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Research Article

A Critical Analysis of Digital Competence Skills among Secondary School Teachers: Theoretical Perspectives

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ABSTRACT

This research critically analyses the digital competence skills of secondary school teachers through various theoretical perspectives to understand the depth and scope of their digital literacy in the modern educational context. The study explores the core components of digital competence including digital pedagogy, content creation, communication, and assessment skills among secondary school educators. Drawing upon frameworks such as the DigCompEdu model and Technological Pedagogical Content Knowledge (TPACK), the paper evaluates how effectively teachers integrate digital tools into their instructional practices. It also investigates the influence of socio-demographic variables, institutional support, and access to infrastructure on the development of digital competence. Findings from recent literature reveal a significant gap between self-perceived digital competence and actual classroom implementation, particularly in rural and under-resourced settings. The paper argues for a structured, context-specific professional development framework that addresses these challenges and supports continuous growth in digital literacy. By bridging theoretical understanding with practical application, this study contributes to a deeper comprehension of the dynamic role digital competence plays in shaping the quality of secondary education.

Keywords: Digital competence, secondary school teachers, digital literacy, DigCompEdu, TPACK, digital pedagogy, professional development, technology integration, teacher education, ICT in education.

Introduction:

The capacity to use digital technology successfully and efficiently to accomplish particular goals is referred to as digital competency skills. These abilities encompass a blend of technical, cognitive, and social skills that enable people to use digital tools for problem-solving, creation, communication, and teamwork. Because digital technologies are so commonplace in both our personal and professional lives, digital competency skills are becoming more and more crucial in today's society. In the 21st century, digital competence has emerged as a fundamental skill set for educators, especially in the context of rapidly evolving technologies and digital learning environments. The conceptual framework of digital competence is rooted in multiple theoretical models, the most notable being the *DigCompEdu* framework (Digital Competence of Educators) and the *Technological Pedagogical Content Knowledge* (TPACK) model. DigCompEdu outlines six key areas of digital competence: professional engagement, digital resources, teaching and learning, assessment, learner empowerment, and facilitating learners' digital competence. It emphasizes that educators must not only know how to use digital tools but also be able to apply them meaningfully in teaching to enhance student learning outcomes. Similarly, the TPACK model integrates three primary domains—technology, pedagogy, and content knowledge—arguing that true digital competence lies in the intersection of these domains. In today's education system, digital competence is no longer optional; it is essential. The 21st century demands a shift from traditional teaching methods to more dynamic, learner-centered approaches that rely heavily on digital integration. Teachers with strong digital skills can design interactive and personalized learning experiences, access a vast array of online resources, and assess students' progress using technology-enhanced tools. Moreover, digital competence enables teachers to prepare students for a digital society, fostering their ability

to critically analyze online content, collaborate using digital platforms, and communicate effectively in a technology-driven world.

The importance of digital competence is especially prominent in secondary education, where students are at a critical developmental stage, preparing for higher education or employment. Teachers play a crucial role in modeling effective digital behavior and equipping students with the skills they need for lifelong learning and responsible digital citizenship. Furthermore, digital competence supports inclusive education, allowing teachers to cater to diverse learning needs through adaptive technologies and multimedia content. It also enhances communication with parents and other stakeholders, thereby strengthening school-community relationships.

Another crucial aspect of digital competence is its role in teacher professional development. Educators who are digitally competent are more confident, creative, and open to innovation. They are also more resilient to challenges such as the shift to online teaching during emergencies like the COVID-19 pandemic. In fact, the pandemic has reinforced the importance of digital competence by highlighting the digital divide and the urgent need for capacity building in ICT use among teachers, especially in under-resourced areas. Despite its growing importance, digital competence development still faces challenges such as limited infrastructure, lack of training, and unequal access to technology. Addressing these requires a comprehensive strategy that includes investment in infrastructure, integration of digital skills training in teacher education, and continuous professional development programs tailored to the evolving needs of teachers.

Theoretical Perspectives:

A. Digital Competence Framework (DigComp)

DigComp 1.0, the European Commission's 2013 introduction of the DigComp framework for citizens, aims to define and structure digital competency for people in all spheres of life (Ferrari, 2013). It is a comprehensive model to assess and develop digital skills for personal, educational, and professional growth. Over time, the framework has evolved. DigComp 2.0 was released in 2016, followed by DigComp 2.1 in 2017, and the most recent update, DigComp 2.2, in 2022. DigComp 1.0 comprises two core components: a self-assessment grid and a detailed competence framework. The self-assessment tool enables users to evaluate their digital proficiency across various domains and levels (Furtáková, 2024).

Widely used across Europe and globally, DigComp serves as a reference point for national digital education policies, curriculum development, and digital upskilling initiatives. It supports not only educators and learners but also policymakers and employers in developing targeted digital learning strategies. Several academic studies have validated its utility in higher education and lifelong learning, including works by Spante et al. (2018), confirming its relevance in both theoretical and applied educational research. The first version, developed by Anusca Ferrari (2013), proposed two main tools: a self-assessment grid for evaluating digital skills across three levels, and a competency framework outlining five core areas of digital competence. The DigComp is built on five key dimensions that systematically define and assess digital competence. Each of which plays a distinct role in identifying and supporting digital skill development for lifelong learning, employability, and civic engagement.

Changes in Dimension 1

The current DigComp structure and the changing need for digital skills in the labor market are not aligned due to the speed at which technology is developing. This discrepancy led to the revision of DigComp 1.0. The newer versions not only update the framework itself but also introduce practical guidelines to support its smooth and efficient implementation. While these updated versions retain the core structure of DigComp 1.0 with 21 competence descriptors organized into five key areas, they have been expanded to address the changing needs of society.

