

Analysis of the Connotation of Digital Literacy and Related Literacy

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Abstract: *With the ever-increasing advancements in digital technologies such as big data and artificial intelligence, the digital literacy of individuals has emerged as a crucial criterion for gauging international competitiveness and national soft power. Enhancing people's digital literacy not only stands as a strategic imperative to meet the demands of the digital era and elevate individuals' overall capabilities but also represents a pivotal approach to bridging the digital divide and fostering inclusive prosperity. In this context, this study delves into the essence of media literacy, computer literacy, information literacy, data literacy, network literacy, digital literacy, and AI literacy. Through a comparative analysis encompassing their origins, historical backgrounds, and defining characteristics, this research aims to achieve a comprehensive and profound understanding of digital literacy, laying a solid foundation for advancing its development.*

Keywords: *Digital literacy, Media literacy, Computer literacy, Information literacy, Data literacy, Network literacy, Artificial intelligence literacy, Analysis of connotation*

1. Introduction

With the transition from the industrial age to the information age and the remarkable advances in science and technology, digital technology has emerged as a transformative catalyst, propelling comprehensive changes, innovation, and crisis management in human society. The rapid evolution of digital technology has fostered the ascent of the digital economy and revolutionized traditional industries and business models. It has facilitated easy access to information, enabled open expression of opinions, and enhanced social interactions, thereby promoting equity in information acquisition and utilization. Moreover, it plays a pivotal role in scientific research and innovation. Collectively, digital literacy exerts a positive influence on the development of individuals, society, and nations, driving economic, educational, and social progress while expanding the horizons of scientific and technological innovation and facilitating social engagement. Nevertheless, the digital era brings forth challenges, thus emphasizing the imperative of enhancing digital literacy.

Since its inception by scholar Eshet-Alkalai in 1994, the concept of digital literacy has garnered increasing global attention and recognition. Numerous nations have formulated policies and guidance documents to facilitate the implementation and advancement of digital technology in the domain of education. Concurrently, researchers have dedicated their efforts to elucidating the definition, components, and strategies for fostering digital literacy, proposing diverse frameworks and models. The development of digital literacy frameworks has gone through multiple versions and revisions, including Eshet-Alkalai's Five Concept framework of digital literacy[1], the EU's Dig Comp framework[2], UNESCO's DLGF framework[3], the UK's JISC framework[4], and so on. Digital literacy initially focused on helping individuals develop basic operational skills in using digital technology. This included familiarizing them with tools, software, and internet operations to improve efficiency in work and learning. In addition, digital literacy encompasses the abilities to search, process, and evaluate digital content and to be aware of digital security and privacy. With the advancement of technology, the concept of digital literacy has expanded. It now places greater emphasis on understanding, analyzing, and applying digital information. It requires individuals to actively engage in digital socialization, collaboration, and innovation. Digital literacy also requires skills in problem-solving, critical and creative thinking, and effective information search and evaluation. Furthermore, digital literacy addresses aspects such as digital ethics, digital citizenship rights, and responsibilities. This demands that individuals hold

positive attitudes and values that drive and adapt to a digitized society. In summary, digital literacy is a comprehensive capability that involves not only personal technological competence but also social and cultural development. It is crucial for both individual and societal advancement.

Driven by the momentum of technological progress, a multitude of literacies have emerged in addition to digital literacy. Alongside digital literacy, we find media literacy, computer literacy, information literacy, data literacy, internet literacy, AI literacy, and more. These literacies form intricate connections with one another. For a comprehensive comprehension of the essence of digital literacy, it becomes imperative to undertake thorough research on how these literacies interrelate, thus mitigating any potential confusion in their application. In 2007, Wang Fan revealed the development trend of the integration of media literacy and information literacy from an educational technology perspective[5]. In 2011, Tatjana Koltay's research found that media literacy provides the foundation for information literacy and that digital literacy extends and expands media and information literacy by emphasizing the skills in using media and information in a digital environment[6]. In 2013, Wang Youmei discussed the relationships between digital literacy and computer literacy, internet literacy, information literacy, and media literacy[7]. In 2014, Tibor Koltay discussed the connection between media literacy and information literacy due to the requirement of critical evaluation, considering both as default qualities[8]. In 2015, Cheng Mengmeng et al. studied the relationships among media literacy, information literacy, and digital literacy, finding similarities in their focus on cultivating human abilities and promoting basic rights and freedoms while emphasizing the use of multimedia resources with the support of information and communication technologies[9]. Although scholars both domestically and internationally have conducted research on digital literacy and its related literacies, these studies have often been limited in scope and fragmented, focusing on a few specific literacies rather than providing a comprehensive view. Consequently, this article aims to delve into the origins, backgrounds, and connotations of computer literacy, media literacy, information literacy, data literacy, internet literacy, digital literacy, and artificial intelligence literacy. By adopting a comprehensive approach, it seeks to establish a solid foundation for a profound and nuanced understanding of the essence of digital literacy.

