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Digital Competence Across International Frameworks A Thematic Synthesis

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Abstract— The prolific integration of technology into education, employment and other public affairs has transformed digital competence as a prerequisite for participation in social processes. In due course of time, the understanding of digital competence expanded beyond technical proficiencies to encompass critical, social and ethical dimensions. This paper presents a thematic synthesis of four influential international frameworks namely European Commission's Digital Competence Framework (DigComp 2.2), UNESCO's Global Framework of Reference on Digital Literacy Skills, Digital Intelligence (DQ) Framework and the ISTE Standards. Using the PRISMA technique, the study reviews major frameworks and research articles to identify themes such as multidimensionality, social participation, problem solving skills, digital ethics, adaptability and lifelong learning. The findings demonstrate a holistic conceptualisation of digital competence that integrates understanding, skills, attitudes and ethics that are required for participating in digitally mediated societies. The paper further highlights emerging challenges such as artificial intelligence, algorithmic literacy and platform dominance and offers future directions for addressing these issues in further framework development and research.

Keywords— Algorithmic Literacy, Artificial Intelligence, Digital Competence, Digital Ethics, Thematic Synthesis

I. INTRODUCTION

The contemporary society is increasingly organised around a digital matrix that permeates significant aspects of human existence such as education, employment, communication and participation in social processes. It is against this backdrop that digital literacy has emerged as one of the most critical competencies to address the complexities of the situation, so much so that it is less a matter of choice and more a matter of inclusion (Castells, 1996; OECD, 2021). Currently digital platforms structure access to information, algorithmic systems determine exposure and decision making, and artificial intelligence increasingly influences the production, circulation and consumption of knowledge (Srnicke, 2016; Couldry & Mejias, 2019; Zuboff, 2019). These developments have increased the urgency of the need for skills that enable people not only to access digital technologies but also to use them in a critical, ethical and efficient manner.

The origin of digital competence is situated in the early conceptualizations of computer literacy, information literacy and media literacy that emerged in response to rapid technological changes and communication practices (Martin, 2006; Bawden, 2001; Buckingham, 2003). Early approaches primarily emphasized upon operational proficiency and the ability to use digital tools and information resources (Gilster, 1997; Bawden, 2008). In some time, scholars began to challenge such instrumental understandings, arguing that digital engagement encompasses conceptual, social, cultural and ethical dimensions that extend beyond technical functionality (Street, 2003; Buckingham, 2015; Selwyn, 2016). On account of this, digital competence is currently understood as a multidimensional construct that encompasses knowledge, skills and attitudes required for systematic participation in digitally mediated settings (Ng, 2012; Ilomäki et al., 2016). This shift makes a broader implication regarding digital technologies not being neutral tools but rather sociotechnical systems embedded in relations of hierarchy, inequality and authority (Beer, 2017; Noble, 2018; van Dijk, 2020).

In this context, numerous international organizations proposed frameworks for conceptualising and assessing digital competence. The most influential among them are the Digital Competence Framework for Citizens (DigComp 2.2), the UNESCO Global Framework of Reference on Digital Literacy Skills, the Digital Intelligence (DQ) Framework and the ISTE Standards. In spite of sharing one common goal, that is preparing people to participate in digital societies, they differ in their assumptions, areas of emphasis and conceptual priorities. Some of them are about citizenship and inclusion, others emphasise upon digital intelligence, educational transformation and lifelong learning. Together they demonstrate a clear shift from a focus on narrow technical definitions to a broader understanding that includes communication, collaboration, creation, ethics and problem solving.

In spite of the increasing prominence of these frameworks in research, policy making and educational practices, there is a limited consensus regarding how these frameworks collectively conceptualise digital competence and talk about the evolving nature of the construct.



This is because existing discussions often examine individual frameworks in isolation, thereby obscuring broader conceptual trends and shared trajectories. Consequently, questions remain regarding the extent to which these frameworks collectively respond to emerging technological developments such as artificial intelligence, algorithmic systems and datafication. Against this backdrop, the present study performs a thematic analysis of four internationally recognised frameworks namely DigComp 2.2, UNESCO, DQ and ISTE to highlight the main conceptual convergences and distinctive emphases. The study aims to synthesise these frameworks to shed light on how digital competence is being redefined in response to new technological, social and educational realities, and to offer directions for future development of the concept in an AI and data driven world.

II. OBJECTIVES

The objectives for the paper are:

1. To examine how digital competence is conceptualised across major international frameworks.
2. To critically analyse the key themes represented across these international frameworks.

III. METHODOLOGY

This study employs a systematic review of existing literature based on the PRISMA framework to examine the portrayal of digital competence across major international frameworks and identifying recurring themes underlying them. The PRISMA method provides a transparent and systematic procedure for identifying the sources of information, screening of studies, determining the eligibility and selecting appropriate studies (Moher et al., 2010). In the first place, a search strategy has been applied across major academic databases including Google Scholar, Scopus, Science Direct, JSTOR and ERIC to identify related studies on digital pedagogy. In addition, official reports and policy documents published by international organisations were also analysed to capture the original documents. The major keywords that had been employed are digital competence, DigComp 2.2, UNESCO Global Framework of Reference on Digital Literacy Skills, DQ Framework, ISTE Standards, digital citizenship, artificial intelligence, algorithms and digital education. Most of the studies chosen are not more than ten years old, in order to ensure contemporary relatability and theoretical grounding, and belong to frameworks, peer journals and book chapters.