Table 1. Digital Competence Areas in DigComp 1.0 and DigComp 2.0

No.	DigComp 1.0 Competence Areas		DigComp 2.0 Competence Areas
1	Information		Information and Data Literacy
2	Communication		Communication and Collaboration
3	Content Creation		Digital Content Creation
4	Safety		Safety
5	Problem Solving		Problem Solving

Each new version introduced more nuanced examples, added data literacy, and incorporated broader societal and environmental aspects, aligning digital skills with emerging global challenges like misinformation, cyber safety, digital well-being, and sustainability.

Figure 1: Graphical representation of dimension 1 of the DigComp 2.0 – 2.2 framework
Source: Vuorikari et al. (2022)

Detailed Overview of DigComp 2.0 Competence Areas

1. Information and Data Literacy

According to the revised DigComp 2.2 framework, is a fundamental digital competency that includes the capacity to identify information needs and find it quickly in digital environments. It requires individuals to not only access digital content but also to move across platforms and sources with purpose and clarity. This competence also includes the critical assessment of the accuracy, trustworthiness, and relevance of both information and data. Teachers can use mobile apps like DIKSHA or ePathshala in offline mode to bridge gaps in information access, especially in areas with limited internet connectivity. Moreover, it emphasizes the ethical handling and systematic organization of digital resources. In today's data-driven world, being able to sift through the vast amount of available online content and use it meaningfully is essential for academic achievement, informed decision-making, and active digital citizenship (Vuorikari et al., 2022). Key sub-skills include:

- **Browsing, searching, and filtering data and content**: Teachers should know how to use search engines effectively, employ advanced filters, and access educational databases or digital libraries relevant to their subjects.
- **Evaluating information and data**: This involves judging the reliability, accuracy, and purpose of digital content, which is crucial in avoiding the spread of misinformation.
- **Managing data, information, and digital content**: Teachers should be able to categorize educational resources, manage student data securely, and store materials in cloud-based systems. In tribal areas, where traditional knowledge coexists with formal education, teachers with strong information literacy can bridge indigenous and modern knowledge systems, making education more contextual and relevant.

2. Communication and Collaboration

The DigComp framework's Communication and Collaboration competency area places a strong emphasis on using digital tools responsibly and effectively to communicate, work together, exchange information, and take an active role in society. It is foundational for educators who aim to foster a connected, participatory, and inclusive learning environment. In the context of teachers in tribal areas, this competence helps overcome physical remoteness and infrastructural limitations by enabling virtual connectivity and knowledge exchange. Despite infrastructure limitations, teachers can use mobile phones for virtual meetings, collaborate with peers through WhatsApp, and network with other educators through social media platforms. This competence area is broken down into six sub-dimensions:

- **Interacting through digital technologies**: This is the capacity to use a range of digital tools, including email, instant messaging, and video conferencing platforms, to communicate effectively (e.g., Zoom, Google Meet), and social media channels (WhatsApp, Telegram).
- **Sharing digital content**: Teachers must understand how to distribute notes, assignments, and assessments securely and ethically, using platforms like WhatsApp groups, Google Classroom, or school portals.
- **Collaborating using digital tools**: Co-creating lesson plans or study materials with other educators using collaborative tools such as Google Docs or Padlet.
- **Netiquette**: Netiquette refers to the knowledge and application of respectful and appropriate behavior in digital communication.

• **Managing digital identity**: Teachers must be aware of how their online presence (social media, professional networks) can impact their personal and professional reputation. In resource-poor tribal areas, communication and collaboration skills enable teachers to network with peers, access remote training, and participate in national-level professional development programs, overcoming geographic isolation (Ilomäki et al., 2016).

3. Digital Content Creation

Digital content creation is critical to digital competence, especially in the education sector. According to the DigComp 2.2 Framework, this competence area encompasses not just the ability to create new digital materials but also the skills to modify, integrate, and ethically reuse existing content, as well as understanding basic programming and automation tools. For educators, particularly in under-resourced and remote areas like tribal regions of Western Odisha, mastering this competence allows for contextualized, learner-centered, and inclusive pedagogy (Vuorikari et al., 2022). This area is divided into four core sub-competences:

• **Developing digital content**: This refers to the ability to create and edit content using digital tools such as word processors (MS Word), presentation tools (PowerPoint, Canva), video editors (Kinemaster, Shotcut), or educational content creation tools (H5P, Moodle).

• **Integrating and re-elaborating digital content**: This sub-competence involves the capacity to adapt, remix, and repurpose existing digital content to suit specific teaching and learning needs. Teachers must be skilled at selecting relevant online resources (e.g., NCERT digital textbooks, DIKSHA videos), integrating them into lessons, and recontextualizing them to reflect the learners' realities in tribal communities.

• **Copyright and licenses**: Understanding intellectual property rights, open licenses, and ethical use of digital content is a vital digital competence. Teachers must be aware of how to properly use, attribute, and share educational resources under licenses such as Creative Commons.

• **Programming**: While not all teachers are expected to be software developers, a basic awareness of programming concepts and logic is increasingly seen as part of digital literacy. This includes understanding how to use coding tools like Scratch, Blockly, or MIT App Inventor to introduce students to computational thinking. Empowering teachers in tribal areas to create localized content, for example, translating digital lessons into tribal languages or embedding culturally relevant examples, promotes inclusivity and engagement among students (Spante et al., 2018).