2. The Connotation of Digital Literacy

Eshet-Alkalai first proposed the concept of digital literacy in 1994 and later introduced the first digital literacy framework in 2004[1]. Subsequently, American educator Paul Gilster used the term in his work *Digital Literacy* in 1997[10]. Following this, scholars from around the world have begun researching the definition, content, and cultivation methods of digital literacy, presenting various frameworks. In 2012, Eshet-Alkalai added a sixth digital skill, real-time thinking skill, which was missing from the original model, thus creating a comprehensively updated digital literacy model that encompasses all key skills needed for effective performance in the digital age[11]. The Digital Competence Framework (Dig Comp) represents a comprehensive set of standards and references developed by the European Commission within the realm of digital competence. Across the iterations of Dig Comp, namely Dig Comp 1.0, Dig Comp 2.0, Dig Comp 2.1, and Dig Comp 2.2, this framework has undergone a progressive evolution and updates to effectively align with the dynamic digital landscape. At present, the latest version, Dig Comp 2.2, places a strong emphasis on digital technology literacy during the process of digital transformation. Notably, it explicitly underscores the interconnectedness between data literacy, algorithm literacy, artificial intelligence literacy, and the attainment of Sustainable Development Goals (SDGs). In 2016, the Joint Information Systems Committee (JISC) of the UK unveiled the JISC Digital Capability Framework. It is structured around six foundational domains: fostering digital identity, nurturing information literacy, leveraging technology for enhanced learning, driving digital learning and innovation, promoting academic and research excellence, and enabling effective leadership and management. The primary objective of this framework is to empower educational institutions and professionals in improving their digital technology capabilities, thus augmenting the realm of digital education and propelling forward research practices[4]. In 2016, the New Media Consortium (NMC) unveiled the *Digital Literacy: An NMC Horizon Project Strategic Brief*, amalgamating general literacy, innovative literacy, and interdisciplinary literacy to establish a comprehensive digital literacy model[12]. Expanding upon the European Union's Digital Competence Framework (Dig Comp 2.0), UNESCO, in 2018, augmented the framework by introducing proficiencies in device and software operation, computational thinking, and occupational relevance[3]. The Digital Intelligence Alliance published the *DQ Global Standards Report 2019: Common Framework for Digital Literacy, Skills, and Readiness* during the esteemed 7th Global Education and Skills Forum. This seminal report introduced the Digital Intelligence Quotient (DQ) framework, outlining three progressive tiers - digital citizenship, digital creativity, and digital competence - to delineate the quintessential digital literacy and skills imperative for individuals

[13]. In China, the Cyberspace Administration of China has proposed that digital literacy and skills comprise a collection of qualities and abilities, such as digital acquisition, production, utilization, evaluation, interaction, sharing, innovation, security, and ethics, that individuals should possess for learning, work, and life in the digital society [14].

In essence, digital literacy encompasses several key elements:

(1) Proficiency in the fundamental operations and usage of digital technology, including skilled utilization of devices, software applications, and internet tools.

(2) The ability to comprehend, analyze, and apply digital information, by understanding its attributes, value, and significance. This involves the skills to assess, filter, and evaluate digital information, and apply it to real-world challenges and scenarios.

(3) Adeptness in digital communication and collaboration, including effective interaction and cooperation through virtual platforms. This includes the capacity to navigate challenges and issues associated with digital communication.

(4) Competence in problem-solving, encompassing problem analysis, solution proposal, and the selection of appropriate digital tools and techniques for implementation.