In addition to this, reference lists of the selected articles had also been examined to identify additional studies relating to the concerned topic. In the screening phase, titles and abstracts of the studies had been scrutinised to ensure that they aligned with the chosen objectives along with global frameworks relating to digital skills. In the eligibility stage, the studies are mainly included if they offered insights into components of digital competence such as operational skills, information literacy, digital citizenship, cybersecurity and digital ethics and excluded if they appeared too much technical and drifted from the key areas of focus. In the final stage, around 20 articles and 4 international frameworks that met the criteria for inclusion had been chosen and then subjected to rigorous thematic analysis to cater to the purpose of the study. This process resulted in the emergence of five overarching themes: (i) the shift from functional skills to multidimensional competence, (ii) personal competence and social participation, (iii) learning, creativity and problem-solving, (iv) digital ethics and responsible engagement, and (v) adaptability and lifelong learning in digital contexts.

IV. OVERVIEW OF MAJOR INTERNATIONAL DIGITAL COMPETENCE FRAMEWORKS

A. European Commission's Digital Competence Framework for Citizens (DigComp 2.2)

The Digital Competence Framework for Citizens (DigComp 2.2) has been developed by the Joint Research Centre (JRC) of the European Commission to identify key areas of digital competence that shall enable policy makers to draft policies, plan education and formulate training modules to promote digital competence among specific target groups (JRC, 2022). It organises digital competence into 5 competence areas further comprising of 21 components, that are supported by certain proficiency levels and examples of knowledge, skills and attitudes besides offering details on emerging technologies such as artificial intelligence.

1. Data and Information Literacy: This competency area relates to the ability to identify information needs, search and access digital information, critically evaluate its credibility and relevance and manage data effectively.

Component Competencies:

- i. Browsing, searching and filtering data, information and digital contents
- ii. Assessing data, information and digital material
- iii. Data, information and digital content management



2. *Communicate and Work Together*: This area addresses the use of digital technologies for communication, collaboration, participation and relationship building in digital contexts. It also stresses responsible digital citizenship and digital identity management.

Component Competencies:

- i. Connected through digital technologies
- ii. Sharing via digital technologies
- iii. Digital technologies and citizenship engagement
- iv. Working with digital technologies together
- v. Netiquette
- vi. Digital ID management

3. *Create Digital Content*: This area is about creating, modifying and distributing digital content and fosters creativity, innovation and respect for intellectual property rights.

Component competencies:

- i. Creating digital content
- ii. Combining and reworking digital content
- iii. Copyright and licences
- iv. Programming

4. *Safety*: This competency area is about the safe, responsible and sustainable use of digital technologies. It's not just about cybersecurity, but privacy, well-being and environmental issues.

Component Competencies:

- i. Secure Devices
- ii. Protection of personal data and privacy
- iii. Protection of health and well-being
- iv. Environmental protection

5. *Problem Solving*: This domain refers to the ability to solve technical problems, to adapt to changing technological environments and to find opportunities for innovation through digital technologies.

Component Competencies :

- i. Troubleshooting technical issues
- ii. Identification of needs and technological responses
- iii. Innovative uses of digital technologies
- iv. Digital literacy gaps assessment

6. *Levels of Proficiency*: A distinguishing feature of DigComp 2.2 is its progression model of eight proficiency levels, based on the European Qualifications Framework (EQF). These levels are defined by increasing degrees of autonomy, complexity and responsibility in digital engagement:

- i. Foundation (Level 1-2) Performing basic digital tasks with assistance.
- ii. Intermediate (Levels 3-4): Can use digital technologies independently to perform tasks and solve routine problems.
- iii. Advanced (Levels 5-6): Critically evaluating solutions to complex problems and supporting others in digital environments.
- iv. Highly Specialised (Levels 7-8): Innovation, advanced problem solving and leadership in highly complex digital contexts.

In addition to this, it demonstrates 250 examples to highlight how these competencies might be applied to contemporary digital settings including those from artificial intelligence, algorithm systems, datafication and internet of things (IoT).

B. A Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2

Built in alliance with the European Commission's Dig Comp 2.0 model, the Global Framework of Reference on Digital Literacy Skills offers a global benchmark for defining and measuring digital literacy skills that is directly based on the Sustainable Development Goal 4.4.2 talking about the percentage of youths and adults that have achieved a minimum level of proficiency in digital literacy skills. In the first place, it defines digital literacy skills as the capacity to access, manage, evaluate and create information safely and effectively using digital technologies for work, learning, and entrepreneurship. Secondly, it talks about five major competence areas and their respective competences, that has been mentioned in the ensuing paragraphs (UNESCO Institute for Statistics, 2018).

