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NEEDS OF DIGITAL LITERACY IN THE ERA OF ARTIFICIAL INTELLIGENCE: A COMPREHENSIVE REVIEW

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Abstract

This comprehensive review examines the evolving and critical need for digital literacy in the era of Artificial Intelligence (AI). It analyses how the proliferation of AI technologies across various sectors necessitates a fundamental redefinition of digital literacy, moving beyond mere technical proficiency to encompass a multifaceted skill set. The paper synthesizes existing literature to identify the core dimensions of AI-era digital literacy, including critical understanding and evaluation of AI-generated content, awareness of AI's societal and ethical implications, practical utilization of AI tools, ethical behaviour concerning data privacy and algorithmic fairness, and adaptability to continuous technological advancements.

The review highlights significant challenges, such as the persistent digital divide, resistance to technology among educators, inadequate training, unequal resource access, and pressing ethical concerns like algorithmic bias. Conversely, it also recognizes AI's potential to personalize learning, foster critical thinking, and enhance educational outcomes. To bridge the identified gaps, the paper emphasizes the urgent need for inclusive AI literacy programs, targeted teacher professional development, interdisciplinary curriculum redesign, supportive policy frameworks, and multi-stakeholder collaboration. The findings underscore that fostering comprehensive digital literacy is essential for empowering individuals to navigate, critically engage with, and ethically contribute to an increasingly AI-integrated society, thereby ensuring equitable and responsible participation in the digital future.

Keywords: Digital Literacy, Artificial Intelligence, Education, Ethical AI, Digital Divide, Workforce Development, Critical Thinking, AI Literacy, Digital Citizenship.

Introduction

The blistering growth and penetration of Artificial Intelligence (AI) in many industries demand the radical development and knowledge of digital literacy among people. The necessity is supported by the disruptive nature of AI in the conventional educational methods and the changing requirements of the future that is integrated with AI (Walczak & Cellary, 2023). The large number of publications in the digital literacy research area and the use of AI as an interdisciplinary field with computer science and education becoming predominant areas is evident in a comprehensive bibliometric analysis of publications on AI in digital literacy research published between 2015 and 2024 (Jantakun et al., 2025). Even the appearance of AI literacy as a keyword of criticality is an indication of the changing nature of digital competence in the modern age (Jantakun et al., 2025).

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Digital literacy in AI age includes various skills, including the ability to understand and apply AI tools critically and ethically, as well as to apply them in practice in different situations (Shiri, 2024). To teachers, digital literacy, in combination with favourable disposition towards technology is important in successfully implementing AI in teaching and assessment processes (Qadir and Omar, 2025). Research indicates that AI literacy is another distinct and critical set of competencies, although it coincides with other digital skills, and it is necessary to focus on its professional growth (Tenberga and Daniela, 2024). Moreover, hiring AI requires the capability to assess, communicate, collaborate, and ethically use AI on the internet, at home, and at the workplace (Ng et al., 2023). This is also in the case of specialized areas, where professionals need AI literacy to move through AI-friendly sectors, including the language industry, which needs the ability to use machine translation and data literacy (Krger, 2024).

Outside of the professional world, digital literacy and AI literacy play a vital role in independent learning, and research has shown that the two have a strong influence on students learning independently (Gani & Mohehu, 2025). With regard to college students, these sub-factors as a critical perception, understanding of the social impact of AI, use of technology, and ethical behaviour allow defining digital literacy in the context of the AI age (H. J. Hwang et al., 2023). This evolving idea of digital literacy in the age of AI does not merely pertain to the technical application but rather to the growth of critical thinking and being able to keep abreast with the continuously evolving dynamics of AI technologies (Gallardo-Echenique et al., 2015; Weimann-Sandig, 2023). This level of literacy creation is essential to make individuals defeat the complexity of AI implementation and its influence on the welfare of society (Wagner & Blewer, 2019; Zhang & Sidik, 2024).

The increased pace of Artificial Intelligence (AI) has created a new wave that fundamentally changes the areas, cultures, and life overall. This change demands a reassessment of the core competencies and digital literacy might become a core competency that can help locate themselves in this versatile setting (Jantakun et al., 2025). It cannot be said that AI is a tool since it is more of a ubiquitous presence that predetermines how individuals' access, process, and create information, which makes it even more important to develop greater digital literacy (Kaur, 2024).