(5) Appreciation and mastery of digital innovation and entrepreneurship, enabling individuals to engage in innovative activities leveraging digital technology. It emphasizes active participation in digital socialization, creation, collaboration, and innovation, fostering critical and creative thinking skills.

(6) An understanding of the ethical and moral considerations surrounding the use of digital technology. This includes respecting the privacy and intellectual property rights of others, adhering to network security norms, and refraining from engaging in online bullying, online fraud, and unethical behavior.

(7) Awareness of digital citizenship rights and responsibilities, which involves comprehending and respecting the laws, regulations, and policies governing the digital realm. It entails the fulfillment of one's rights and responsibilities as a digital citizen.

3. The Connotation and Characteristics of Relevant Literacy

3.1. Media literacy

The concept of media literacy was first introduced by British scholars E.R. Leavis and his student Dennis Sampson in their publication *Culture and Environment: Cultivating Critical Awareness* in 1933 [15]. These scholars highlighted that mass media, driven by commercial interests, often caters to the audience's base desires and offers instant gratification. This is evident in the trivial gossip, violence, superficial aesthetic values, and promotion of popular culture. Such commercially-oriented content selection and presentation deviates significantly from people's spiritual needs, especially impacting the healthy development of adolescents. Adolescents are at a critical stage of identity formation, value shaping, and social identification, making them susceptible to the influence of media. Excessive media consumption can also lead to a lack of physical activity, social interaction, and time for learning, negatively affecting their overall well-being.

Therefore, media literacy has become particularly important in our current era. Its primary objective is to awaken people's discernment and critical awareness when confronted with popular culture propagated by mass media. The British scholar Cary Bazaljet defines media literacy as the ability to learn and adeptly utilize media to express one's thoughts [16], while the American Center for Media Literacy defines it as the ability to make choices, understand, question, evaluate, and respond to various media messages, as well as the ability to create and produce media [17]. The Action Coalition for Media Education and the Media Literacy International Leaders Conference both propose that media literacy aids individuals in approaching and analyzing media, critically evaluating and exploring the essence of diverse media, and ultimately creating and producing media information [18].

Currently, media literacy has become indispensable. It encompasses the following aspects: the ability to comprehend media, think critically, and effectively utilize media; the capacity to discern and evaluate information to combat information overload and fake news, thereby enhancing independent thinking and judgment; and the aptitude to generate and share information, fostering awareness and active participation in media while using media as a tool to access and disseminate valuable information.

3.2. Computer literacy

In the 1960s, computer science embarked on its initial phase, gradually unveiling the significance and potential of computers. This prompted explorations into their applications and integration into education. It was within this context that Seymour Papert and his colleagues pioneered the development of the Logo programming language during the late 1960s and early 1970s. Logo, through its utilization of graphics and programming, proved instrumental in fostering logical thinking and nurturing creativity among children[19]. This educational paradigm underscores the utmost importance of active student engagement, exploratory learning, and practical application, thus laying the groundwork for the subsequent concept of computer literacy.

In the 1980s, Seymour Papert advocated a broader understanding of computer literacy beyond simply acquiring technical computer operational skills. He emphasized the pivotal role of computer technology in facilitating learning and problem-solving, while accentuating individual agency and creativity. Papert advocated for leveraging computers as tools for learning, thereby fostering personal reflection and the development of vital learning capabilities[19]. In 2002, Tsai defined computer literacy as the amalgamation of knowledge, skills, and attitudes necessary for individuals to proficiently navigate computer technology in their daily lives. Furthermore, the International Technology and Engineering Educators Association (ITEEA) posits computer literacy as the aptitude to grasp fundamental concepts of computer science and information technology, adeptly utilizing digital tools and technologies to resolve problems and create innovative products.

In essence, computer literacy encompasses the comprehension and application of various aspects of computer hardware, software, and computer networks. Moreover, it encompasses the ability to effectively employ pertinent information technology and digital tools to accomplish objectives.

3.3. Information literacy

In the 1970s, an information explosion occurred, generating and disseminating an enormous volume of information, which presented challenges to people's lives and work. Paul Zurkowski, as president of the Information Industry Association and the American Library and Information Science Committee, observed the exponential growth of information and recognized the necessity for individuals to possess the skills to process and utilize this abundance of information in the era of information overload. His comprehension of the impact of information technology on libraries and the field of information science, as well as the need for individuals to possess information processing skills, laid the foundation for the development of information literacy.