1. Information and Data Literacy:

- i. Browsing, searching and filtering data, information and digital content
- ii. Evaluating data, information and digital content
- iii. Managing data, information and digital content



2. Communication and Collaboration:

- i. Interacting through digital technologies
- ii. Sharing through digital technologies
- iii. Engaging in citizenship through digital technologies
- iv. Use digital tools and technologies for collaborative processes and for co construction and co creation of resources and knowledge.
- v. Netiquette
- vi. Managing digital identity

3. Digital Content Creation:

- i. creation of digital content
- ii. copyright and licences
- iii. programming

4. Safety:

- i. Protection of devices
- ii. Protection of personal data and privacy
- iii. Protection of health and wellbeing
- iv. Protection of the environment.

5. Problem Solving:

- i. Solving technical problems
- ii. Identifying needs and technological responses
- iii. Identifying digital competence gaps
- iv. Computational Thinking

6. Career Related Competencies:

It includes using, interpreting and manipulating digital technologies for a particular field.

C. The Digital Intelligence Framework

The Digital Intelligence Framework, also referred to as the DQ Framework is a globally recognised standard for digital literacy, skills and readiness often formalised as IEEE 3527.1™ (IEEE Standards Association, 2020). It defines digital intelligence as an all encompassing set of technical, cognitive, metacognitive and socioemotional competencies grounded in human moral standards and enabling individuals to face the challenges and reap the benefits of the digital ecosystem (DQ Institute, 2020). It's major characteristics are that it is an all embracing concept that has been formulated by aggregating preceding frameworks, ensures flexible adoption and customisation and has the potential of continuously upgrading itself. It talks about three levels, eight areas and twenty four competencies that can be enumerated in the ensuing paragraphs (DQ Institute,2020).

1. Digital Citizenship: It ensures safe, responsible and ethical participation in the digital ecosystem. It comprises of:

- i. Digital Citizen Identity: It refers to managing online presence and reputation.
- ii. Balanced Use of Technology: It includes balancing screen time and healthy technology habits.
- iii. Behavioural Cyber Risk Management: It includes protecting against cyber threats, scams and harmful content that often relate to personal online behaviour.
- iv. Personal Cyber Security Management: In incorporates safeguarding personal data against cyber threats such as hacking, scams and malware.
- v. Digital Empathy: It refers to being aware and sensitive to one's own and others' needs, feelings and concern.
- vi. Digital Footprint Management: It promotes understanding and management of digital footprints.
- vii. Media and Information Literacy: It includes discernment and critical evaluation of online information and media.
- viii. Privacy Management: It includes ability to handle all personal information shared online so as to protect one's and others' privacy.

2. Digital Creativity: It marks the ability to become a successful member of the digital ecosystem and create fresh ideas, technologies and content to turn ideas into reality. It includes:

- i. Digital Content Creator Identity: It includes creating digital artefacts and multimedia that aligns with present day problems and issues.
- ii. Healthy Use of Technology: It denotes the ability to understand the benefits and harms of technology on one's mental and physical health.
- iii. Content Cyber Risk Management: It refers to the ability to identify, mitigate and manage content cyber risks online.
- iv. Network Security Management: It refers to the ability to detect, avoid and manage cyber threats.
- v. Self-Awareness and Management: It refers to the ability to understand how one's value system aligns with the digital ecosystem.
- vi. Online Communication and Collaboration: It refers to the ability to use technology to communicate and collaborate across online platforms.



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- vii. Content Creation and Computational Literacy: It refers to the ability to synthesise and produce content in a creative and effective manner.
 - viii. Intellectual Property Rights Management: It refers to the ability to understand and manage intellectual property rights such as copyrights, trademarks and patents.
3. *Digital Competitiveness*: It refers to the ability to address global challenges and create new opportunities in the digital economy in the form of entrepreneurship and jobs that shall promote growth of the economy. It includes:
- i. Digital Changemaker Identity: It refers to the ability to build oneself up so as to introduce a change in the digital economy.
 - ii. Civic Use of Technology: It refers to the ability to use technology in order to promote the well-being of local, national and global communities.
 - iii. Commercial and Community Cyber Risk Management: It refers to the ability to understand, mitigate and manage community cyber risks that might exploit individuals financial such as through embedded marketing and online propaganda.
 - iv. Organisational Cyber Security Management: It refers to the ability to forecast and assess existing and potential security risks, and develop and implement intervention strategies to protect and optimise an organization's digital assets.
 - v. Relationship Management: It refers to the ability to handle one's online relationships through collaboration and conflict management to attain mutual consensus and outcomes.
 - vi. Public and Mass Communication: It refers to the ability to communicate with online participants in order to exchange messages, ideas and opinions that shall reflect upon larger discourses.
 - vii. Data and AI Literacy: It refers to understanding artificial intelligence and its societal impact.
 - viii. Participatory Rights management: It refers to the ability to understand and advocate one's powers and rights within the digital environment, such as the rights to protect one's data.

D. The ISTE Standards: A Comprehensive Framework for Digital Literacy and Educational Technology

The ISTE Standards, developed by the International Society for Technology in Education, are a globally respected framework for guiding teaching, learning, leadership and coaching in order to create high impact, sustainable, scalable and equitable learning experiences (ISTE, 2024).

