DIGITAL SKILL ASSESSMENTS: PRE & POST COVID

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ABSTRACT

This study explores the evolution of digital skills assessment between pre- and post-COVID, focusing on how the COVID-19 pandemic accelerated both the urgency and complexity of evaluating digital competence across sectors. Prior to 2020, assessment frameworks emphasised basic ICT skills that were often evaluated through standardised and summative tools. However, the global shift to remote education, telehealth, and virtual work exposed critical gaps in adaptability, contextual fluency, and digital resilience skills not captured by traditional assessments. Through a systematic narrative review of academic literature and institutional reports, this paper analyses key trends, frameworks, and innovations that have emerged in the post-pandemic era. The findings show a marked transition toward formative, adaptive, and performance-based assessments, supported by artificial intelligence, learning analytics, and gamification. These new methodologies aim to assess not only technical proficiency but also socio-emotional and ethical competencies, such as digital collaboration, online communication, and responsible use of AI tools. Sector-specific analysis reveals differentiated adaptations in education, healthcare, government, and the workforce, with increasing emphasis on dynamic, continuous, and context-sensitive evaluation models. The study highlights persistent challenges, including the digital divide, algorithmic bias, and policy fragmentation, while offering guidance for designing inclusive and scalable assessment systems. As digital ecosystems become more complex and pervasive, the ability to measure digital readiness equitably and meaningfully becomes a central priority for educational research and policy.

Keywords: Digital Skill; Digital Competence; Skills Assessment; COVID-19; Artificial Intelligence.

1.0 INTRODUCTION

In this technology-driven world, digital skills are slowly evolving from being a specialised area of expertise to a crucial element for every individual in order to engage in all aspects of modern life. The global shift towards digitisation influenced the way individuals interact socially and also changed how current society defines digital competence, obtains information, and evaluates their learning and productivity. The development of digital skills before 2020 was a gradual and strategic process. Structured digital literacy programs have been adopted in educational systems, with governments and organisations complying with existing competency frameworks. In 2018, the Digital Competence Framework for Citizens (DigComp) of the European Union became a standard framework. It identified five fundamental domains, which include information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving [16]. The International Society for Technology in Education (ISTE) collaborated with DigComp to create standards for schools, and the Digital Intelligence (DQ) Framework offered a global approach to the development and evaluation of digital intelligence. These frameworks guide methods of assessment that focus on summative evaluation, including standard testing, certification of program completion, and structured observations. The fixed and measurable set of proficiencies that can be certified through a formal process was the dominant model of digital competence. This methodical approach carries a linear progression from a beginner to an expert and prioritises the technical skills. Before the pandemic, scholars emphasised the importance of digital skills, including critical thinking, digital communication, ethical awareness, and collaborative problem-solving [58]. However, the assessment tools to evaluate these skills were underdeveloped, and the assessment environments were unable to replicate the real-world scenarios.

1.1 The Pandemic as a Force for Reevaluation

The global pandemic outbreak that started at the end of 2019 unexpectedly disrupted this digital transformation. COVID-19 acted as a broad-scale catalyst that caused schools, universities, and educational institutions to switch to remote teaching, healthcare systems to telehealth, and businesses to switch to remote work. Hodges et al. [27] concluded that this situation was not a controlled digital transformation experiment but rather a forced adaptation that was essential for survival in times of crisis. The pandemic exposed the gaps in adapting digital competencies and inequalities in digital access. As the basic digital literacy of the individual is insufficient, people must engage with digital platforms in a creative, collaborative, and critical manner, even when they are faced with uncertainty.

To function efficiently in the new digitalisation world, it was a necessity for individuals to possess the digital skills that were both context-sensitive and adaptable, which needed to exceed what had been previously taught and evaluated. The pandemic revealed the deficiencies of the existing digital skill framework assessment, which failed to consider the dynamic, situational, and performance-based competencies. For instance, teachers or educators who had previously used in-person instruction had to quickly adapt to asynchronous online platforms. This required not only a knowledge of digital tools but also emotional intelligence and pedagogical creativity. Similar to other sectors, the professionals were required to collaborate across digital platforms to make decisions based on real-time data and navigate the privacy concerns and digital security with minimal guidance.

The importance of digital resilience, which is the ability to successfully adapt and react to unforeseen challenges using digital tools, was highlighted during this pandemic period. According to Bozkurt et al. [7], the pandemic brought to light the shortcomings of static models of digital competence and prompted a reconsideration of the definition of meaningful digital readiness. Therefore, it was necessary to develop a new method to evaluate people's digital interactions, problem-solving skills in real-world scenarios, and ability to use the digital tools efficiently under pressure. This signified the shift from conventional models to a more formative, authentic, and performance-oriented assessment.