In 1974, Paul Zurkowski first introduced the concept of information literacy, defining it as the ability to enhance problem-solving skills and competencies by accessing extensive information from multiple sources with the aid of information tools[20]. The American Presidential Committee on Information Literacy proposed that information literacy is the ability of an individual to recognize when information is needed and adeptly locate, evaluate, and effectively use the information to fulfill specific needs[21]. In 1992, Christina S. Doyle suggested that information literacy assists individuals in better filtering and accessing valuable and comprehensive information when confronted with a large volume of data, thereby facilitating rational decision-making. Individuals can continually adapt and integrate their existing knowledge systems, critically think, and enhance their problem-solving abilities when applying information[22].

In essence, information literacy encompasses the capabilities to search, evaluate, organize, and convey information, alongside the proficiency to master information technology tools and resources. It involves the ability to acquire, utilize, and disseminate information while also understanding the credibility and privacy security of information. Enhancing information literacy aids individuals in better adapting to the development of an information society, elevating work efficiency, and strengthening self-learning and innovation capabilities.

3.4. Network literacy/Internet literacy

The advent of the internet has sparked a revolution, obliterating international and geographical barriers and profoundly influencing people's work and daily lives. However, the internet has also given rise to a crisis of disconnect, calling for a reflection on the defining traits of our time, an emphasis on individual growth, and the establishment of appropriate connections between social culture and internet technology. The introduction of network literacy offers a solution to address the challenges brought about

by the internet and transform them into opportunities. It enhances our comprehension and utilization of the internet while underscoring the sustainable development of individuals and society, fostering remarkable progress in the digital age.

The concept of internet/network literacy was initially put forward by McClure, who defined it as the practical capacity of individuals to access and utilize internet information from both a knowledge and skills standpoint[23]. In 1999, scholar SelfeC. expanded upon this concept by incorporating a range of personal values and practical skills into the framework of network literacy[24]. Chinese scholar Wei Bu proposed that network literacy involves the ability to discern, access, analyze, and effectively utilize information. Bu emphasized the cultivation of critical awareness and resistance to negative information among young people, equipping them to develop, express, and safeguard their identities through the internet[25]. In 2018, foreign scholars Bauer and Ahoeei argued that network literacy should also encompass social responsibilities, such as cybersecurity, ethics, and collaboration and communication skills[26]. Huang Yongyi suggested that network literacy necessitates individuals to possess comprehensive knowledge and operational skills on the internet, including self-management abilities and the capacity to analyze, evaluate, produce, and disseminate information, to resist harmful content. Additionally, it entails effectively harnessing the internet to foster personal growth and development[27].

In summary, internet literacy/network literacy comprises various dimensions, such as internet search and resource management, online communication and collaboration, internet ethics and legalities, cybersecurity awareness, and internet culture and societal impacts. It involves mastering effective search and information evaluation skills on the internet, learning to communicate and collaborate efficiently online, adhering to ethical standards and legal regulations, safeguarding personal information, and developing a profound understanding of ethics on the internet. Internet/network literacy empowers individuals to confront the challenges brought about by the digital age and harness the positive potential of the internet.

3.5. Data literacy

The era of Big Data has witnessed an exponential surge in data volume and posed numerous challenges, but it has also unlocked immense potential. It has fostered a data-centric mindset, enabling individuals to abstract, condense, and generalize data in ways that prompt profound introspection. Big Data empowers us to comprehend the interconnections between the past, present, and future, uncover patterns of stability and change, and contemplate strategies to address societal and global transformations. The concept of data literacy aims to meet the demands of the Data Age by emphasizing individuals' comprehension and competence in utilizing data to enhance decision-making, encourage innovation, and safeguard personal data privacy. The integration of Big Data and human intellect has led to astounding discoveries and innovations.