4. Safety

The Safety dimension of the DigComp 2.2 framework refers to the competencies necessary to ensure secure, responsible, and ethical usage of digital tools and platforms. In today's digital learning environments, particularly within education systems, Device protection, personal data protection, mental and physical health protection, and environmental protection are becoming necessities rather than options. Training teachers on digital safety and privacy helps prevent issues like cyberbullying or misuse of data, crucial in communities where digital literacy may be low. For secondary school teachers in tribal areas, digital safety awareness plays a critical role not only in safeguarding their digital activities but also in educating students who are often first-time users of technology. This area includes four key sub-competencies:

• **Protecting devices and content**: Protecting digital devices from threats such as viruses, malware, phishing attacks, and unauthorized access is fundamental to maintaining data integrity and educational continuity.

• **Data privacy and protection**: With the increasing digitization of education, through platforms like Google Classroom, DIKSHA, or WhatsApp groups, teachers and students alike share personal data online. The ability to understand data privacy, consent, and the implications of data sharing is essential.

• **Digital well-being**: Recognizing the impact of screen time, cyberbullying, or online addiction on both teachers and students. Practicing digital balance and promoting mindfulness in digital spaces.

• **Environmental awareness**: Sustainability is an often-overlooked but increasingly relevant dimension of digital safety. This includes understanding the environmental impact of digital technologies, such as e-waste, carbon footprint from data centers, and energy consumption. For teachers in tribal schools, where students may be using shared devices, safety training ensures ethical use of technology and prevents digital risks like identity theft, exposure to inappropriate content, or cyber exploitation (Vuorikari et al., 2022).

5. Problem Solving

The fifth competence area in the DigComp 2.2 Framework, Problem Solving, represents the culmination of all digital skills by emphasizing how individuals creatively and critically engage with digital technologies to address challenges, innovate processes, and adapt to technological change. This area is particularly vital for secondary school teachers in tribal regions of Western Odisha, who often face infrastructural limitations, limited access to training, and digital exclusion. Their ability to identify problems and develop pragmatic, context-specific digital solutions directly affect teaching effectiveness and professional satisfaction. Teachers in tribal areas use creative solutions, such as integrating low-tech approaches with digital tools, to overcome resource challenges. Problem solving in the digital domain involves four sub-competencies, each representing a core component of adaptive and innovative digital engagement: Identifying digital needs and problems:

Recognizing when technology can solve a pedagogical problem, like using educational videos for students who struggle with textbook learning.

• **Solving technical problems**: This sub-competency involves the ability to diagnose and troubleshoot basic to moderately complex technical issues encountered while using digital devices, platforms, and applications. Teachers may face problems such as:

• **Using technology creatively**: Designing new approaches to teaching using AR/VR, simulations, or gamification tools, even on low-tech platforms.

• **Identifying digital competence gaps**: This refers to a teacher's ability to assess educational needs and determine which digital tools or technologies can best address them. For instance, a teacher might identify that students struggle with English pronunciation and may decide to use voice-based learning apps or YouTube tutorials. For teachers in tribal Odisha, digital problem-solving equips them to adapt to resource constraints, innovate with minimal infrastructure, and develop context-sensitive solutions that improve learning outcomes (Furtáková, 2024).

Regarding tribal educators in Western Odisha. The Digital Competence Framework for Citizens (DigComp) is a helpful tool for building critical digital skills given resource constraints such as limited access to devices, internet connectivity, and training opportunities. Covering communication, problem-solving, safety, content creation, and information and data literacy, DigComp offers a systematic way to grasp and grow competencies across important domains. For teachers working in underserved tribal areas, this framework can help identify specific skill gaps and guide professional development efforts tailored to their unique contexts. By fostering foundational digital competencies, DigComp empowers educators to use whatever technological resources are available, such as shared mobile devices, offline content, or community ICT centers, thus enhancing their ability to support student learning in increasingly digital environments.

B. Technological Pedagogical Content Knowledge (TPACK)

Mishra and Koehler (2006) created the Technological Pedagogical Content Knowledge (TPACK) framework, originally known as Technological Pedagogical Content Knowledge (TPCK), to outline the types of knowledge that educators need in order to successfully incorporate technology into the classroom curriculum. The framework is based on Shulman's (1986) concept of Pedagogical Content Knowledge (PCK), which emphasised the connection between curriculum knowledge and teaching strategies. TPACK adds Technological Knowledge (TK) as a critical third aspect to this paradigm in order to address the realities of teaching and learning environments in the twenty-first century. Later, Thompson and Mishra (2007–2008) improved the abbreviation TPCK to a more pronounced and memorable word, TPACK, which better reflects the integrated character of its components and facilitates communication. This rebranding also represented the need for a more unified way of thinking about how technology, pedagogy, and content come together to create a comprehensive framework for teacher expertise in digitally mediated instruction.

Theoretical Foundations and Evolution

Although the formal expression of TPACK first appeared in 2006, its origins can be found in earlier work. Mishra (1998) offered a quick look at the triad of material, theory, as a substitute for pedagogy, and technology in the framework of educational software design. Pierson (1999, 2001) also investigated how classroom practices combine pedagogical reasoning and technology. Examining the dynamic interaction between content, pedagogy, and technological affordances, scholars like Keating and Evans (2001) and Zhao (2003) also added to the discussion. Though under different names or frameworks, other significant academics, Hughes (2004), McCrory (2004), Margerum-Leys and Marx (2002), and Niess (2005) have also shown sensitivity to the interaction among the three domains (Schmidt et al., 2009).