1.2 Adapting Frameworks for Digital Competencies

Following the outbreak, there was a shift in evaluating digital competence in educational systems and other sectors. More integrative and context-based evaluations replaced the previous reliance on summative assessments like exams and tests. This change aligned with the current perspectives on the value of adaptive learning environments and lifelong learning. Universities and educational institutions are actively implementing the digital and project-based evaluations. There are portfolios, simulations that simulate real-life tasks and peer-assessment models. These approaches allowed for the assessment of deeper learning outcomes, such as collaboration, digital creativity, and ethical decision-making, which are essential in today's unpredictable and technologically mediated contexts [74].

In addition, the integration of emerging technologies into assessment practices has gained more traction. Nowadays, learning analytics and artificial intelligence (AI) are utilised to monitor learner engagement, provide immediate feedback and personalise assessment experiences. These technologies have the ability to detect patterns in digital behaviour, which allows for a more complex comprehension of competence that transcends binary responses [78]. An AI-driven assessment can offer a more dynamic and personalised assessment of digital fluency by simulating complex problem-solving scenarios and can adapt to the learner's responses in real time. As a result, the digital assessment is moving towards a more immersive and continuous approach where learners can demonstrate their skills through real-world interactions rather than isolated tasks.

DigComp and other frameworks have also changed to reflect this shifting towards a digitalised world. The integration of digital competence in personal, civic and professional domains has been emphasised to support the development of self-reflective tools where it allows the individuals to assess their progress over time. Similarly, the DQ Framework foreseesremote work, virtual collaboration and ethical use of AI technologies, highlighting the expanding scope of what digital intelligence offers. These developments represent the paradigm shift where the digital skills assessment is increasingly focused on facilitating continuous digital adaptation and growth rather than merely validating prior learning.

1.3 Purpose and Significance of the Study

A significant gap remains in the systematic analysis of the digital skills assessments transformation during the COVID-19 crisis despite the increasing literature during this time. While there are numerous studies examines the technology adoption and digital access during pandemic, few studies provide a thorough comparison of assessment model before and after pandemic across various sectors. This study aims to fill the void by analysing the conceptual and practical transformation of digital skills assessments as example comprehending on how COVID-19 has reshaped the tools and strategies. This study examines the objectives of accessing digital competence across various sectors, including education, healthcare, government, and business.

The main research question for this study is how the digital skills assessments changed in different sectors during the pre- and post-COVID-19 pandemic. To address the question, this study highlights the implications of this shift for educational policy, curriculum design, workforce development, and public administration. By looking

at the transformation from a certification-based assessment to a performance-based assessment, this study shows the importance of having flexible and adaptable assessment methods that match the digital world. There are both theoretical and practical reasons why this study is important. Theoretically, it contributes to the growing of digital resilience, lifelong learning, and the integration of soft and hard skills in competency models. Practically, it guides the educators, trainers, and policymakers in seeking to design more effective digital literacy programs and assessments for a post-pandemic world. The techniques for assessing preparedness are constantly changing along with the digital environment. Understanding these developments is crucial for building equitable, inclusive, and future-ready systems of education and workforce training.

2.0 LITERATURE REVIEW

2.1 Foundational Concepts and Core Frameworks

Digital competence has been a critical aspect throughout the last decade, defined by various frameworks reflecting the evolving demands of a digital society. Leading pre-pandemic models include the ISTE Standards for Students, which outlined digital literacy competencies aimed at fostering critical thinking, creativity, and ethical participation among K–12 learners [37]. Alongside the ISTE model, the European Commission's DigComp (Digital Competence Framework for Citizens) broke down digital competence into five areas: understanding information and data, communication and teamwork, creating digital content, staying safe online and solving problems, laying the groundwork for a Europe-wide approach to lifelong digital learning.

A scholarly parallel to DigComp, the Digital Intelligence (DQ) Framework, emerged to operationalise digital readiness more globally. It proposed 32 competencies across eight domains. This includes aspects such as identity, empathy, communication, and security, thereby extending beyond mere technical ability to encompass the societal and emotional dimensions of digital behaviour [19]. The framework's linkage with organisations such as the OECD and IEEE helped cement its relevance for digital citizenship, especially among youth populations.

Despite these frameworks offering clear theoretical guidance, practical implementation varied widely. While DigComp and DQ detailed competency areas via proficiency levels and illustrative cases [71], their real-world integration into curricula remained sporadic. Studies showed a difference between the ideal guidelines and what actually happens in schools or workplaces where digital competence often just meant being able to use a device instead of having clear and measurable skills.