In 2004, Milo Shield first introduced the notion of data literacy in his article *Information Literacy, Statistical Literacy, and Data Literacy*. It refers to the ability to acquire and manipulate data. Data literacy empowers individuals with the skills to access, manipulate, and interpret data to support their learning and work in related domains[28]. Nancy Love perceives data literacy as a necessity for handling diverse data types and draw scientifically sound conclusions[29]. Prado highlights the ethical considerations that are pivotal to data literacy[30]. Stephenson et al. define data literacy as the awareness and competency in effectively discovering, critically evaluating, and utilizing data-driven solutions. Initially, rooted in the realm of education in physics, Hua Xiang describes data literacy as the ability to explore data using computers[31]. Meanwhile, Jingbo Zhang and colleagues elucidate data literacy from both the competency and ethical perspectives, encompassing skills such as data collection, organization, management, processing, analysis, sharing, and collaborative innovation with scientific data, alongside adherence to ethical norms and codes of conduct in data utilization[32].

Based on the information above, data literacy entails comprehensive facets, including data awareness, data acquisition, assessment and processing, data analysis and interpretation, data protection and privacy, and data sharing and dissemination. It involves understanding the importance and value of data, mastering data acquisition and evaluation methodologies, possessing data processing and analysis skills, recognizing the significance of data security and privacy protection, and effectively disseminating and sharing insights derived from data analysis. Developing data literacy empowers individuals and organizations to harness the potential of data, enabling them to solve problems, make informed decisions, and gain a competitive advantage in the data-driven era.

3.6. AI literacy

In the advancing stages of the Fourth Industrial Revolution, driven by digital information technologies such as Artificial Intelligence, we have witnessed rapid development. AI-powered products such as smart payments and smart homes have significantly enhanced people's overall life experiences. Artificial intelligence has permeated various aspects of our lives, giving rise to the concept of AI literacy.

The notion of AI literacy is continually evolving and developing, making it challenging to attribute its original proposal to a specific individual or institution. Nonetheless, it is a crucial subject that has garnered widespread attention in academic, educational, and industrial circles. According to Ming Wang, AI literacy encompasses knowledge, skills, attitudes, and ethics related to artificial intelligence[33]. Yi Wang and Qianhua Wang argue that AI literacy should encompass four elements: AI knowledge, AI thinking, AI learning and application, and AI ethics[34]. Duri Long and Brian Magerko from the Georgia Institute of Technology explore the concept of AI literacy and emphasize three core abilities: understanding the basic concepts and principles of AI, ethical competence, and the ability to interact with and utilize AI technologies[35]. In the article establishing the concept of AI literacy, Yi Y argues that AI literacy goes beyond understanding the technology itself and involves broader abilities. These abilities include comprehending the basic concepts and functionalities of AI, critically evaluating and interpreting information and results generated by AI, and considering the ethical and societal implications of AI technologies[36].

AI literacy is crucial in the era of artificial intelligence. It encompasses awareness of the impacts of AI, understanding key concepts and principles, grasping ethical considerations, and possessing practical application skills. This entails recognizing the ethical issues that AI may give rise to, making responsible decisions, and effectively utilizing AI technologies for tasks such as data analysis and algorithmic thinking. By developing AI literacy, individuals are better equipped to face the challenges of the AI era and integrate them into their personal and professional development.

4. The Relationship between Digital Literacy and Related Literacy

4.1. Analysis of origin and historical background

The background of digital literacy and related literacy and the purpose proposed by literacy are summarized in Table 1, and the results are shown in Table 1.

Table 1: Comparison of the background and purpose of related concepts.

Comparison object	Time of delivery	First proposer	Background	objective
media literacy	1933	ER Leavis	The rapid development of radio, film and newspaper.	To avoid young people going astray under the impact of the media, we advocate cultivating public understanding and critical awareness of the media.
computer literacy	1960-1980	Seymour Papert, et al	The initial development of computer; The development of Logo programming language.	Individuals can adapt and participate in the rapid development of technology in computer era.
information literacy	1974	Paul Zurkowski	With the development of information, the society has changed from industrialization to informationization.	Individuals are able to acquire, process and create effectively, improve social participation and critical thinking, and promote the development and progress of individuals and society.
network literacy	1994	McClure	The rise and popularity of the Internet.	To adapt to the requirements of digital age; To avoid information misdirection and risks, and actively participate in the construction and development of information society.
digital literacy	1994	Yoram Eshet-Alkalai	Rapid development of digital technologies; The importance of digitalization for individuals and society.	To cultivate people's ability to understand and apply digital technologies to enhance the competitiveness and adaptability and societies in the digital age.
data literacy	2004	Milo Shield	The rapid development of information technology and internet; Generation of large amounts of data.	To cultivate the ability of individuals to effectively use data in the era of big data.
AI literacy	now	Unknown	Machines replace humans for a range of activities.	To enhance the ability to interact with and use AI systems; Effectively use and manage AI technology to achieve sustainable development of individuals and society.