Artificial intelligence, the Internet of Things (IoT), big data, and talent analytics during the era of Society 5.0 produce a significant change in various areas and demand flexible, innovative, and highly competitive human resources (Gustini et al., 2025). Integration of AI and digital media necessitates the new media literacy education and must centre on the critical awareness of the AI algorithm and practices of data collection (Risteska, 2023).

The paper aims to provide the comprehensive description of the dynamic conceptualization of the idea of digital literacy in the environment of AI, its multifaceted nature, the barriers to its widespread introduction, and the possibilities to enhance it within the framework of various groups of people. The digital literacy gap should also be bridged to avoid marginalization of underserved population even more (Mathur, 2025).

Key Dimensions of Digital Literacy in the AI Era

Table 1

Digital Literacy Dimensions and its Key Aspects

Dimension of Digital Literacy	Key Aspects
Critical Understanding	Evaluating AI-generated content, recognizing biases
AI Social Impact Recognition	Understanding societal implications, ethical considerations
AI Technology Utilization	Practical application of AI tools, problem-solving
Ethical Behaviour	Responsible use of AI, data privacy, algorithmic fairness
Technological Proficiency	Basic operational skills for digital devices and AI applications
Adaptability to New AI Tools	Continuous learning and skill development to keep pace with AI advancements

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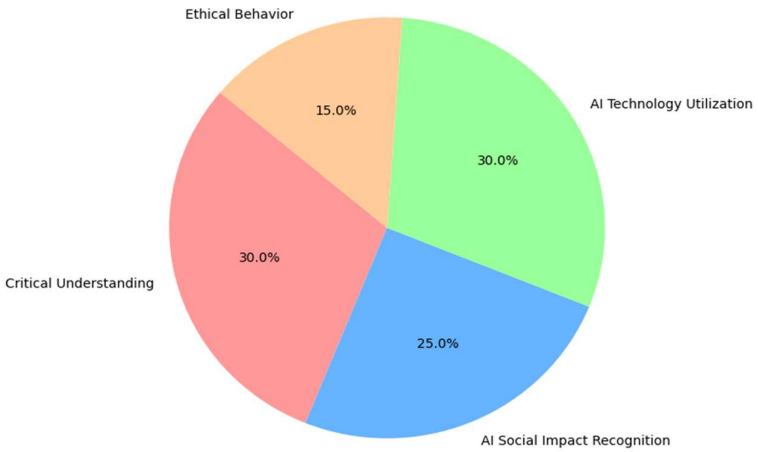
Figure 1
Key Digital Literacy Dimensions in the AI Era



Needs of the Study

Even though the transformative potential of AI is becoming increasingly more recognized, there remains a considerable gap in the knowledge of the precise digital literacy skills necessary to utilize and embrace AI technologies effectively (Mah & Gro, 2024). This paper responds to the pressing challenge of defining and promoting a holistic system of digital literacy, including both technical skills and prowess and critical thinking, ethical literacy, and adaptive learning in the era of AI. This issue of inability to interact with generative and conventional AI technologies and achieve fluency is a typical problem in all fields (Silva et al., 2024). A successful and sustainable digital transformation requires the development of proper support services (Mah & Gro, 2024).

The consequences of AI are spread across various groups of people, such as educators, students, or the elderly who need to be approached in a specific way regarding digital literacy (Bogoslov et al., 2024; Kang, 2025; Zheng, 2025). It is necessary to conduct this study in order to synthesize the current knowledge about the influence of AI on digital literacy, to determine the best practices to build AI literacy, and to make practical recommendations to the policymakers, educators, and technology developers. These endeavours will help in addressing such obstacles as inadequate infrastructure and different capabilities of participants, which have been witnessed in AI training programs (Primasari et al., 2025). To promote effective and sustainable AI adoption and, specifically, among older citizens, personalized methods, including special courses, training, or mentoring programs, are also needed (Bogoslov et al., 2024). In addition, the digital literacy of teachers should be improved to achieve AI-led educational change (Zheng, 2025).

