digital Capabilities Framework (UK)	Holistic approach with six elements including collaboration, information literacy, and well-being. Easily integrates into institutional policies and offers practical tools for educators.	Its strong orientation towards higher education may require adaptation for use in other education sectors.
Digital Teaching Professional Framework (DTPF)(UK)	Uses the Exploring, Adopting, and Leading progression stages to support the development of digital teaching practice. Extensive resources and training support its application in further education and training.	Its specific orientation towards the UK further education and training sector may limit direct transfer to other sectors or national contexts.
Professional Standards Framework (PSF) (UK)	Emphasizes teaching excellence and reflective practices. Strong alignment with accreditation processes in higher education.	As a broader professional standards framework for higher education, it provides less explicit attention to digital competence and emerging technologies.
Teachers' Digital Literacy Framework (China)	Aligns with Chinese national policies and educational digitalization goals. Integrates digital awareness, technological knowledge and skills, digital application, social responsibility, and professional development within China's educational digitalization agenda.	Closely aligned with China's policy and educational context and may therefore require adaptation in other systems.

ICT Competency Framework for Teachers (UNESCO)	Globally recognized and adaptable to diverse contexts. Comprehensive focus on ICT integration in teaching and policy.	Its broad international orientation may require substantial contextualization and implementation planning at the national or institutional level.
AI Competency Framework for Teachers 2024 (UNESCO)	Places explicit emphasis on AI-related competencies, including human-centered values, AI ethics, AI knowledge and applications, AI pedagogy, and professional development. Provides a three-level progression model (Acquire, Deepen, and Create) to support teachers' continuing development of AI competencies.	As a recent global framework, its practical application across diverse educational, technological, and infrastructural contexts still requires further evidence.

Some of the frameworks were developed with a wide range of users and settings in mind, while others are more closely tied to a particular education system or sector. DigCompEdu and the UNESCO ICT-CFT, for example, cover several areas of teacher digital competence and professional development and can be used in different settings. Even so, they may still need to be adjusted to local circumstances. DTPF, PSF 2023, and China's Digital Literacy Framework for Teachers have stronger links with particular sectors or national policy settings. This gives them a clearer connection with the needs of their intended users, but parts of these frameworks may be less easy to transfer directly elsewhere.

There are also different views of where digital competence fits within teachers' professional work. DigCompEdu sets out digital competence in a defined structure with a progression pathway. Jisc takes a wider view, bringing digital identity, well-being, information literacy, and collaboration into its understanding of digital capability. PSF 2023 approaches the issue differently. Digital practice sits within broader areas of professional knowledge, values, and teaching activity rather than appearing as a separate competence domain. In other words, the boundaries of teacher digital competence are not drawn in the same way across the frameworks.

The period in which a framework was developed also matters. Earlier frameworks paid considerable attention to ICT use, digital resources, and the use of technology in teaching. The UNESCO AI Competency Framework for Teachers has a more specific concern: AI. It gives much greater visibility to human-centered values, AI ethics, AI knowledge, and AI pedagogy. For this reason, its narrower coverage of general digital competence is consistent with what the framework was designed to do. It is also a relatively new framework, and there is not yet the same amount of evidence about its use in different educational settings. The seven frameworks therefore offer different ways of looking at teacher digital competence rather than one model that can simply be applied everywhere. Framework selection and adaptation need to take account of the educational sector, policy context, institutional capacity, technological development, and the professional needs of teachers.

5.2. Implications for different educational contexts

The comparison indicates that teacher digital literacy frameworks cannot be transferred from one educational context to another without considering differences in policy, institutional structures, technological conditions, and teacher development needs. DigCompEdu and ICT-CFT were developed for use across a relatively wide range of settings, but this does not mean that they can be adopted without adjustment. Local educational conditions still need to be considered. DTPF and China's Digital Literacy Framework for Teachers are more closely tied to particular sectors and policy settings. Their design shows more directly how the meaning and use of digital competence can change according to the context in which teachers work.

This point matters for open and distance education, where much of the teaching and interaction with learners takes place through digital technologies. Teachers in open universities therefore face demands that are not always the same as those in other settings. DigCompEdu and ICT-CFT contain areas that can be related to online teaching and learner engagement. Jisc looks more broadly at digital capability within an institutional setting, while DTPF gives greater attention to the practical development of digital teaching. China's framework adds another consideration: teacher digital competence is closely connected with wider educational policies and institutional goals.

The growing use of AI also adds a new dimension to teacher development in open and distance education. UNESCO's AI Competency Framework for Teachers draws attention to human-centered values, ethical use, AI knowledge, pedagogy, and professional learning. For institutions adopting such technologies, however, teacher competence cannot be considered separately from infrastructure, institutional support, and local educational conditions. Rather than adopting any single framework in full, institutions may therefore benefit from selecting and adapting elements from different frameworks according to their educational purposes, technological capacity, and teacher development needs.

6. Conclusion

6.1. Summary of the study findings

This study provides a comparative analysis of seven teacher digital literacy and digital competence frameworks: DigCompEdu, the Jisc Digital Capabilities Framework, the Digital Teaching Professional Framework (DTPF), the Professional Standards Framework (PSF), China's Digital Literacy Framework for Teachers, UNESCO's ICT Competency Framework for Teachers (ICT-CFT), and UNESCO's AI Competency Framework for Teachers. The comparison looked at what the frameworks cover, how they are organized, and the priorities they set. Six dimensions were used to examine them further: content coverage, applicability, integrability, implementation support, innovation and future orientation, and impact and effectiveness.