Rather than focusing solely on discrete technology skills, the ISTE framework reconceptualises digital literacy as a transformational educational competency that ensures pedagogy, equity and ethical participation in digital environments. Besides, it is aligned in nine languages and are aligned to UNESCO's Sustainable Development Goals. The ISTE framework is classified into four major sets of standards, each addressed to a different educational stakeholder group namely students, educators, educational leaders and coaches (ISTE, 2024).

1. *Students*:

- i. Empowered Learner: Fostering learner agency, technology enables students to play an active role in choosing, achieving and demonstrating competency in their learning goals.
- ii. Digital Citizen: It includes aspects such as managing digital footprints, online interactions, safeguarding one's mental health and privacy.
- iii. Knowledge Constructor: It means that students should critically curate different resources using digital tools to construct knowledge, produce artifacts and meaningful learning experiences.
- iv. Innovative Designer: It emphasises design thinking, enabling learners to use a systematic process to identify problems, plan solutions and iterate prototypes using digital tools.
- v. Computational Thinker: Students should develop computational thinking skills by breaking down problems, engaging with data and constructing algorithms and models to find solutions.
- vi. Creative Communicator: Here, communication is understood not just as text creation but as multimodal expression enabling students to choose appropriate digital media and formats to share ideas tailored to audience and purpose.
- vii. Global Collaborator: Here learners use digital tools to connect and collaborate across geographical and cultural boundaries, fostering global understanding and teamwork skills.

2. *Educators*:

- i. Learner: Educators can improve upon themselves by learning from and with others in order to explore practises that use technology to enhance learning outcomes.
- ii. Leader: Educators should seek opportunities to promote learner empowerment through the use of digital tools.



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- iii. Citizen: Educators inspire students to behave ethically in digital spaces.
 - iv. Collaborator: Teachers use collaborative technologies not only with students but also with colleagues to improve practise and share ideas.
 - v. Designer: A critical role of educators is to design technology enhanced learning experiences that shall accommodate different learners and inculcate digital and disciplinary skills.
 - vi. Facilitator: Educators shall facilitate learning using technology to support student performance such as by teaching design process and computational thinking.
 - vii. Analyst: Educators must use data to transact instruction and support students in accomplishing learning outcomes by creating alternate assignments for them.
3. *Educational Leaders:*
- i. Digital Citizenship Advocate: Leaders must ensure that all students engage in the use of technology for learning and build their digital citizenship skills primarily by appointing skilled teachers in technology, leveraging an inclusive digital ecosystem and a critical examination of the digital content.
 - ii. Visionary Planner: Leaders must come up with a vision to leverage technology by using different community perspectives, build a plan to implement the vision and evaluate its progress.
 - iii. Empowering Leader: Leaders must create a culture where educators and students are empowered to use technology such as by building competency, promoting collaboration and developing personalised learning assessments.
 - iv. Systems Designer: Leaders shall guide teams to implement equitable technological policies, ensuring that resources and infrastructures are scalable and establish partnerships to help students gain real life experiences.
 - v. Connected Learner: Leaders shall promote continuous professional development for themselves and others.
4. *Coaches:*
- i. Agents of Change: Coaches shall inspire educators and leaders to use technology to create equitable to high quality learning.
 - ii. Connected Learner: Coaches indulge in continued professional learning to set examples for the educators and learners.
 - iii. Collaborator: Coaches shall establish good relations with educators in order to enhance learning experiences.
 - iv. Learning Designer: Coaches guide and assist educators in designing learning experiences and environments that are responsive to the diverse needs and interests of all learners.
 - v. Professional Learning Facilitator: Coaches design, implement and assess professional learning that supports educators and leaders in using technology to improve teaching and learning outcomes.
 - vi. Data Driven Decision Maker: Coaches model and support the use of both qualitative and quantitative data to guide their instructional practices and professional learning.
 - vii. Digital Citizen Advocate: Coaches model responsible digital citizenship and support educators and students in understanding the rights, responsibilities, and opportunities associated with participation in a digital world.
- V. A THEMATIC SYNTHESIS OF INTERNATIONAL DIGITAL COMPETENCE FRAMEWORKS
- A. From Functional Skills to Multidimensional Competence*
- One of the most significant transformations that can be mapped across the existing frameworks is the smooth transition from conceptualising digital competence as a set of functional skills to a multidimensional construct. The concept of digital competence emerged from the preliminary discussions on digital literacy, mostly centring around the integration of technology into daily life that encompassed one's ability to access, understand and use digital information (Gilster, 1997). Interestingly, as digital technologies became increasingly embedded in social, educational and professional contexts, the limitations of skill based approaches simply emphasising upon operational abilities started getting exposed (Ferrari, 2013). Consequently, scholars began to frame broader conceptualisations that not only spoke about technical skills but also larger aspects such as critical thinking, communication, problem solving, ethical use and responsible participation (Janssen et al., 2013; Spante et al., 2018).