One of the gaps in this research area is the necessity to investigate the ethical dimension of AI, including the bias in algorithms, privacy of data and the possibility of technological determinism. These issues are especially important in the application of AI to the vulnerable population and in such critical areas as digital citizenship (Mathur, 2025; Risteska, 2023). The implementation of AI requires a balance of technological innovation and the humanistic principle to make the AI integration into the educational systems responsible and value-driven (Voicu, 2025). This involves the development of critical consciousness about AI algorithms and data collection practices in order to enhance inclusiveness and diversity (Risteska, 2023).

Objectives

The key objectives of the present overview of the review are as follows:

1. To define and explain the evolving features of digital literacy in the Artificial Intelligence (AI) context. It entails taking note of critical thinking, recognizing the societal consequences of AI, practical application of AI technologies, as well as ethical behaviour in applying them (H. S. Hwang et al., 2023).

2. To analyse the current stage of digital literacy among different groups of individuals, such as college students (Kang, 2025), teachers of secondary schools (Zheng, 2025), and the underrepresented population,

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one will need to establish the primary issues and challenges to its development in the age of AI.

3. To examine the opportunities of efficient pedagogical models, technological interventions, and policy frameworks that can be utilized to enhance digital literacy. This is aimed at establishing responsible and ethical relationships with AI technologies in various educational and community environments (Kaur, 2024), and the purpose is consistent with the capabilities of human-cantered values and digital citizenship (Damanik et al., 2025).

4. To ascertain the future research directions and recommendations that can be used on how the AI literacy programs can be promoted to be inclusive and sustainable. It will help to ensure that the marginalized communities receive an equitable portion of the digital era (Mathur, 2025), as well as contribute to the establishment of inclusive AI literacy programs (Jantakun et al., 2025).

Methodology

Inclusion and Exclusion Criteria

In this review, a systematic literature review methodology is used in the identification, evaluation, and synthesis of academic literature on digital literacy in the age of Artificial Intelligence. The systematic review will be conducted in accordance with the existing principles of systematic reviews, which will guarantee high rigor and transparency of the selection and analysis of the studies. It entailed a thorough search of academic databases such as Scopus, Web of Science, DOAJ and Google Scholar (Li et al., 2025; Wang and Huang, 2025).

Overview of Inclusion and Exclusion Criteria for Literature Selection

Table 2

Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Publication Dates	2015-2025	Outside 2015-2025 timeframe
Topic Focus	Digital literacy, AI literacy, or related competencies in the context of AI, AI impacts on digital skills, education, societal implications, ethics, workforce development	Studies not directly addressing the intersection of digital literacy and AI; pure AI technology development without human literacy implications
Study Types	Empirical studies, literature reviews, theoretical papers, case studies	Opinion pieces, news articles, non-peer-reviewed publications (unless critical grey literature)
Language	English	Non-English languages
Specific Applications	Prioritized studies focusing on AI for digital literacy in education, healthcare, or financial services	Studies focused solely on general digital skills without explicit mention of AI's influence

The inclusion criteria were that the publication must be published in the past five years (not older than 2015), and the topic of the study must be digital literacy, AI literacy, or any similar competencies in the context of AI. This includes scholarly work on the consequences of AI on digital capabilities, educational processes, impacts on society, and ethical aspects and workforce preparation. Empirical research, literature reviews, theoretical papers, and case studies were taken into account which were written in English. The research that specifically discusses the use of AI in the digital literacy context, including in the fields of education, healthcare, or finances, was a priority (Akanfe et al., 2025; Anurogo et al., 2023). In contrast, the articles that were published earlier than the given time were excluded, as well were the studies that did not focus on the intersection of digital literacy and AI directly. Generally, opinion pieces, news articles and non-peer-reviewed publications were excluded, unless they were of exceptional relevance as grey literature to give a wider context. Surveys that were conducted in languages besides English and a study that only examined general digital skills but did not specifically discuss the role of AI in the process was also included.

Information will be surveyed with the help of a template that will be created to contain data on study design, population, major findings about digital literacy and AI, challenges identified, and solutions suggested.

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The synthesized data will be thematized to determine the general trends, challenges that keep on reoccurring, and the effective campaigns that can be used to improve digital literacy in the AI era.