From the above, it is evident that there are similarities in the emergence of digital literacy and its related literacies:

(1) The advent of digital technology: These literacies have evolved in tandem with the rapid development of digital technology. With the widespread usage and improved accessibility of electronic devices, computers, and the internet, individuals require relevant literacies to effectively engage with and apply these technologies.

(2) Enhancement of personal capacities and societal participation: These literacies emphasize the enhancement of individuals' technological skills, information processing abilities, and their active involvement in the digital society and economy. They underscore the importance of sustainable development for individuals, organizations, and society in the digital era.

(3) Valuing critical thinking and ethical awareness: These literacy concepts stress the significance of approaching digital technologies with a critical mindset, while recognizing the importance of data privacy, information security, and ethical considerations. They encourage individuals to embrace a sense of responsibility and ethical consciousness when utilizing and applying technology.

4.2. Analysis of connotation and characteristics

4.2.1. Analysis of the connotation and characteristics of digital literacy and media literacy

Media literacy originated with the emergence of film, the first visual medium, which had a profound impact on traditional media such as radio, television, and newspapers. The rise of new media has made it increasingly difficult for individuals to determine the accuracy of information and its influence on personal values. The concept of media literacy empowers people to critically evaluate, create, and produce media content, enabling them to express themselves and communicate effectively, especially in the realm of advertising. Media literacy equips young audiences with the necessary tools to cultivate a critical approach towards commercial communication, a significant aspect that digital literacy may lack.

Media literacy is grounded in journalism and communication research, whereas digital literacy originates from information science and education. It emerged after media literacy and exhibits characteristics of diversity, comprehensiveness, individualization, and interactivity. The rapid information turnover and ubiquitous nature of digital information present new challenges to human existence. Compared to media literacy, digital literacy has a broader scope, encompassing various digital technological means and offering diverse problem-solving approaches. Enhancing digital literacy not only enables individuals to critically discern information in the digital society and derive useful value but also facilitates communication, content creation, and complex problem solving.

Digital literacy, built upon media literacy, places a greater emphasis on technological proficiency and extends critical processing, analysis, usage, and creation of media information to different digital technology domains.

4.2.2. Analysis of the connotation and characteristics of digital literacy and computer literacy

Computer literacy refers to an individual's fundamental comprehension and practical skills in utilizing computer hardware and software. It emphasizes the ability to proficiently operate computers, employ common office software and network tools, and troubleshoot basic computer issues. Computer literacy mainly focuses on hardware, software, and skills directly associated with computers. Conversely, digital literacy encompasses a broader concept that involves a comprehensive understanding and application of digital technology. It surpasses mere computer operation and technical applications, stressing an individual's overall competence and adaptability in a digital environment. Digital literacy encompasses not only operational skills found in computer literacy but also encompasses comprehension of digital technology, critical thinking, information evaluation, privacy protection, network security, ethical awareness, and more.

4.2.3. Analysis of the connotation and characteristics of digital literacy and information literacy

Information literacy and digital literacy are interconnected in terms of the need for critical evaluation. Both can be viewed as ways to navigate complex contexts. The distinction lies in the fact that information literacy originated from library retrieval, particularly for information professionals like academic librarians, while digital literacy has a broader focus. It extends beyond libraries to encompass requirements in education, government, the economy, and more for the general population.

Information literacy emphasizes the ability to acquire, evaluate, organize, and utilize various forms

of information. Furthermore, digital literacy emphasizes comprehension, application, and innovation in digital tools and technology. Its ultimate goal is to address problems, creatively utilize devices, serve oneself and society, and apply digital skills in life, which surpasses the scope of information literacy.