However, the COVID-19 pandemic served as a pivotal moment. Digital competence frameworks were recalibrated to address emergent needs. The DigComp 2.2 revision [32] incorporated over 250 new examples featuring AI, remote/hybrid work, and digital wellbeing, a reflection of how digital competence had shifted from instrumental tool usage to adaptive interaction with evolving digital environments [22],[32]. The update signalled the retention of the five core competency areas with enhanced depth and relevance.

Further, foundational frameworks became platforms for more advanced model development. One example is DigIQ (2025), which builds on the DigComp lineage to include AI skills as an independent core competency. This move positioned AI literacy not as an optional add-on but as central to digital competence, laying the groundwork for what soon became a broader pedagogical and policy paradigm.

Parallel to DigIQ, psychometrically orientated tools, such as the AI Competency Objective Scale (AICOS), have emerged. Designed in 2025 to capture current domain knowledge, especially concerning generative AI, these scales help quantify AI literacy in measurable, standardised terms [42], [43] . Alongside AICOS, research such as the "From G-factor to A-factor" study found that AI literacy includes skills like effective communication, creative thinking and working together with machines, which has changed how we understand digital competence to include these human-machine collaboration abilities.

These developments underscore a conceptual shift where the digital competence is no longer just about using technology, ordinary or advanced, but about critically understanding, adapting to and co-existing with intelligent systems. The theoretical foundations laid pre-pandemic remain valuable. In the post-pandemic context, the conceptualization of digital competence has evolved to encompass algorithmic awareness, AI ethics, and interactive competencies, reflecting a more dynamic and context-dependent framework moving forward.

2.2 Development of New Digital Competencies During the Pandemic

The COVID-19 pandemic marked a pivotal moment in the evolution of digital skills and competencies worldwide. Practically overnight, entire sectors, education, healthcare, government, and business were forced to transition from physical to digital environments, resulting in a dramatic expansion of the required digital competencies. Prior to the pandemic, digital competence primarily referred to basic ICT abilities such as using email, navigating web browsers, and creating documents using word processing tools [69]. However, the pandemic revealed that these foundational skills were insufficient for a world operating almost entirely online.

2.2.1 Transformation in Education Sector

Among the most affected was the education sector. Teachers, students, and administrators had to adapt rapidly to online learning environments. This shift required the development of advanced skills, such as managing learning management systems (LMS), conducting synchronous and asynchronous classes, creating interactive digital content, and utilising collaborative tools like Google Classroom, Zoom, Microsoft Teams, and Moodle [8]. Additionally, educators were required to evaluate students in digital formats, which required fluency with online assessment tools and e-proctoring systems.

A UNESCO (2020) report revealed that over 1.6 billion learners in more than 190 countries were affected by school closures, making online learning not just an alternative but a necessity. Even educators with no prior technological experience had to quickly acquire new digital skills due to this widespread disruption. In many cases, the lack of infrastructure and training created significant barriers, especially in under-resourced areas.

2.2.2 Shifts in Workforce Competencies

The corporate world experienced a similar transformation. With the rise of remote work, employees needed to acquire digital competencies beyond basic computer literacy. These included cloud-based collaboration, virtual meeting management, project coordination using tools like Trello and Asana, and the use of digital productivity suites [21]. In addition to technical skills, remote workers had to develop digital soft skills such as digital communication etiquette, online collaboration, digital time management, and self-regulated learning [14].

The pandemic also necessitated that managers adopt digital leadership skills to supervise teams virtually, monitor performance using digital tools, and maintain motivation and morale in a dispersed workforce. These changes indicate a shift from isolated digital skill sets to integrated digital competencies that combine technical and socio-emotional capabilities.

2.2.3 Healthcare Sector Digitalization

The healthcare sector also underwent significant digital transformation. The use of telemedicine, electronic health records, AI-based diagnostic systems, and mobile health applications became standard in many settings. According to the World Health Organisation (2021), digital platforms played an essential role in patient triage, data analysis, contact tracing, and health communication during the pandemic.

Healthcare professionals had to learn how to conduct virtual consultations, manage digital health records securely, and navigate privacy compliance regulations. For example, nurses and doctors required training in the use of digital interfaces for video consultations and electronic prescriptions, skills previously limited to a small segment of the workforce. The acceleration of digital adoption in healthcare emphasised the need for upskilling and reskilling in health informatics and digital ethics.

2.2.4 Digital Citizenship and Daily Life

Beyond professional settings, the pandemic also affected ordinary citizens' daily lives, requiring new competencies in digital financial literacy, cybersecurity, and online service navigation. People needed to manage online banking, digital payments, telehealth appointments, and government services like welfare support and vaccination appointments. This transformation pushed digital skills into the category of essential life skills [71].
In many cases, the digital divide became more pronounced, highlighting disparities in access and literacy. Vulnerable groups such as the elderly, rural populations, and low-income communities were at risk of digital exclusion. This inequality prompted governments and NGOs to develop targeted digital inclusion programmes.