In spite of these rapid transformations, earlier frameworks mostly prioritised skill based operational and informational competencies, but in some time they started adopting the concept of 'digital competence' that reflected a broader and more holistic understanding of digital engagement. The DigComp Framework developed by the European Commission goes beyond technical competencies to talk about broader aspects such as content creation, responsible communication, data protection and troubleshooting (JRC, 2022). Similarly, UNESCO's Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2 that is largely based on DigComp 2.0 added the dimensions of software operations and career related competencies to extend global applicability (UNESCO, 2018). The Digital Intelligence (DQ) Framework extends this perspective by incorporating dimensions relating to digital health, digital citizenship, digital emotional intelligence and digital rights altogether addressing the social and moral implications of digital engagement (DQ Institute, 2020). The shift is also evident in frameworks such as the ISTE Standards that talks about innovative designing, global collaborations and data driven decision making (ISTE, 2024). Across all these frameworks, it can be seen that digital competence has been largely conceptualised as a dynamic construct that encompasses cognitive, social, ethical and participatory dimensions (Ilomäki et al., 2016; Janssen et al., 2013). The shift is not merely terminological but reflects larger transformations in digital settings, as the individual is not just a consumer of information but an user, producer and decision maker in digital settings. In this regard, digital competence emerges not as a fixed set of abilities but as an evolving capacity that is shaped by technological change, social expectations and the demands of lifelong learning.

B. Personal Competence and Social Participation

Another significant dimension related to the contemporary conceptualisation of digital competence reflects the coexistence of personal competence and social participation in digital ecosystems. Earlier approaches to digital competence mostly focussed on individual capacities to access, use and assess digital resources efficiently altogether labelling it as a set of attributes that can be acquired and demonstrated in the personal context (American Library Association, 2013; Ilomäki et al., 2016). However, the proliferation of social media, online communities and collaborative platforms across time challenged the individualistic assumptions underlying digital competence and highlighted the social and participatory nature of digital practises (Lankshear & Knobel, 2008; Livingstone, 2012). This tension is noticeable across the existing contemporary frameworks as

they emphasise upon the acquisition of personal competence alongside the ability engage effectively with others in digitally mediated settings. UNESCO's Global Framework of Reference on Digital Literacy Skills and European Commission's DigComp 2.2 introduce communication and collaboration among the core competence areas, that focusses on online interactions, content sharing, management of digital identities and internet etiquettes (UNESCO, 2018; JRC, 2022). The DQ Framework further extends this to introduce concepts related to digital footprints, digital empathy, relationship management and contact risks altogether integrating ethical responsibility and meaningful participation (DQ Institute, 2020). In addition to this, ISTE marks a more pronounced shift towards the participatory understandings of digital competence among educational stakeholders by promoting digital citizenship, intercultural engagement, continuous professional development through connected learning (ISTE, 2024). The existing frameworks suggest how digital competence has evolved from being mere personal competence to a conglomerate of social skills that encompasses the ability to participate ethically, responsibly and conjointly in digitally mediated environments. While personal competencies might remain foundational, its significance can only be realised through effective communication, knowledge sharing and engagement across different digital communities. This synthesis suggests that the frameworks are moving towards a more relational understanding of digital competence positioning it as a social practise rather than only being a technical one.

C. Learning, Creativity and Problem Solving Skills

There has been a homogeneity in the application of digital competence across the existing frameworks relating to learning, creativity and problem solving. Earlier understandings of digital competence primarily focussed on the abilities to access, understand and utilise information multiple sources (Gilster, 1997). Contemporary frameworks increasingly portray individuals as creators of knowledge, divergent thinkers and problem solvers in digitally mediated settings (Ilomäki et al., 2016). This transformation reflects an increasing notion that digital competence extends beyond technological applicability to the consumption of digital resources for purposes related to learning, generation of ideas, creation of digital content and addressing of complex problems. This orientation particularly manifests itself in DigComp 2.2 Framework and that not only talks about the searching and filtering of digital information, but also the creation of digital content besides highlighting significant concerns of copyright and licensing (JRC, 2022).



UNESCO's Global Framework of Reference on Digital Literacy Skills in addition to the existing competence also mentions problem solving as an essential dimension of digital competence that includes solving of technical problems and using digital technologies in an innovative manner to address existing challenges that might be personal, educational or professional (UNESCO, 2018). The DQ Framework reinforces these competencies by emphasising upon digital creativity, that mentions about the creation of digital artefacts that is capable of tackling present day issues besides highlighting the nuances of intellectual property rights management (DQ Institute, 2020). It also introduces the novel dimension of digital competitiveness that aims to address global challenges and create new opportunities in the digital economy by promoting entrepreneurship and jobs (DQ Institute, 2020). A similar approach is also evident in ISTE Standards, as it positions learners as constructors of knowledge, computational thinkers and effective communicators of digital content (ISTE, 2024). The existing propositions indicate how digital competence is not merely an educational outcome but as a foundational ability for personal, social and professional development in the digital age. These developments indicate a broader reorientation of digital competence that enables individuals to not only navigate digital ecosystems but also transform them through creative engagement.