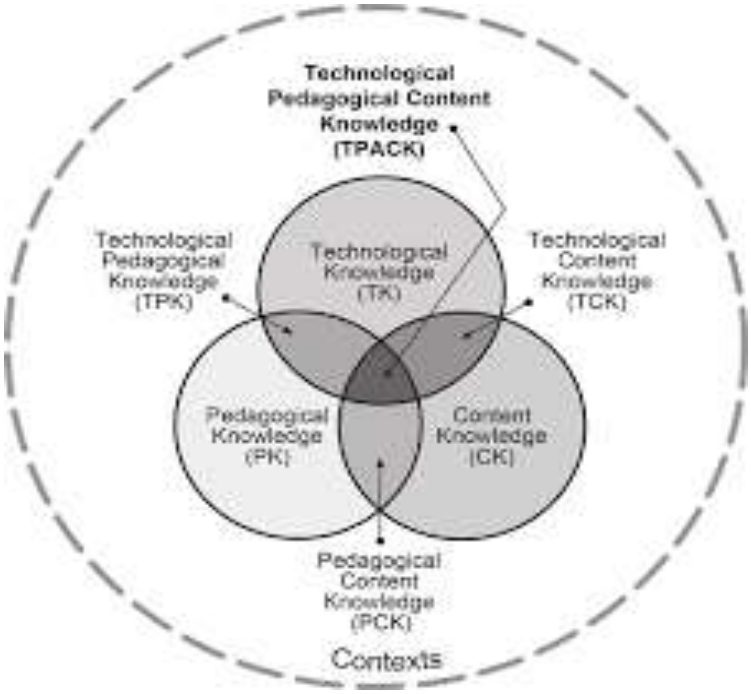

Figure 2: The components of the TPACK framework
Sources: (graphic from http:// tpack.org).

Conceptual Foundations of TPACK

TPACK is composed of **seven interrelated knowledge domains** that collectively enable teachers to deliver technologically enriched, pedagogically sound, and content-accurate instruction:

1. Content Knowledge (CK): It describes a teacher's in-depth knowledge of the material they are supposed to teach. This includes not only factual information and concepts within a discipline but also the frameworks and structures that organize that knowledge. CK varies significantly across educational levels and disciplines; for example, the mathematical concepts taught in elementary school differ vastly in complexity and depth from those addressed at the graduate level. Moreover, CK encompasses the specialized ways of thinking and reasoning that are characteristic of a given discipline. Teachers must therefore possess a strong grasp of their subject area to effectively support student understanding and foster discipline-specific cognitive skills (Koehler et al., 2013).

2. **Pedagogical Knowledge (PK):** It encompasses the broad principles and strategies related to teaching and learning processes, independent of specific subject matter. It involves understanding how students learn, how to manage classroom environments, how to plan instruction, and how to assess learning outcomes effectively. PK also includes familiarity with a range of instructional approaches and the ability to adapt these methods to diverse classroom contexts (Koehler et al., 2013).

3. **Technological Knowledge (TK):** It embraces an understanding of how to use computer software and hardware, presentation tools such as document presenters and projects, and other technologies used in educational contexts. Most importantly, TK covers the ability to adapt to and learn new technologies. It is important to note that TK exists in a state of flux, due to the rapid rate of technology change and due to the protean nature of technology (Koehler & Mishra, 2008).

4. **Pedagogical Content Knowledge (PCK):** It reflects the assertion that effective teaching requires more than separate understanding of content and pedagogy. PCK also acknowledges the fact that different content lends itself to different methods of teaching. For example, the teaching of speaking skills for a foreign language teacher requires student-centered activities where students engage in meaningful and authentic communicative tasks (Koehler et al., 2013).

5. **Technological Content Knowledge (TCK):** It defines knowledge of the reciprocal relationship between technology and content. Technology impacts what we know, and introduces new affordances as to how we can represent certain content in new ways that was not possible before. For example, today, students can learn about the relationship between geometric shapes and angles by touching and playing with these concepts on the screens of handheld, portable devices. The development of Carbon-14 dating for archaeology and the way Google Trends may be used to forecast the spread of the flu virus are two examples of how technology also makes it possible to find new content and representations of content (Qualman, 2013).

6. **Technological Pedagogical Knowledge (TPK):** Technological Pedagogical Knowledge (TPK) refers to a teacher's ability to understand how technology can support and transform pedagogical strategies. This form of knowledge emphasizes the interplay between instructional methods and technological tools, guiding educators in selecting and applying technology in ways that align with specific teaching goals and learner

needs. TPK involves more than technical proficiency; it requires a deep understanding of how particular technologies can facilitate or constrain certain pedagogical approaches.

7. **Technological Pedagogical Content Knowledge (TPACK):** It stands for the comprehensive and integrated knowledge that teachers require in order to successfully develop and apply technology-based teaching practices. This system combines the three primary kinds of knowledge: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK), thereby enabling efficient and context-sensitive teaching methods. By focusing on their dynamic intersections, TPACK goes beyond the solitary knowledge of each component.

Dimensions of Digital Competency Skills

Kumar (2022) articulated that knowledge, practical application, digital technology, evaluation, information dissemination, communication, collaborative sharing, and innovative utilization of online pedagogical methodologies are essential components of contemporary education. Ramkrishna delineated five dimensions of Teacher's Digital Competence, which encompass Knowledge of Digital Practices, Proficiency in Utilizing Digital Technology for Educational Purposes, Evaluation and Validation of Online Information, Management and Communication of Digital Data, as well as Collaboration and Sharing of Digital Data for Teaching and Learning.