A number of themes appear across the seven frameworks. These include the use of technology, information and data literacy, ethical responsibility, digital pedagogy, professional development and lifelong learning, and learner empowerment. The emphasis placed on these areas, however, is not always the same. DigCompEdu sets out digital competence in considerable detail and includes a progression pathway for educators. Jisc looks at digital capability more broadly, while DTPF is more closely concerned with digital teaching in further education and training. PSF approaches digital practice as part of wider professional standards in higher education. The Chinese framework reflects the priorities of national educational digitalization. ICT-CFT, in contrast, was developed with adaptation to different educational settings in mind. The more recent AI Competency Framework adds issues that were less visible in earlier frameworks, particularly AI knowledge, ethics, and pedagogy.

No framework appears equally strong in every area examined. Those with a wider scope may be easier to use across different settings, although some local adjustment is still likely to be needed. Frameworks developed for a particular country or education sector have a different advantage: they tend to reflect the needs and conditions of their intended users more directly. The AI Competency Framework has a more specialized focus, but it responds directly to recent changes in educational technology. Therefore, the selection or adaptation of a framework should take into account the educational context, institutional needs, available resources, and the purpose for which it is used.

6.2. Practical implications

The findings of this study may be useful for educational institutions, policymakers, and those involved in teacher professional development. Existing frameworks do not need to be adopted as complete models. Institutions can select relevant elements from different frameworks and adapt them according to their own teaching environments, teacher needs, and policy requirements.

The findings are also relevant to open and distance education, where digital technologies play an important role in teaching, communication, assessment, and learner support. Teachers in these settings need not only technical skills, but also the ability to design online learning activities, communicate with learners, use digital resources responsibly, and continue developing their digital competence. The increasing use of AI also brings new requirements related to AI knowledge, ethical use, and teaching practice. Institutional support, training opportunities, and appropriate technological resources are therefore important when digital literacy frameworks are applied in practice.

6.3. Future research

More evidence is needed on what happens when these frameworks are actually used by teachers and institutions. A framework that appears workable in one setting may be used quite differently in another. Future research could therefore pay more attention to teachers' experiences, including the ways they interpret the framework, the parts they find useful, and the problems they meet in practice. Interviews, surveys, or case studies would provide evidence that cannot be obtained from framework documents alone.

The growing use of AI in education raises a different set of questions. Some earlier frameworks were developed before generative AI became widely used, and it is not yet clear whether their existing competency areas are sufficient for this change. This is an issue worth following as classroom practice develops. Research in different types of institutions, including open and distance education, could also show which parts of these frameworks remain useful across settings and which need to be reconsidered for particular contexts.

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References

- [1] European Commission, 2020, Digital Education Action Plan 2021–2027: Resetting Education and Training for the Digital Age. https://education.ec.europa.eu/sites/default/files/document-library-docs/deap-communication-sept2020_en.pdf
- [2] Gilster P, 1997, Digital Literacy. John Wiley, New Jersey.
- [3] Martin A, Grudziecki J, 2006, DigEuLit: Concepts and Tools for Digital Literacy Development. Innovation in

- Teaching and Learning in Information and Computer Sciences, 2006(4): 249–267.
- [4] UNESCO, 2018, A Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2. UNESCO Institute for Statistics. <https://uis.unesco.org>
 - [5] Council of the European Union, 2018, Council Recommendation on Key Competences for Lifelong Learning. Official Journal of the European Union, 2018(C189): 1–13. [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018H0604\(01\)](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018H0604(01))
 - [6] Falloon G, 2020, From Digital Literacy to Digital Competence: The Teacher Digital Competency (TDC) Framework. Educational Technology Research and Development, 2020(68): 2449–2472. <https://doi.org/10.1007/s11423-020-09767-4>
 - [7] Fernández-Batanero JM, Román-Graván P, Montenegro-Rueda M, et al., 2021, Digital Teaching Competence in Higher Education: A Systematic Review. Education Sciences, 2021(11): 689. <https://doi.org/10.3390/educsci11110689>
 - [8] Ministry of Education of China, 2022, Digital Literacy Framework for Teachers. Ministry of Education.
 - [9] European Commission, 2017, Digital Competence Framework for Educators (DigCompEdu): Developing Digital Competence in Education. Publications Office of the European Union. <https://ec.europa.eu/jrc/en/digcompedu>
 - [10] Jisc, 2015, Building Digital Capabilities: The Six Elements Defined. <https://www.jisc.ac.uk/building-digital-capability>
 - [11] ISTE, 2017, ISTE Standards for Coaches. International Society for Technology in Education. <https://www.iste.org>
 - [12] Mishra P, Koehler MJ, 2006, Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. Teachers College Record, 2006(6): 1017–1054.
 - [13] ISTE, 2017, ISTE Standards for Educators. <https://www.iste.org/>
 - [14] OECD, 2021, Digital Education Outlook 2021: Pushing the Frontiers with Artificial Intelligence, Blockchain, and Robots. OECD Publishing. <https://doi.org/10.1787/589b283f-en>
 - [15] Education and Training Foundation, 2018, Taking learning to the next level: Digital Teaching Professional Framework. Education and Training Foundation.
 - [16] UNESCO, 2017, Working Group on Education: Digital Skills for Life and Work. Broadband Commission for Sustainable Development. <https://broadbandcommission.org>
 - [17] Advance HE, 2023, Professional Standards Framework for Teaching and Supporting Learning in Higher Education (PSF 2023). Advance HE.
 - [18] UNESCO, 2018, UNESCO ICT Competency Framework for Teachers: Version 3. UNESCO.
 - [19] Miao F, Cukurova M, 2024, AI Competency Framework for Teachers. UNESCO. <https://doi.org/10.54675/ZJTE2084>

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