2.2.5 National and Policy-Level Responses

Countries around the world responded with large-scale digital upskilling and reskilling initiatives. In Malaysia, the Malaysia Digital Economy Blueprint (MyDIGITAL) emphasises human capital development in the digital economy. The Digital Skills Training Directory and programmes under the National Economic Recovery Plan (PENJANA) focused on preparing the workforce for digital transformation [44].

Additionally, international frameworks like DigComp 2.1 and its updated version, DigComp 2.2, were revisited to better reflect post-pandemic needs, including digital well-being, safe technology use, and resilience [71]. These updates provided a scaffold for national-level digital literacy programmes aiming to build more holistic digital citizens.

2.2.6 Lasting Impact and Future Directions

The pandemic blurred the lines between technical, cognitive, and emotional digital competencies. There is now a growing recognition that digital skills are not confined to IT professionals or specific industries but are universally

required across all levels of society. The ongoing shift towards hybrid work and learning environments points to the value of lifelong learning models and continuous professional development focused on digital skills.

In summary, COVID-19 catalysed a profound expansion of digital competencies. From emergency digital adaptations to more structured and permanent integrations, the trajectory of digital skill development points to a future where digital literacy is deeply embedded in all domains of life.

2.3 Post-COVID Digital Competence Assessment Trends

The post-COVID-19 landscape has continued to evolve with an intensified focus on digital competence assessment. As societies transitioned from crisis response to recovery and adaptation, there was a global recognition of the need to systematically assess digital competencies not only to evaluate current capabilities but also to guide future skill development. The shift from emergency digital adoption to strategic digital integration has catalysed innovation in digital assessment methodologies, frameworks, and implementation strategies across education, government, and industry sectors.

2.3.1 Evolution of Assessment Frameworks

In the post-pandemic era, digital competence assessment frameworks have become more nuanced and inclusive. Pre-existing frameworks such as DigComp (EU), ISTE Standards (US), and the UNESCO ICT Competency Framework for Teachers were revisited and expanded to reflect the broader range of digital skills necessitated by the pandemic [71], [64] .

For instance, DigComp 2.2 introduced additional descriptors and examples to reflect emerging post-pandemic needs, such as managing disinformation, digital emotional intelligence, and remote collaboration tools. The ISTE Standards began emphasising digital citizenship and computational thinking as core competencies, reflecting a shift from purely operational skills to critical, ethical, and creative engagement with digital technology (ISTE, 2021).

Malaysia's National Digital Literacy Framework (NDLF) was also updated to incorporate post-COVID learning. The framework now includes competencies such as cyber wellness, adaptive thinking in digital environments, and digital safety for vulnerable communities [44]. These additions recognise that digital literacy is no longer limited to technical proficiency but also includes psychosocial and ethical dimensions.

2.3.2 Digital Tools and Platforms for Assessment

The proliferation of digital tools and learning management systems (LMS) during the pandemic laid the groundwork for integrated digital assessment platforms. Post-COVID, many institutions began leveraging these systems not just for instruction but for formative and summative assessments of digital skills.

Platforms such as Moodle, Blackboard, and Google Classroom incorporated analytics features to track digital engagement, interaction quality, and technological navigation. In higher education, e-portfolios and digital badges have gained traction as tools for demonstrating digital competencies in more dynamic and evidence-based ways [55].

Artificial Intelligence (AI) is increasingly used to support adaptive assessments that can tailor questions based on a learner’s real-time performance. Such systems can identify specific skill gaps, suggest appropriate interventions, and chart personalised learning paths [41]. For example, the OECD’s Future of Education and Skills 2030 initiative explores how digital tools can provide ongoing, formative feedback for lifelong learning.

2.3.3 Sector-Specific Implementation

Different sectors have adopted varying approaches to post-COVID digital competence assessment. In the education sector, ministries and universities have formalised digital literacy benchmarks for both students and staff. For instance, the Malaysian Ministry of Higher Education introduced digital competency modules as part of curriculum reform and staff training initiatives [45].

In the workplace, corporations have developed digital skills audits and readiness surveys tailored to specific job roles and functions. The World Economic Forum [75] reports that over 50% of surveyed global companies implemented some form of digital skill assessment to inform reskilling programs. Public sector agencies have also taken steps to embed digital competency assessments in performance reviews, training needs analysis, and professional development plans [53].

2.3.4 Challenges and Opportunities

Despite these advances, several challenges persist in post-COVID digital competence assessment. One major concern is equity. Access to digital tools and internet connectivity remains uneven across geographies and socio-

economic groups, affecting both skill development and accurate assessment. There are also concerns about the reliability and validity of self-assessment tools, which may be prone to bias or misjudgment [67].