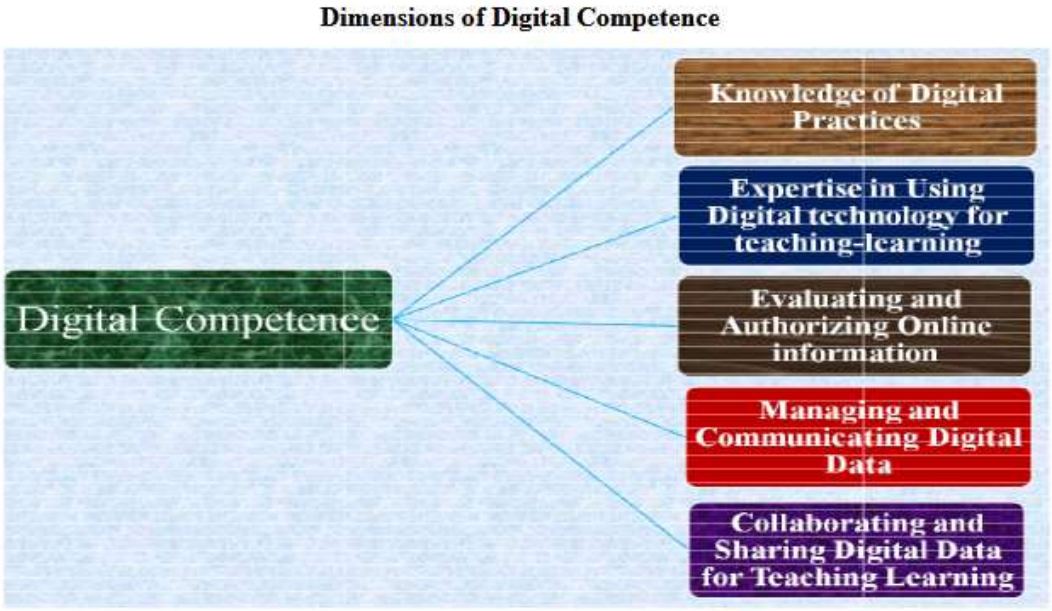

Figure 3: Dimension of Digital Competence

Knowledge of Digital Practices

Knowledge of Digital Practices encompasses the ability to assemble various components, create and organize files and folders, transfer files between storage devices, operate CD/DVD drives, safeguard digital data, produce printed materials utilizing a printer, develop and disseminate content in multimedia formats pertinent to subject-related options and concepts, employ an LCD projector in instructional settings, utilize appropriate tools for searching, utilizing, or creating necessary information from the internet, employ scanners to digitize images, utilize web cameras for online communication, and capture images effectively.

Expertise in Using Digital Technology for Teaching-Learning

Digital technology pertains to the proficient utilization of presentation software, word processing applications, electronic mail communication, educational video content, online interactions, and digital resources tailored for diverse student populations, downloading subject-specific files, incorporating animations into presentations, retrieving relevant subject matter from online sources, engaging with spreadsheet applications such as MS Excel, and utilizing various web search engines including Google, Yahoo, Ask, WebCrawler, My Web Search, among others.

Evaluating and Authorizing Online Information

Evaluating and Authorizing Online Information entails consulting with subject matter experts regarding inquiries through online platforms, sourcing pertinent information from a multitude of comparable web resources, differentiating between credible and non-credible online information, employing mobile devices for educational purposes, identifying authentic websites for citation, and adhering to ethical practices when utilizing information accessed online.

Managing and Communicating Digital Data

Managing and Communicating Digital Data includes the ability to save documents in multiple file formats, frequent visitation of educational websites for information updates, searching for text and images on web pages, sharing applications for educational objectives, utilizing virtual laboratories and e-books, and engaging with online courses offered through MOOC and Swayam platforms.

Collaborating and Sharing Digital Data for Teaching Learning

It refers to effective communication with students regarding homework and assignments through mobile devices and the internet, sharing information via formal networking platforms, organizing and disseminating information online and through social networking sites, consulting with experts online using instant messaging applications such as WhatsApp, Facebook, Yahoo, MSN, Skype, etc., and utilizing online platforms for procuring relevant educational materials such as books, models, and charts.

Assessment of Digital Competency Skills

Assessment of digital competency skills involves evaluating the knowledge, abilities, and attitudes individuals especially educators possess in using digital tools effectively and responsibly for teaching, learning, communication, content creation, and problem-solving. In the context of secondary school teachers working in tribal areas, assessing digital competence is particularly vital to understand their readiness to leverage technology for inclusive and quality education delivery. The European Digital Competence Framework (DigComp), developed by the European Commission (Ferrari, 2013; Vuorikari et al., 2022), offers a robust structure for assessing digital skills across five competence areas:

1.Information and Data Literacy,
2. Communication and Collaboration,
3. Digital Content Creation,
4. Safety, and
5. Problem Solving.

Each of these domains is evaluated across proficiency levels, ranging from foundational to advanced enabling a nuanced understanding of digital capabilities. For this study, proficiency will be categorized into three practical tiers: Basic: Teachers can perform fundamental digital tasks with support. Intermediate: Teachers can independently apply digital tools in classroom activities. Advanced: Teachers innovatively integrate digital technology in pedagogically sound and contextually relevant ways. In Indian educational research, scholars such as Kumar (2022) and Ramkrishna have identified additional assessment dimensions tailored for teachers, which include:

- Knowledge of Digital Practices – assessing operational skills like file management, printing, and basic tool usage.
- Use of Digital Tools in Teaching – evaluating integration of presentation software, email, online resources, and animations into classroom practices.
- Evaluation of Online Information – measuring the ability to distinguish credible sources, apply digital ethics, and use academic tools responsibly.
- Digital Data Management and Communication – assessing online sharing, virtual lab engagement, and participation in e-learning platforms.
- Collaboration and Sharing – examining the ability to use networking tools for professional communication, resource sharing, and consultation with experts.