In comparison to information literacy, digital literacy places more emphasis on individuals' processes of acquiring knowledge, skills, and emotions. It is a deliberate process of utilizing digital technology to search for valuable information that enhances self-efficacy. This establishes a beneficial cycle in which individuals achieve a level of proficiency in using digital technology to seek information that is personally valuable to them.

4.2.4. Analysis of the connotation and characteristics of digital literacy and network literacy

Network literacy and digital literacy were proposed in the same year, and both are crucial competencies in the digital era. Network literacy focuses on the awareness and practices of information retrieval, communication, network security, and privacy protection in the context of the internet and the online environment. Digital literacy, on the other hand, emphasizes the proficient use and understanding of digital technology, as well as the ability to address problems and challenges in the digital environment.

Network literacy serves as an integral component of digital literacy. Building upon network literacy, digital literacy enhances functionality in terms of navigating the vast information network to meet individual needs and the critical thinking skills necessary throughout this process.

4.2.5. Analysis of the connotation and characteristics of digital literacy and data literacy

Data is digitized information, and data literacy is an important aspect of information literacy. In the era of big data, methods such as data mining and web crawling are used to acquire information and extract valuable insights through data processing and analysis. In critical applications, we evaluate the credibility of information and employ statistical methods and mathematical operations to summarize and generalize the data. This enables us to effectively utilize the resources of big data, make accurate decisions, and take appropriate actions.

Data literacy shines in the realms of data production, storage, and management primarily. Digital literacy aids individuals in selecting valuable information based on data processing. It also involves considering the positive impact on individuals and society at large. Moreover, digital literacy encompasses the ability to use media, create and search for information, understand, evaluate, communicate, and utilize information for the benefit of individuals and society. These requirements extend beyond the scope of what data literacy covers[37]. Hence, data literacy can be considered as a subset of digital literacy.

4.2.6. Analysis of the connotation and characteristics of digital literacy and AI literacy

AI literacy is a facet of digital literacy that assists individuals in adapting to the intelligent era. It involves comprehending the fundamental concepts, algorithms, and methodologies of artificial intelligence (AI), discerning when it is appropriate to employ AI technology to address problems, and evaluating and controlling its applications. AI literacy nurtures individuals' understanding and cognitive abilities to effectively harness and respond to the influence of AI technology on individuals, society, and the economy.

In comparison to digital literacy, AI literacy places a greater emphasis on fostering thinking skills. For instance, computational thinking employs scientific thoughts and AI methodologies to solve real-world issues, enabling individuals to better adapt to the forthcoming challenges in an intelligent society. It is not solely a mode of thinking but also an aptitude, serving as a noteworthy approach to cultivate both innovation and practical abilities among citizens.

In summary, digital literacy is not mutually exclusive with media literacy, computer literacy, information literacy, network literacy, data literacy, and AI literacy. They can be seen as hierarchical relationships built upon each other, intersecting and supporting each other. These literacies interconnect and transform in different technological and historical contexts, gradually constructing the broader and more comprehensive concept of digital literacy. Therefore, the author believes that digital literacy is a broader concept formed through the evolution of media literacy, information literacy, network literacy, data literacy, and AI literacy. It includes the knowledge and skills related to tools in network literacy, skills of media literacy in digital contexts, skills of information literacy in determining, acquiring, evaluating, integrating, applying, understanding, producing, collaborating, and sharing information, as well as the common elements of data literacy in the processing and reutilization of information and AI literacy in cultivating thinking skills in the intelligent era. It represents the comprehensive knowledge

and abilities needed in the digital era and tightly connects individuals and society in their development in the digital age.

5. Conclusion

In conclusion, digital literacy exhibits a profound interconnectedness with companion literacies, intertwining and synergistically bolstering one another. This symbiotic relationship arises from the ever-evolving demands of individuals, encompassing their cognizance, proficiencies, and affective intelligence across distinct epochs of development. Remarkably, digital literacy epitomizes a more all-encompassing, holistic, and contemporaneous essence, permeating the surging tide of technological resurgence and industrial metamorphosis. Manifesting as a comprehensive and systematic contemplation of individuals' digital *modus vivendi*, it assumes a pivotal role in propelling economic and societal advancements, heralding transformative progress.

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