Nevertheless, the opportunity for scalable, data-driven, and context-aware assessments has never been greater. Governments and educational institutions are increasingly exploring public-private partnerships to expand access to assessment tools and digital credentials. The use of micro-credentials, digital badges, and blockchain-verified certificates is expected to rise, offering individuals a more flexible and portable way to showcase their digital competencies [9].

Post-pandemic, the assessment of digital competence is no longer confined to measuring ICT know-how. It has evolved into a multifaceted endeavour that encompasses technical, cognitive, and socio-emotional dimensions, reflecting a more holistic understanding of what it means to be digitally competent in a connected world.

2.4 Emerging Trends and Methodological Innovations in Skills Assessment

Adaptive learning and personalised assessments have emerged as two of the most transformative trends in post-pandemic education. AI-powered systems such as enhanced versions of Moodle with UDL principles provide continuously tailored learning pathways based on user [30], [31]. This change represents a philosophical shift: assessments are now tools that analyse learning trajectories, not just outcomes, enabling formative interventions and metacognitive skill development [10].

A second major trend is the integration of AI and gamification across sectors. AI engines facilitate real-time feedback and dynamic content adaptation, augmenting instructional and evaluative effectiveness. Meanwhile, gamified assessments utilising badges, levels, and leaderboard mechanics boost learner engagement and accuracy of skill measurement, as research has confirmed their effectiveness in procedural knowledge acquisition [3], [48].

At the cutting edge, psychometric innovations such as AICOS [42], [43] and generative-AI literacy indices [1] now offer standardised, objective scales of AI competency. These tools operationalise previously abstract constructs such as prompt design, creative co-generation with AI, and ethical discernment, providing new clarity in human–AI collaboration aptitudes.

Emerging trends converge on hybridised assessment systems that use multimodal data, adaptive modelling, and ethically informed frameworks to evaluate digital competence comprehensively. Such systems promise deeper insight into meta-level digital literacy, balancing tool proficiency with critical engagement, collaboration, and resilience.

2.5 Digital Skills Assessments: A Sectoral Analysis

This section presents a sector-based analysis of digital skills assessments across two key temporal periods: pre-COVID and post-COVID. The pandemic accelerated digital transformation in nearly every sector, prompting rapid changes in assessment strategies, competency expectations, and measurement methodologies. The development and new demands for evaluating digital competency are better understood when viewed through a comparative lens that spans the business/workplace, government/public sector, healthcare, and education sectors.

2.5.1 Digital Skills Assessments Pre-COVID

Prior to COVID, digital skills assessments were largely foundational, reflecting efforts to equip individuals with basic digital literacy to navigate technology in daily life and work. The following table summarises prominent tools and frameworks in key sectors before the pandemic's onset.

2.5.2 Digital Skills Assessments Post-COVID

The COVID pandemic served as a major inflection point in digital transformation, catalysing new learning formats, healthcare delivery models, and remote work paradigms. Consequently, digital skills assessments evolved to measure context-specific, adaptive, and resilience-based competencies. Table 1 summarises notableessment frameworks and tools that emerged or gained momentum.

Table 1: Digital Skills Assessment Tools and Frameworks by Sector (Pre-COVID)

Sector	Tool/Framework	Key Skills Assessed	Methodology/Approach
Education	Northstar Digital Literacy	Basic ICT skills, internet use, Office tools, social media, digital safety	Online, self-paced quizzes; scenario-based questions; badges/certifications upon completion [50]
	ICDL (International Certification of Digital Literacy)	Core productivity and employability skills: Office tools, online safety, file management	Globally standardized computer-based exams and simulations [33]
	DigComp (EU)	Data literacy, digital communication, safety, content creation, problem solving	European competency framework guiding self-assessment and curriculum development [70]
	DigCompEdu	Teachers' digital pedagogy: digital resources, learning environments, learner empowerment	Self-reflection tools (e.g., SELFIEforTEACHERS); adapted questionnaires [55]
Healthcare	eHEALS	Perceived eHealth literacy	8-item self-reported Likert scale [49]
	DHLI	Digital health navigation, content creation, reliability assessment	21-item self-report scale using 4-point Likert-type responses [68]
	CHAT	Conversational assessment of health literacy	Verbal, dialogue-based 10-question screening [6]
	DHRQ	Patient digital readiness	Brief questionnaire assessing digital access and self-efficacy [72]
Business/Work place	General Competence Assessments	Productivity, adaptability, basic tech fluency	Survey-based studies; factor analysis in SME contexts [57]
	UNESCO Digital Literacy for Employment	Digital communication, content creation, safe online practices	Policy-driven frameworks for national employability and ICT workforce development [64]
Government	UK Essential Digital Skills Framework	Basic functional skills for life/work: email, passwords, transactions, online safety	National framework with embedded assessment tools for adults [18]
	OECD Public Sector Digital Skills Framework	Competencies needed for digital government transformation	Workforce-oriented skills framework integrating structural transformation [52].