D. Digital Ethics and Responsible Engagement

The increasing integration of digital technologies into daily affairs has established the centrality of digital ethics and responsible engagement across the existing digital competence frameworks. The rapid penetration of digital technologies into every sphere of human existence has raised concerns relating to privacy, security, digital well-being and responsible online conduct. In fact, recent scholarship has also suggested increasing concerns misinformation, datafication and numerous forms of cyberthreats, altogether necessitating a stronger ethical orientation within digital competence frameworks (Pangrazio & Selwyn, 2023; Livingstone et al., 2021). It is because of this that digital competence has further extended its scope to be conceptualised in relation to ethical responsibilities and critical judgements required to participate in digitally mediated settings. The DigComp 2.2 specifically outlines safety as a core competence area, by emphasising upon the protection of digital gadgets, securing of personal data and promotion of health and wellbeing (JRC, 2022).

In the revised frameworks, there are provisions related to artificial intelligence and other emerging technologies, in order to ensure that the users are aware of contemporary advancements (JRC, 2022). A similar orientation has been reflected in UNESCO's Global Framework of Reference on Digital Literacy Skills as it incorporates safety, security and responsible use of technology as essential dimensions (UNESCO, 2018). The DQ Framework primarily focuses on and adds domains relating to digital citizenship, digital safety, digital security, digital use and digital emotional intelligence (DQ Institute, 2020). It talks about the balanced use of technology that includes healthy screen habits, protection against cyberthreats, scams and harmful content and effective cyber risk management. It also talks about demonstrating empathy in digital interactions and also manage online relationships through collaborations and conflict managements altogether highlighting the importance of ethical responsibilities. As far as the ISTE Standards are concerned, it talks about the learners being encouraged to manage their digital identities, safeguard their confidentiality and adjudicate the outcomes of their online actions (ISTE, 2024). In addition to this, the standards extend ethical responsibility beyond students to other stakeholders such as educators, leaders and coaches, as they are expected to model responsible use of technology, promote equitable digital participation and promote inclusive digital learning (ISTE, 2024). The analysis establishes how effective participation in networked societies is governed by ethical discernment and responsible conduct apart from technical capabilities

E. Adaptability and Lifelong Learning

The continuous proliferation of artificial intelligence, algorithmic mediation, big data analytics and other generative technologies has significantly altered the nature of digital experiences. Unlike earlier phases of digitalisation that had been confined to access, searching and consumption of digital resources, contemporary settings demand smart engagement with technology capable of generating content, curating information and automating decisions (Laupichler et al., 2022; Long & Magerko, 2020). In the current scenario, algorithms are largely capable of influencing consumption of information by shaping perceptions and opinions, automated systems mediate major decision making processes such as relating to finance and employment and generative AI tools contribute to learning processes such as by creating instructional materials.

This has led to serious concerns relating to algorithm bias, misinformation, black box logic, opacity and surveillance that have become central to the discourse of digital competence (Livingstone, 2019; Zuboff, 2019; Couldry & Mejias, 2019). Recent scholarship argues that a reconceptualisation of digital competence is required that shall go beyond operational and participatory skills to include capacities such as critical thinking, ethical reasoning, adaptability and lifelong learning. There is a need for continuous upgrading of skills so that one can develop the required knowledge, skills and dispositions required for meaningful participation in the evolving digital societies. The DigComp 2.2 offers the most explicit recognition of these emerging realities because while it retains its original competence areas it introduces numerous examples related to artificial intelligence. It goes on to talk about machine learning and its feeding on huge chunks of data, using AI in major decision making processes in accordance with user goals, risks of activating virtual assistants that might expose private conversations and awareness regarding risks of data breaches (JRC, 2022). UNESCO's Global Framework of Reference on Digital Literacy Skills approaches the concern from a broader perspective, since it was formulated before the advent of Generative AI. It's emphasis on problem solving, information literacy and career related competencies implicitly recognises the need for continuous upgradation of skills in response to changing technological and labour market conditions (UNESCO, 2018). The DQ Framework also promotes adaptability by foregrounding digital readiness attained through focus areas such as critical thinking, emotional intelligence, digital safety, digital rights and responsible participation in digital settings (DQ Institute, 2020). The ISTE Standards also manages to offer a strong articulation of lifelong learning by framing it as a pedagogical disposition. It encourages learners, educators and leaders to be engaged in continuous enquiry, experiment and repurpose existing knowledge to address emerging challenges and opportunities (ISTE, 2024). The synthesis makes it fairly evident how adaptability, continuous upskilling and critical engagement with emerging technologies are almost indispensable for effective participation in AI mediated societies.

VI. FUTURE DIRECTIONS FOR DIGITAL COMPETENCE FRAMEWORKS

A. Strengthening AI and Algorithm Literacy

Although some of the aforementioned frameworks have mentioned about artificial intelligence, explicit competencies related to AI literacy, algorithmic mediation and human-AI collaborations are still lacking.

As AI systems increasingly influence learning, communication and decision making processes, future frameworks should incorporate competencies that shall enable users to understand, analyse and critically engage with AI based technologies (Long & Magerko, 2020; Lintner et al., 2024; Biagini et al., 2025).