Thematic Analysis of Literature

Digital Literacy in the Age of AI: The Redefinitions of Digital Literacy: The problem with defining digital literacy is that it is being redefined, and new AI-specific capabilities are being introduced. The Implication of AI on Education Practices: The impact of AI in education with references to teaching, learning and assessment. Problems and Obstacles to AI Literacy: The obstacles are infrastructure gaps, the absence of digital literacy, and change resistance. Pedagogical Approaches and Interventions: Education on effective practices and programs to develop digital and artificial intelligence literacy in different populations of people. The Ethical aspects of AI: The issues of algorithm bias, privacy and ethical use of AI. Policy and Societal Implications: Education on the general effect of AI on digital citizens, the formation of labour, and fair access.

Literature

The existing literature shows that the study of Artificial Intelligence as a digital literacy topic has been much expanded, and an exhaustive bibliometric examination of the recent past between 2015 and 2024 shows that the two interdisciplinary fields regarding computer science and education represent the popular ones (Jantakun et al., 2025). Such development points at the dynamic nature of digital competence, in which AI literacy will serve as a key word. Scientific studies have reported the ways AI can be employed to enhance Information and Communication Technology (ICT) and digital literacy among academic practitioners and students (Kaur, 2024).

The suggested AI-based research engines typically have advanced search algorithms, predictive analytics, and automated data processing, easing the process of academic research and improving its performance and success (Kaur, 2024). Improperly applied AI technologies in education have a tendency to reveal tremendous disparities particularly between urban and rural areas (Damanik et al., 2025). It entails instating local contextualized, and locally-consistent frameworks of digital citizenship. One of the requirements of the successful AI implementation is said to be its capacity-building because it prepares educators to use AI as the powerful instrument in their teaching (Damanik et al., 2025).

Furthermore, it is also indicated by research that the digital literacy of the AI world has four great abilities sub-factors which are critical understanding, artificial intelligence social impact recognition, artificial intelligence technology utilization and ethical conduct (H. S. Hwang et al., 2023). These sub-factors dwell on the holistic approach to digital literacy that is an additional step to technical skills to critical assessment and accountable use of AI. Data on Punjab show that both male and female students have the same degree of interest in new technologies and experience the same issues using them (Rafiq-uz-Zaman et al., 2025). These results indicate that gender is not a significant factor in influencing technology adoption in higher education. The technological resistance by the teachers, the deficiency of training, and the unequal resources are some of the challenges illustrated in the literature that create the need to adopt AI slowly and effectively in the learning institutions (Zheng, 2025). Also, there is the issue of ethical implications of AI, such as data privacy, algorithm bias, and the potential of technological determinism, which is a significant concern, particularly when using AI with vulnerable groups (Mathur, 2025).

Despite such critical barriers, AI has been identified as the chance to personalize the learning experience, aid the development of critical thinking among learners, and provide them with real-time feedback or support, especially in underserved groups (Mathur, 2025; Tatipang et al., 2025). STEAM education focuses on imagination, investigative, and problem-solving ability that are needed in modern communities (Rafiq-uz-Zaman, 2025a). Besides, AI can be used to bridge the gaps in literacy, develop a distinctive curriculum, and offer personal learning with the assistance of adaptive platforms (Mathur, 2025). Performance of teachers is generally accepted as one of the major determinants of quality in education. The study of special education institutions in Pakistan identifies insufficient resources, obsolete practices, and the lack of professional growth as the factors that hamper the effectiveness of teaching (Rafiq-uz-Zaman et al., 2025b). The comparative analysis of the perceptions of teachers working in the public and private schools demonstrates that there is a general acceptance of the principle of educational equality, but there are many differences in the opinions on the effectiveness and viability of the use of SNCs (Nadeem et al., 2024).