Table 2: Digital Skills Assessment Tools and Frameworks by Sector (Post-COVID)

Sector	Tool/Framework	Key Skills Assessed	Methodology/Approach
Education	Online Assessment Tools	Online learning outcomes, collaboration, media literacy	E-portfolios, peer discussion forums, e-tests on Moodle, Google Forms, Flip, Edpuzzle, Socrative [5].
	Teacher Digital Competence (TDC)	Online pedagogy, content creation, learner engagement	DigCompEdu-based instruments; self-perception scales for hybrid teaching [36]
	AI-powered and Adaptive Systems	Personalized pathways, content gaps, diverse task types (e.g., visuals, maps, coding)	AI platforms offering real-time feedback, machine learning models for adaptive diagnostics [41]
	Gamified Assessments	Motivation, engagement, retention, 21st-century skills	Badges, level progression, leaderboard integration with learning tools [47].
Healthcare	HLS19-DIGI and COVID-adapted DHLI	eHealth usage, telehealth participation, mobile health literacy	Mixed-method validation and cross-national comparisons [51]
	Telehealth Readiness Tools	Remote care competence, digital safety, video communication	Scenario-based assessments for patients/providers [38].
Business/Workplace	Remote Work Digital Skills Assessment	Communication, collaboration, productivity in virtual settings	Organizational self-evaluations, job description mapping [21].
	Digital Transformation Literacy	Strategic digital adaptation, use of cloud/AI tools, workforce agility	Post-pandemic surveys of SMEs and HR frameworks [15]
Government	State Digital Equity Scorecard	Internet/device access, cybersecurity, digital inclusion	GIS mapping, gap analysis, community listening sessions [79]
	WHO Global Strategy on Digital Health	Institutionalized digital literacy in health systems	Frameworks for capacity building and digital ecosystem strengthening [76]
	OECD Public Sector Digital Competence (Updated)	Leadership in digital governance, service design, resilience to technological shifts	Policy-oriented skills evolution reflecting digital-first governance [53]

3.0 METHODOLOGY

This study adopts a systematic narrative review approach to examine the evolution of digital competence assessment from the pre-COVID era to the post-pandemic period. The goal is to provide a comprehensive, integrative understanding of how assessment frameworks, practices, and innovations have shifted over time, particularly in light of the global health crisis. A narrative review method is the best choice for this study because it helps combine information from different fields, understand complicated trends in context, and thoughtfully consider both theory and real-world findings. This involves constructing a coherent storyline that traces conceptual developments across various sectors, including education, public administration, and healthcare [23],[55],[70].

3.1 Systematic Narrative Review

The rationale for employing a systematic narrative review lies in the nature of the research question, which seeks to explore changes in digital competence assessment frameworks and practices over time and across multiple domains. Unlike meta-analytical methods that focus on statistical synthesis, narrative reviews are interpretive and

flexible, allowing the researcher to integrate diverse forms of evidence [24]. This capability is particularly important for a topic like digital competence, which is shaped not only by academic literature but also by policy frameworks, technological advancements, and sector-specific requirements.

By incorporating both peer-reviewed sources and institutional reports, this method enables the researcher to uncover how assessment strategies evolved in response to global disruptions like the COVID-19 pandemic [66], [53]. Furthermore, the review draws on the structured process proposed by Popay et al. [54], which emphasises transparency, reproducibility, and thematic synthesis. Through this approach, the review synthesises data while maintaining coherence across different sectors and times.

3.2 Literature Search Strategy

The literature search was carried out systematically across four major academic databases: Scopus, Web of Science, and Google Scholar. These databases were selected due to their comprehensive indexing of scholarly publications across disciplines relevant to the study, including education, information technology, healthcare, and policy studies. Search terms were carefully constructed using Boolean operators and keyword combinations to capture the full range of relevant literature. Key search terms included "digital competence", "digital literacy", "digital skills", "assessment", "evaluation", "COVID-19", "pandemic", "education", "telehealth", "workforce", "artificial intelligence", and "learning analytics" [20], [63].

The search was focusing on literature published from 2010 to 2025. This timeframe was chosen to capture the development of digital skills assessment frameworks over a sustained period, encompassing both the foundational pre-COVID phase and the transformational changes brought about by the pandemic. Special emphasis was given to publications from 2021 onwards, reflecting the post-pandemic recalibration of digital assessment practices [53], [77].