Assessment Tools and Procedures:

In this study, digital competence will be assessed using a structured questionnaire adapted from the DigComp self-assessment tool and aligned with the CIET-NCERT ICT Competency Standards for Teachers in India (2021). The questionnaire will consist of Likert-scale items, scenario-based performance questions, and task-based rubrics that cover the following:

- Searching and curating quality digital content relevant to their subject.
- Communicating with parents, students, and colleagues through digital platforms like WhatsApp, Google Classroom, or DIKSHA.
- Creating multimedia teaching materials using basic tools like PowerPoint, Canva, or Kinemaster.
- Safegusarding digital identities, using secure logins, and educating students on cyber safety.
- Demonstrating innovation by repurposing low-tech or offline tools (e.g., solar-powered projectors, radio, or mobile apps) for teaching in resource-scarce tribal schools.

The Technological Pedagogical material Knowledge (TPACK) framework (Mishra & Koehler, 2006) improves the assessment by highlighting the interplay between technological skills, pedagogy, and subject material knowledge. TPACK-based assessment tools allow for a contextual understanding of how well teachers adapt digital technologies to their pedagogical strategies and subject matter, particularly in socio-culturally diverse settings like tribal Odisha. Therefore, assessment of digital competency skills is both a diagnostic and developmental tool. It identifies gaps, informs targeted training, and ultimately contributes to professional

growth, educational innovation, and improved student outcomes especially in marginalized educational contexts where equity and inclusion are priorities.

Summary of Research Based on Digital Competence

In recent years, digital competence with a focus on its impact on the effectiveness of teaching, productivity in research, teacher education, and professional development has been widely studied in an educational context. An extensive literature review was conducted, revealing several key findings about teachers' digital literacy and how it impacts their professional practice. Contrarily, numerous studies suggest that the pre-service teachers show a good level of digital competence in certain facets, like choosing suitable digital resources, participating in digital pedagogical practices, and self-reflection in teaching. Benali et al., (2018) indicate that teachers exhibit proficiency in their areas but often face challenges in digital assessment and creating digital content. Such gaps indicate the need to address these deficiencies and also indicate the need for targeted professional development. Several research or studies indicate the positive association between high levels of digital competence and research productivity. Yazon et al. (2019) found that teachers who are more advanced in digital competency skills are more productive in research activities. This indicates that digital competency is not only essential for teaching but also for scholarly engagement. However, the digital skills are not the same across the globe. Cebi & Reisoglu (2020) discovered that the pre-service teachers' digital competence differed significantly based on gender and fields of study. These differences indicate the need for digital literacy training that considers discipline-specific and demographic factors. The relationship between digital competence and teaching effectiveness has also been investigated in the context of e-learning platforms. Osuji & Aranilewa (2022) found that teachers who had strong digital literacy, communication, and content creation skills could use e-learning platforms effectively. This finding highlights the importance of digital literacy to access to technology and also the skills to integrate it into the pedagogical practices. Similarly, Kaur & Sharma (2022) found that research scholars demonstrate higher digital competence who are from engineering, science, and management than those from education and languages. This indicates that the types of discipline also play a significant role in shaping digital skills.

While some studies focus on individual factors such as gender, teaching experience, and age. On the other hand, some studies emphasize the importance of structured professional development programs aligned with a framework like the DigCompEdu model. Furthermore, the reviews revealed that the teaching performance of the teacher is enhanced through digital competence. Several studies revealed that teachers who are proficient in using digital tools (Jogezai et al., 2023; García-Delgado et al., 2023). It should be noted that digital competence does not enhance the effectiveness of teaching. Pedagogical knowledge and the ability to adapt to contextual factors play an important role in determining teaching quality. Regarding teacher education, several studies indicate a gap between basic digital skills of pre-service teachers and the advanced digital competency skills required for effective pedagogical application. The pre-service teachers with basic digital skills struggle to incorporate digital content into their teaching practices (Sumarni et al., 2023; Maghfiroh et al., 2023). This indicates the need to restructure the teacher education programs to provide ongoing, comprehensive training in digital pedagogy. Research also revealed that the teachers with digital skills report higher job satisfaction. This indicates that both digital competence and job satisfaction are also linked to each other. Similarly, Obadimeji & Oredein (2023) found a positive correlation between digital confidence and job satisfaction among teachers. This indicates that teachers who have competence in using digital tools foster a more engaging and fulfilling work experience. Access to digital resources and infrastructure is another two key factors that influence digital competence. Some research reveals that teachers from urban areas show higher levels of digital literacy or digital competence than those from rural areas (Babu & Suneela, 2023; Radhamani & Kalaivani, 2023). This gap in digital competence emphasizes the need for policies aimed at providing equal access to digital resources across different areas. Some studies suggest a discrepancy between teachers' self-evaluation and their real-world digital practices in the classroom.

Recent studies emphasize the role of institutional support to enhance digital competence. Female teachers who have engaged in a digital training program possess higher levels of digital competence (Swami, 2024; Choudhary, 2024). Contrarily, Iqbal et al., (2024) found that there were no significant gender differences in digital competence. This suggests that access to training and motivation are more important determinants than demographic factors. Similarly, Suzer & Koc (2024) found that the younger teachers are more digitally competent due to their greater familiarity with technology. Moreover, private institutions and urban schools have higher digital engagement among their teachers due to better digital infrastructure (Saini & Pandey, 2024; Pan et al., 2024). This emphasizes the importance of institutional policies that foster digital literacy through continuous professional development and leadership (Tomczyk, 2024; Khalil & Alsenaidi, 2024). The interaction between digital competence and technostress is also a new area of concern. Instructors with inadequate digital proficiency are more susceptible to experiencing technostress to a greater degree, which can manifest as burnout or technology resistance (Camarillo, 2024). However, adequate support and training can reduce stress and help them build more positive attitudes toward technology. Overall, digital competence is a complex concept that has an important function in improving teaching efficacy, research efficiency, and occupational satisfaction. Even though most teachers feel highly competent in using digital technology, there are still huge discrepancies in some fields, especially those related to high-level pedagogical uses and

integration of digital content. These gaps highlight the need for continuous, contextually relevant professional development programs that address teachers' specific digital literacy needs. The Literature indicates that digital competence should not be interpreted as a static quality but rather a dynamic skill set that progresses with guided assistance, access to material, and constant training. The integration of digital technologies into education necessitates an all-embracing strategy considering individual, institutional, and environmental factors.