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Summary of Key Themes and Findings from Reviewed Literature

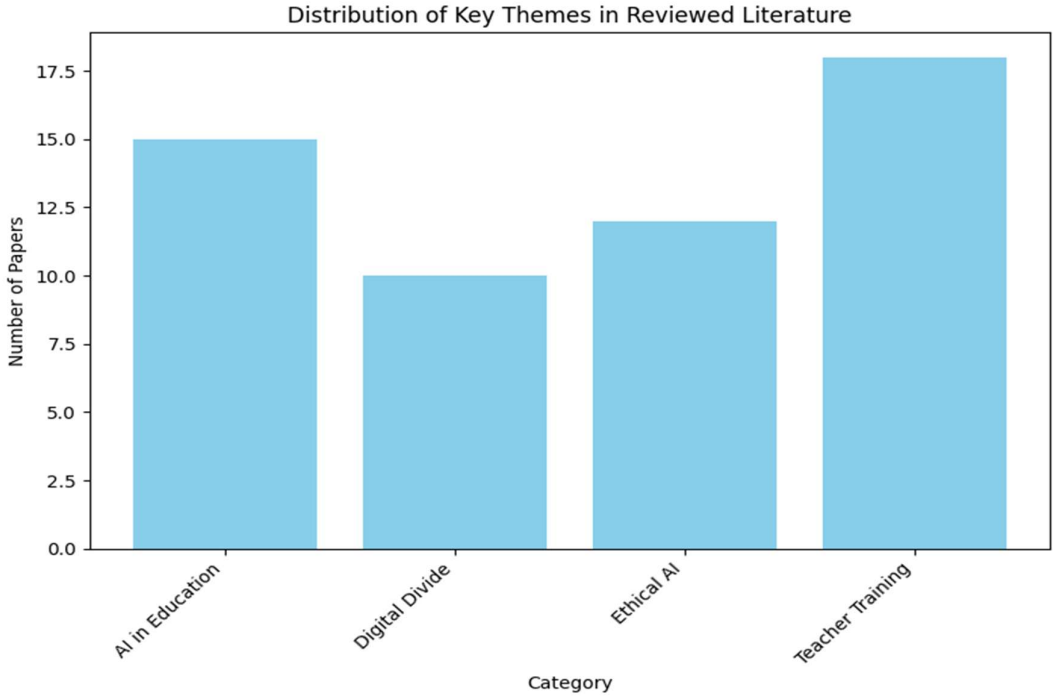
Table 3:

Summary of Key Themes and Key Findings

Theme	Key Findings
AI in Education	AI in Education The integration of AI in education is still in its initial phases with very strong differences between urban and rural environment; capacity building in the teacher domain is a core element (Damanik et al., 2025). AI will be able to make learning more individualized and encourage critical thinking amongst learners (Tatipang et al., 2025). Smart AI tools are improving the digital literacy and ICT skills (Kaur, 2024).
Digital Divide	Digital Divide Digital technologies have spread unwillingly contributing to the digital divide with underserved populations pushed to the margins. Disruptive AI may be in the form of AI-based digital literacy platforms (Mathur, 2025).
Ethical AI	Ethical AI Data privacy and algorithmic bias are examples of ethical implications of AI, as well as a risk of technological determinism (Mathur, 2025). Ethical behaviour is also a sub-factor within the digital literacy of the AI era (Hwang et al., 2023).
Teacher Training	Teacher Training The successful application of AI in the educational system presupposes a primary requirement teacher capacity-building (Damanik et al., 2025). Technological resistance in teachers and lack of training are some of the challenges (Zheng, 2025).

Figure 2

Distribution of Key Themes



List of Major Challenges in Digital Literacy Development in the AI Era

1. The resistance of teachers toward technology (Zheng, 2025).
2. Lack of education to teachers (Zheng, 2025)
3. Disproportionate access to resources of digital literacy building (Zheng, 2025)
4. Digital divide, which causes marginalization of underserved groups (Mathur, 2025)
5. Ethical issues faced; algorithmic bias, data privacy and technological determinism (Mathur, 2025).
6. The inability to adapt to AI devices among students (Tatipang et al., 2025)
7. Lack of knowledge regarding particular digital literacy skills to engage with AI (Mah and Gro, 2024).