Key institutional reports from global bodies such as the OECD, UNESCO, and WHO were also reviewed. Peer-reviewed academic studies often fail to capture the international digital policy directions and large-scale assessment strategies outlined in these sources.

3.3 Inclusion and Exclusion Criteria

To ensure the relevance and quality of the selected literature, the study applied well-defined inclusion and exclusion criteria. Included works had to be published between 2015 and 2025 and specifically address digital competence, literacy, or skills assessment. Only sources available in English and accessible in full text were considered. Accepted materials encompassed peer-reviewed journal articles, systematic reviews, conceptual frameworks, government or institutional reports, and widely cited academic books [35], [12].

Studies were excluded if they focused on ICT in general without reference to assessment or if they lacked a clearly defined methodology. Similarly, publications based on opinion or anecdotal evidence without rigorous data collection or analysis were omitted. Conference abstracts without full proceedings, blog posts, and unpublished theses were also excluded in order to maintain academic rigour and reliability.

3.4 Synthesis and Interpretation of Findings

The final step in the methodological process involved synthesising the data into a coherent narrative. This synthesis was structured along three conceptual pillars. First, a temporal lens was applied to contrast the traditional frameworks of digital assessment prior to 2020 with the innovative and often urgent adaptations made in response to the pandemic. There was a shift from standardised ICT assessments to dynamic and context-specific evaluations of digital capabilities, such as remote collaboration, online security, and platform proficiency [55], [53].

Second, a sectoral analysis revealed that each domain responded differently to digital transitions. In education, assessments increasingly measure complex competencies such as digital pedagogy and online engagement [36]. In healthcare, digital readiness assessments are now essential for measuring telehealth literacy and system navigation [77]. The public and private workforce sectors have adopted frameworks that prioritise cybersecurity, digital productivity, and data ethics [66], [11]

Third, the synthesis highlighted emerging innovations such as AI-driven platforms that personalise assessments, dashboards for real-time competency monitoring, and learning analytics used to inform continuous professional development. These reflect a philosophical shift in assessment: from discrete testing moments to continuous, embedded evaluation processes that guide learning and behaviour [29], [28].

3.5 Limitations

This study has limitations. The review was limited to English-language literature, which may have resulted in the exclusion of significant studies from regions where digital skill development is influenced by localised socio-cultural contexts. Furthermore, although institutional and grey literature were incorporated, certain digital assessment tools that are either unpublished or non-public and are utilised by governments or private organisations

may not have been included. Lastly, the academic and policy literature may not yet represent certain innovations that emerge after mid-2025, due to the rapid evolution of AI and educational technologies.

Despite these limitations, the study offers a robust, cross-sectoral view of the digital competence assessment landscape. The rigorous and transparent methodology enhances the reliability of findings and provides a valuable foundation for subsequent empirical studies.

4.0 RESULTS

4.1 Comparative Analysis of Digital Skills Assessment: Pre- and Post-COVID

The domain of digital competence assessment has experienced significant change, primarily driven by the COVID-19 pandemic. The digitalisation of learning, work, and healthcare was expedited during this period of global disruption, resulting in a transformation of the skills required and the manner in which they are evaluated. A comparison of the pre-COVID-19 and post-COVID-19 periods demonstrates significant changes in technological integration, methodologies, skill priorities, and assessment objectives. Table 3 provides a synthesised overview of these developments.

This transformation underscores a shift from digital literacy as an optional add-on to a core competency required across every sector [55].Pre-pandemic efforts focused on equipping learners with basic technological fluency, typically measured through standard multiple-choice assessments or self-evaluation questionnaires. In contrast, the post-pandemic context demands advanced and contextualised skills, and assessments now must measure them in real-time, personalised, and scalable formats [13].

4.2 New Forms of Assessment

The post-COVID-19 era witnessed the integration of AI, adaptive learning, and gamification into assessment practices. AI-powered assessment tools have become increasingly prevalent, offering personalised feedback, automated grading, and formative analytics to inform instruction [28]. Adaptive assessments use models like the Rasch model to adjust the difficulty of questions based on how well a person is doing, which helps identify their skill gaps more accurately.

Gamified assessments have gained popularity due to their motivational advantages. These incorporate game elements, such as points, leaderboards, or badges, to captivate users while assessing their competencies [17]. These tools have been particularly beneficial in educational and healthcare environments, where it is essential to maintain engagement in digital environments [80].

4.3 Sector-Specific Findings

In the field of education, digital skills assessments have undergone a transformation from a sole emphasis on student digital literacy to an evaluation of the pedagogical uses of digital tools by teachers. Educators are now required to exhibit proficiency in digital lesson planning, e-learning platforms, and formative assessment tools [56]. Employers are increasingly evaluating employees' capabilities in the areas of cybersecurity awareness, digital collaboration, project management software, and remote communication.