Suggestions

Based on the summary of the related literature, the following suggestions are given for conducting further research on related topic.

- Examine disparities in digital skills between teachers in rural and urban schools in Odisha or other parts of India.
- Study the effectiveness of state-run digital literacy programs on teachers' classroom practices.
- Explore if and how gender influences digital skills among pre-service and in-service teachers.
- Investigate how digital skills impact research output among university faculty.
- Identify barriers and opportunities in implementing digital pedagogy in tribal-dominated regions.
- Study how digital competence influences morale, stress, and job satisfaction.
- Evaluate how digitally literate teachers perform in online teaching environments.
- Review how well teacher education institutions prepare pre-service teachers for digital teaching.
- Compare digital skill levels across fields like science, arts, management, and education.
- Examine how language (Odia/English) influences digital tool usage and understanding.
- Investigate how digital workload and pressure affect teachers' mental health and performance.
- Study how availability of devices, internet, and electricity affects digital skill development.
- Evaluate how initiatives like Mo School contribute to bridging the digital divide.
- Compare self-assessment of digital competence with demonstrated classroom use.
- Develop and test a tailored digital competence training model suitable for socio-economic and educational context.

Conclusion

In conclusion, the research on digital competence highlights its critical role in enhancing teaching effectiveness, research productivity, and overall job satisfaction among educators. It becomes increasingly important to understand the region-specific challenges and opportunities in developing digital literacy among teachers and pre-service educators. The findings from various studies underscore that while many teachers demonstrate proficiency in basic digital skills, there remain significant gaps in high-level digital pedagogical applications, content creation, and digital assessment. These shortcomings call for targeted, continuous professional development programs that are aligned with institutional goals and tailored to the socio-cultural and infrastructural realities of Odisha and other parts of the country. Factors such as gender, discipline, access to digital infrastructure, and rural-urban divides influence the level of digital competence, pointing towards the need for inclusive policies and support mechanisms. Moreover, the psychological impact of inadequate digital skills, such as technostress, further emphasizes the need for a supportive ecosystem that promotes confidence and adaptability among teachers. Future strategies should consider an integrated approach combining individual training, institutional support, and equitable access to resources. Digital competence should be viewed not as a fixed attribute but as a dynamic skill set that evolves with proper guidance, resources, and practice, especially in a diverse and developing region like Odisha and other states of India.

References

1. Furtáková, L. (2024, June). *DigComp Framework: From 1.0 to 2.2*. Paper presented at Quo Vadis 2024: CommUnity, University of Ss. Cyril and Methodius in Trnava.
2. Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent education*, *5*(1), 1519143.
3. 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. https://doi.org/10.2760/115376
4. Ilomäki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital competence – An emergent boundary concept for policy and educational research. Education and Information Technologies, 21(3), 655–679. https://doi.org/10.1007/s10639-014-9346-4
5. Mishra, P. (1998). *Flexible learning environments: Exploring the role of design in educational software*. Educational Technology, 38(5), 63–68.

6. Pierson, M. E. (1999). *Technology integration practice as a function of pedagogical expertise*. In Proceedings of the Society for Information Technology & Teacher Education International Conference 1999, 1221–1226.
7. Pierson, M. E. (2001). *Technology integration practice as a function of pedagogical expertise*. Journal of Research on Computing in Education, 33(4), 413–430. Edited https://doi.org/10.1080/08886504.2001.10782325
8. Keating, T., & Evans, E. (2001). *Three computers in the back of the classroom: Pre-service teachers' conceptions of technology integration*. In Proceedings of the Society for Information Technology & Teacher Education International Conference 2001, 1671–1676.
9. Zhao, Y. (2003). *What teachers should know about technology: Perspectives and practices*. Information Age Publishing.
10. Hughes, J. (2004). *Technology learning principles for preservice and in-service teacher education*. Contemporary Issues in Technology and Teacher Education, 4(3), 345–362. https://citejournal.org/volume-4/issue-3-04/
11. McCrory, R. (2004). *Mathematics, pedagogical content knowledge, and technological content knowledge: A model for thinking about what is known and what is to be known*. Contemporary Issues in Technology and Teacher Education, 4(4), 509–531. https://citejournal.org/volume-4/issue-4-04/
12. Margerum-Leys, J., & Marx, R. W. (2002). *Teacher knowledge of educational technology: A case study of student/mentor teacher pairs*. Journal of Educational Computing Research, 26(4), 427–462. https://doi.org/10.2190/TJ9K-F8P1-VTPG-4M3C
13. Niess, M. L. (2005). *Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge*. Teaching and Teacher Education, 21(5), 509–523. https://doi.org/10.1016/j.tate.2005.03.006
14. Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). *Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers*. Journal of Research on Technology in Education, 42(2), 123–149. https://doi.org/10.1080/15391523.2009.10782544
15. Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? Journal of Education, 193(3), 13–19.
16. Koehler, M. J., & Mishra, P. (2008). *Introducing Technological Pedagogical Content Knowledge*. In AACTE Committee on Innovation and Technology (Ed.), Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators (pp. 3–29). Routledge.
17. Qualman, E. (2013). *Socialnomics: How social media transforms the way we live and do business* (2nd ed.). Wiley.
18. Kumar, S. (2022). *Digital competence and techno pedagogical skills as criterion for teacher effectiveness of prospective teachers* (Doctoral dissertation, University of Madras). Shodhganga. http://hdl.handle.net/10603/392510
19. Ferrari, A. (2013). DIGCOMP: A framework for developing and understanding digital competence in Europe (Punie, Y., & B. N. Brečko, Eds.). Office for Official Publications of the European Communities. https://doi.org/10.2788/52966
20. Mishra, P., & Koehler, M. J. (2006). *Technological Pedagogical Content Knowledge: A framework for teacher knowledge*. Teachers College Record, 108(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x
21. Benali, M., Kaddouri, M., & Azzimani, T. (2018). Digital competence of Moroccan teachers of English. *International Journal of Education and Development Using Information and Communication Technology, 14*(2), 99-120.
22. Yazon, A. D., Ang-Manaig, K., Buama, C. A. C., & Tesoro, J. F. B. (2019). Digital literacy, digital competence and research productivity of educators. *Universal Journal of Educational Research, 7*(8), 1734-1743. https://doi.org/10.13189/ujer.2019.070812
23. Çebi, A. & Reisoğlu, I. (2020). Digital Competence: A Study from the Perspective of Pre-service Teachers in Turkey. *Journal of New Approaches in Educational Research, 9*(2), 294-308. https://doi.org/10.7821/naer.2020.7.583
24. Osuji, C. U. & Arannilewa, A.O. (2022). Teachers' Digital Competence and Utilization of E-learning Platforms in Private Secondary Schools in Ado Local Government Area of Ekiti State. *International Journal of Advanced Research and Learning, 1*(3), 12-23.
25. Kaur, M., & Sharma, M. (2022). Digital competence among research scholars in relation to their academic achievement and selected demographic variables. *Indian Journal of Research, 11*(10), 71-74. https://doi.org/10.36106/paripex
26. Jogezai, N. A., Koroleva, D., & Baloch, F. A. (2023). Teachers' digital competence in the post COVID-19 era: The effects of digital nativeness, and digital leadership capital. *Contemporary Educational Technology, 15*(4), 466. https://doi.org/10.30935/cedtech/13620