B. Addressing Datafication and Platform Governance

Digital participation is largely embedded in platform ecosystems of large scale data extraction, algorithmic curation and corporate surveillance. Existing frameworks on more on privacy and security and less on the structural dynamics of platform power and datafication. Future frameworks need to inculcate critical understanding regarding the effects of digital platforms on visibility, behaviour and access to information (Couldry & Mejias, 2019; van Dijck et al., 2018; Kwet, 2020).

C. Encouraging Critical Digital Citizenship

Current frameworks are mostly based on responsible online behaviour and ethical participation, but digital societies today require citizens who are able to critically assess the effects of misinformation, algorithmic bias, digital exclusion and other forms of technological interventions. Future frameworks should therefore strengthen competences related to critical digital citizenship, democratic participation and civic engagement in digitally mediated public spheres (Choi, 2016; Cortesi et al., 2020).

D. Identification of Sociocultural and Contextual Influences

Digital competence does not emerge in a isolation but is rather shaped by social, cultural and economic conditions. Existing frameworks tend to emphasise general competencies bearing limited consideration for contextual differences in access, opportunities and digital experiences. Future conceptualisations should explicitly recognise the role played by sociocultural factors in the progress and outcomes of digital competence (Ragnedda, 2020; Warschauer, 2003; Helsper, 2021).

E. Enhancing Assessment and Measurement of Digital Competence

Although existing frameworks offer comprehensive conceptualisations of digital competence, challenges are present in operationalising and assessing them. There are many dimensions that are difficult to measure by conventional assessment methods such as ethical reasoning, critical engagement and adaptive learning.

Future research needs to focus on the development of context sensitive and authentic assessment approaches that shall capture the multidimensional nature of digital competence (Janssen et al., 2013; Carretero et al., 2017).

VII. CONCLUSION

The paper conceptualised digital competence not as a discrete set of technical skills, but as a multidimensional capability enabling individuals to navigate the social, ethical and political complexities of digitally mediated life. Across the frameworks reviewed, there is a common movement from operational proficiency to more holistic notions of participation highlighting communication, collaboration, critical judgement, creativity and responsible engagement. This convergence is a marker of a wider recognition that the problems of the digital age are no longer mainly technological, but profoundly human, requiring people to negotiate issues of trust, identity, agency and participation in ever more interconnected environments. At the same time, the review demonstrates that digital competence is still an emerging concept, the limits of which are continuously changing due to the emergence of new technologies. The rise of artificial intelligence, algorithmic governance and data-driven systems raises important questions around the suitability of existing frameworks and skillsets necessary for meaningful engagement in future digital societies. Digital competence should thus be viewed not as a static end result but as a dynamic and constantly developing ability to adapt to changing technological realities while remaining anchored in human values, ethical responsibility and social inclusion.