During the pandemic, digital health literacy (dHL) became a critical component of healthcare. The capacity of patients and practitioners to navigate telemedicine platforms, access digital health information, and make informed decisions is currently being assessed [49].

5.0 DISCUSSION

5.1 Interpretation of Key Findings

This review's findings demonstrate that digital skills assessments have transitioned from static, uniform models to dynamic, adaptive systems that correspond with changing digital environments. Pre-COVID-19 evaluations focused on fundamental digital operations and frequently lacked integration with practical application. After 2020, digital skills were positioned within specific contexts, including education, health, and remote work. This necessitated assessments that considered adaptability, critical thinking, and collaborative capabilities [69].

The emergence of AI-powered and adaptive assessments, which provide learners with immediate, personalised feedback and encourage autonomy, is indicative of this development. By adjusting to the unique learning curves of each individual and providing insightful information, these tools address the deficiencies of conventional testing [28]. Furthermore, authentic assessments of digital proficiency are now available through performance-based evaluations, including collaborative projects and e-portfolios.

Table 3: Comparison of Digital Skills Assessments Pre- and Post-COVID

Dimension	Digital Skills Assessments Pre-COVID	Digital Skills Assessments Post-COVID
Primary Focus of Assessment	Foundational digital literacy, basic ICT proficiency, general productivity tools, individual skill validation.	Advanced digital competencies, domain-specific digital literacy (e.g., telehealth, remote work), digital resilience, AI literacy, and systemic digital readiness.
Key Skills Emphasized	Computer operations, internet browsing, software use (e.g., MS Office), email, and basic online safety.	Online collaboration, digital content creation, cybersecurity, critical digital thinking, data literacy, adaptive problem-solving, and digital well-being.
Primary Methodologies	Standardised tests, self-perception surveys, basic online quizzes, paper-based evaluations.	Performance-based assessments, e-portfolios, AI-powered diagnostics, adaptive assessments, and gamified learning evaluations.
Driving Forces	General digital transformation, gradual ed-tech integration, workforce needs.	Pandemic-driven remote operations, urgency of digital equity, rapid tech advancement, and AI integration.
Challenges	Access issues, limited ICT infrastructure, underdeveloped assessment tools, and overestimation of self-skills.	Widened digital divide, need for rapid upskilling, reliability of new tools, data privacy and AI ethics.
Emerging Trends	ICT standardisation frameworks (e.g., ICDL, Northstar).	Adaptive learning systems, AI in assessment, digital equity policies, cross-sectoral collaboration.

5.2 Addressing the Digital Divide

Despite technological advancements, the digital divide remains a significant barrier. While assessments have become more advanced, not all learners or institutions have equal access to the necessary tools or infrastructure. The situation exacerbates inequalities, particularly in marginalised communities, and poses ethical concerns for the future of digital education and workforce development [53].

As AI-driven tools proliferate, concerns around data privacy, algorithmic bias, and fairness become increasingly urgent. According to Williamson and Eynon [73], scholars caution against the overreliance on opaque technologies, which have the potential to exacerbate existing inequalities if not properly regulated. Therefore, the development of assessments must be guided by cultural sensitivity, transparency, and equity.

5.3 Implications for Future Research and Policy

The increasing recognition of the societal implications is evidenced by the integration of digital skills into national digital equity strategies, such as the EU's Digital Education Action Plan or UNESCO's digital literacy framework [22],[66]. In order to guarantee sustainability and coherence, assessments must be consistent with these policies.

Objective performance measures and longitudinal studies should be the primary focus of future research, rather than descriptive accounts and self-report data. This includes validating adaptive assessments, developing culturally inclusive tools, and exploring cross-sectoral approaches.

6.0 CONCLUSION

The COVID-19 pandemic functioned as a catalyst, forcing a rapid reassessment of digital skill needs and the tools used to evaluate them. A comparative analysis reveals a paradigm shift from basic digital literacy toward advanced, context-specific, and adaptive digital competence. This change has occurred across sectors, from education and healthcare to the public and private workforce, highlighting the universal relevance of digital skills in the post-pandemic world.

The adoption of AI-powered, adaptive, and gamified assessments has been driven by technological innovation, which provides more nuanced and learner-centered approaches. Ongoing attention is necessary to address persistent challenges, including algorithmic bias, policy fragmentation, and the digital divide. Ensuring inclusive and equitable access to digital skills development and assessment is not merely a technical issue but a societal imperative.

In light of these findings, stakeholders in education, healthcare, and policy must continue to invest in inclusive digital infrastructure and evidence-based assessment systems. Future research should prioritise validation, scalability, and ethical governance to ensure that digital skills assessments are not only accurate but also just and accessible for all.

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