27. García-Delgado, M. Á., Rodríguez-Cano, S., Delgado-Benito,V., & Di Giusto-Valle, C. (2023). Digital teaching competence among teachers of different educational stages in Spain. *Educ. Sci., 13*,581. http://dx.doi.org/10.3390/educsci13060581
28. Sumarni, S., Iskandar, I., & Santosa, I. (2023). Assessing digital competence among pre-service language teachers: Strengths and Challenges. *Journal of English Education and Teaching, 7*(3), 613-631.
29. Maghfiroh, A., Styati, E. W., Fachriza, A., Khoiriyah, Wanida, S., Syaputra, R. A., & Lathifah. (2023). Future-ready educators: Assessing digital competence and teaching preparedness among prospective teachers in the 21th century. *Indonesian Journal on Learning and Advanced Education, 6*(1), 47-61. https://doi.org/10.23917/ijolae.v6i1.23081
30. Obadimeji, C. C., & Oredein, A. O. (2023). Postgraduate college staff digital competence as a predictor of lecturer's job satisfaction for sustainable education. *Gen-Multidisciplinary Journal of Sustainable Development, 1*(1), 1-14.
31. Babu, P., & Suneela, M. E. (2023). Empowering educators in the digital age: A comprehensive study of secondary school teachers' digital competence. *International Journal of Novel Research and Development, 8*(11), 439-443.
32. Radhamani, K., & Kalaivani, D. (2023). Digital competence among secondary teachers. *International Journal of Science and Research, 12*(6), 1004-1006.
33. Swami, M. (2024). A study on assessing the digital competency profile of teachers in Odisha. *International Journal of Science and Research, 13*(7), 5-9. https://dx.doi.org/10.21275/MR24527205609
34. Choudhary, M. A. (2024). A study of digital competency of secondary school teachers in relation to gender and type of school. *Journal of Emerging Technologies and Innovative Research, 11*(2), 829-835.
35. Iqbal, I., Hussain, I., Tahir, M. S. (2024). Teachers' digital competence and its relationship with teachers' effectiveness at higher education level in Punjab. *Journal of Education and Social Studies, 5*(2), 271-285.
36. Suzer, E., & Koc, M. (2024). Teachers' digital competency level according to various variables: A study based on the European DigCompEdu framework in a large Turkish city. *Educ Inf Technol, 29*, 22057–22083. https://doi.org/10.1007/s10639-024-12711-1
37. Saini, A. K., & Pandey, L. M. (2024). Teacher educators' digital competence: A study from teacher education institutions of Uttarakhand. *ShodhKosh: Journal of Visual and Performing Arts, 5*(1), 1427-1443.
38. Pan, L., Haq, S., Shi, X., & Nadeem, M. (2024). The impact of digital competence and personal innovativeness on the learning behavior of students: Exploring the moderating role of digitalization in higher education quality. *Sage Open, 14*(3), https://doi.org/10.1177/21582440241265919
39. Tomczyk, L. (2024). Digital transformation and digital competences of urban and rural polish youths. *Politics and Governance, 12*. 1-18. https://doi.org/10.17645/pag.7381
40. Khalil, H., & Alsenaidi, S. (2024). Teachers' digital competencies for effective AI integration in higher education in Oman. *Journal of Education and e-Learning Research, 11*(4), 698-707. https://doi.org/10.20448/jeelr.v11i4.6097
41. Camarillo, J. R. (2024). Digital competence in relation to the technology integration og public elementary school teachers in Davao Del Sur division. *International Journal of Research Publication and Reviews, 5*(6), 1102-1108. https://doi.org/10.55248/gengpi.5.0624.1435