REFERENCES

- [1] American Library Association. (2013). Digital literacy, libraries, and public policy: Report of the Office for Information Technology Policy's Digital Literacy Task Force. American Library Association.
- [2] Bawden, D. (2001). Information and digital literacies: A review of concepts. *Journal of Documentation*, 57(2), 218–259. <https://doi.org/10.1108/EUM0000000007083>
- [3] Bawden, D. (2008). Origins and concepts of digital literacy. In C. Lankshear & M. Knobel (Eds.), *Digital literacies: Concepts, policies and practices* (pp. 17–32). Peter Lang.
- [4] Beer, D. (2017). The social power of algorithms. *Information, Communication & Society*, 20(1), 1–13. <https://doi.org/10.1080/1369118X.2016.1216147>
- [5] Buckingham, D. (2003). *Media education: Literacy, learning and contemporary culture*. Polity Press.
- [6] Buckingham, D. (2015). Defining digital literacy: What do young people need to know about digital media? *Nordic Journal of Digital Literacy*, 10(Jubileumsnummer), 21–35.
- [7] Carretero, S., Vuorikari, R., & Punie, Y. (2017). DigComp 2.1: The digital competence framework for citizens with eight proficiency levels and examples of use. Publications Office of the European Union. <https://doi.org/10.2760/38842>
- [8] Castells, M. (1996). *The rise of the network society*. Blackwell.
- [9] Choi, M. (2016). A concept analysis of digital citizenship for democratic citizenship education in the Internet age. *Theory & Research in Social Education*, 44(4), 565–607. <https://doi.org/10.1080/00933104.2016.1210549>
- [10] Cortesi, S., Hasse, A., Lombana-Bermudez, A., Kim, S., & Gasser, U. (2020). Youth and digital citizenship+ (plus): Understanding skills for a digital world. Berkman Klein Center for Internet & Society, Harvard University.
- [11] Couldry, N., & Mejias, U. A. (2019). *The costs of connection: How data is colonizing human life and appropriating it for capitalism*. Stanford University Press.
- [12] DQ Institute. (2020). *The DQ framework: Global standards for digital literacy, skills and readiness*. DQ Institute.
- [13] Ferrari, A. (2013). DIGCOMP: A framework for developing and understanding digital competence in Europe. Publications Office of the European Union. <https://doi.org/10.2788/52966>
- [14] Gilster, P. (1997). *Digital literacy*. Wiley.
- [15] Helsper, E. J. (2021). *The digital disconnect: The social causes and consequences of digital inequalities* (2nd ed.). Sage.
- [16] IEEE Standards Association. (2020). IEEE Standard for Digital Intelligence (DQ) Framework—IEEE Std 3527.1-2020. IEEE. <https://doi.org/10.1109/IEEESTD.2020.9084477>
- [17] 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>
- [18] International Society for Technology in Education. (2018). *ISTE standards for students*. ISTE.
- [19] International Society for Technology in Education. (2018). *ISTE standards for educators*. ISTE.
- [20] International Society for Technology in Education. (2018). *ISTE standards for education leaders*. ISTE.
- [21] International Society for Technology in Education. (2019). *ISTE standards for coaches*. ISTE.
- [22] Janssen, J., Stoyanov, S., Ferrari, A., Punie, Y., Pannekeet, K., & Sloep, P. (2013). Experts' views on digital competence: Commonalities and differences. *Computers & Education*, 68, 473–481. <https://doi.org/10.1016/j.compedu.2013.06.008>
- [23] Kwet, M. (2020). Digital colonialism: US empire and the new imperialism in the Global South. *Race & Class*, 62(4), 3–26. <https://doi.org/10.1177/03063968211010893>
- [24] Lankshear, C., & Knobel, M. (2008). *Digital literacies: Concepts, policies and practices*. Peter Lang.
- [25] Laupichler, M. C., Aster, A., Schirch, J., & Raupach, T. (2022). AI literacy in higher and adult education: A scoping literature review. *Computers and Education: Artificial Intelligence*, 3, 100101. <https://doi.org/10.1016/j.caeai.2022.100101>
- [26] Livingstone, S. (2012). Critical reflections on the benefits of ICT in education. *Oxford Review of Education*, 38(1), 9–24. <https://doi.org/10.1080/03054985.2011.577938>
- [27] Livingstone, S. (2019). Audiences in an age of datafication: Critical questions for media research. *Television & New Media*, 20(2), 170–183. <https://doi.org/10.1177/1527476418811118>
- [28] Livingstone, S., Stoilova, M., & Nandagiri, R. (2021). Data and privacy literacy: The role of the school in educating children in a datafied society. *Learning, Media and Technology*, 46(1), 92–107. <https://doi.org/10.1080/17439884.2020.1827017>



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- [29] Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–16. <https://doi.org/10.1145/3313831.3376727>
- [30] Martin, A. (2006). A European framework for digital literacy. *Digital Kompetanse*, 2(1), 151–161.
- [31] Mihailidis, P. (2018). Civic media literacies: Re-imagining engagement for civic intentionality. *Learning, Media and Technology*, 43(2), 152–164. <https://doi.org/10.1080/17439884.2018.1428623>
- [32] Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group. (2010). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *International Journal of Surgery*, 8(5), 336–341. <https://doi.org/10.1016/j.ijsu.2010.02.007>
- [33] Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education*, 59(3), 1065–1078. <https://doi.org/10.1016/j.compedu.2012.04.016>
- [34] Noble, S. U. (2018). *Algorithms of oppression: How search engines reinforce racism*. NYU Press.
- [35] OECD. (2021). *21st-century readers: Developing literacy skills in a digital world*. OECD Publishing. <https://doi.org/10.1787/a83d84cb-en>
- [36] Pangrazio, L., & Selwyn, N. (2023). Towards a school-based ‘critical data education’. *Pedagogy, Culture & Society*, 31(3), 405–420. <https://doi.org/10.1080/14681366.2021.1911977>
- [37] Ragnedda, M. (2020). *Enhancing digital equity: Connecting the digital underclass*. Palgrave Macmillan. <https://doi.org/10.1007/978-3-030-49079-1>
- [38] Selwyn, N. (2016). *Education and technology: Key issues and debates* (2nd ed.). Bloomsbury.
- [39] 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. <https://doi.org/10.1080/2331186X.2018.1519143>
- [40] Srnicek, N. (2016). *Platform capitalism*. Polity Press.
- [41] Street, B. V. (2003). What's “new” in New Literacy Studies? Critical approaches to literacy in theory and practice. *Current Issues in Comparative Education*, 5(2), 77–91.
- [42] UNESCO Institute for Statistics. (2018). A global framework of reference on digital literacy skills for indicator 4.4.2. UNESCO Institute for Statistics.
- [43] van Dijk, J. (2020). *The digital divide*. Polity Press.
- [44] van Dijk, J., Poell, T., & de Waal, M. (2018). *The platform society: Public values in a connective world*. Oxford University Press. <https://doi.org/10.1093/oso/9780190889760.001.0001>
- [45] Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The Digital Competence Framework for Citizens—With new examples of knowledge, skills and attitudes*. Publications Office of the European Union. <https://doi.org/10.2760/115376>
- [46] Warschauer, M. (2003). *Technology and social inclusion: Rethinking the digital divide*. MIT Press.
- [47] Zuboff, S. (2019). *The age of surveillance capitalism: The fight for a human future at the new frontier of power*. PublicAffairs.