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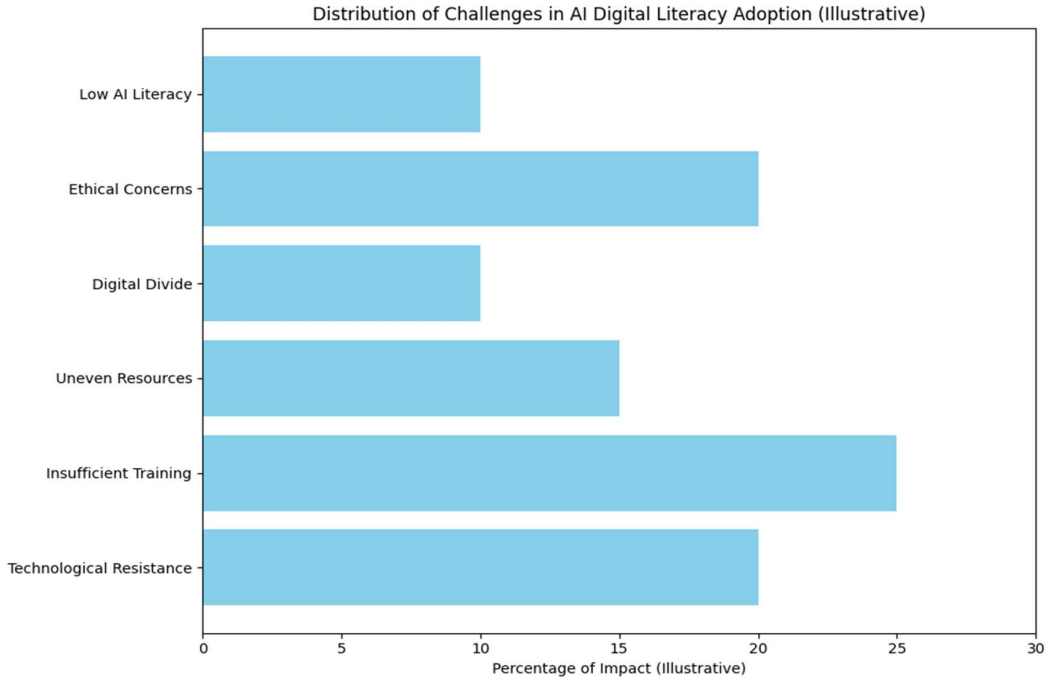
Figure 3

Distribution of Challenges in AI Digital Literacy Adoption



5 Findings

Digital literacy in the AI era is intrinsically multidimensional, and it, therefore, connotes the critical vision, the capacity to discern the social impact of AI, efficiency in utilizing AI technology, and ethical behaviour (H. S. Hwang et al., 2023). The ability to effectively utilize various AI-powered tools can be viewed as one of the main competencies in the case of college students (H. S. Hwang et al., 2023). This is a wide definition that goes further than the technical ability to utilize technology and aligns with the general need of people to not only have the opportunity to utilize technological possibilities but also be able to comprehend and utilize them in different aspects of life, such as healthcare and economy (Anurogo et al., 2023). These findings reveal how the paradigm has been changed to the more integrated and holistic paradigm of digital competence as opposed to the previous siloed approaches.

However, the issues related to the promotion of digital literacy, particularly in teachers are still serious. The barriers to the successful implementation of AI in teaching practices among teachers are often the technological resistance, the lack of training, and unequal access to resources (Zheng, 2025). Likewise, there is a widespread problem of low levels of AI literacy and lack of skills of the 21st century, which is noticeable among younger generations, and makes the careful selection of educational interventions especially significant (Alamudi, 2025). These issues are causing an ongoing digital divide, especially to the disadvantaged communities (Mathur, 2025). The table below presents a summary of the identified digital literacy competencies, and the chart shows the distribution of these challenges.

Nonetheless, there has been a significant push among medical students and potential teachers, as well as other demographic groups, to apply AI in their education and career growth, understanding that it has immense potential advantages (Fahrurrozi et al., 2024; Sanr, 2025). AI is turning into a significant stimulus of acquiring the necessary digital skills, improving the experience of personal learning, and cultivating the ability to think critically in students (Pintea et al., 2025; Zebua, 2024). This overall enthusiasm provides a learning watershed to the curricular modifications and intensive training programs that can bridge the existing gap in AI literacy and readiness and, in this way, allow the future generation to work in different work and society contexts (Sanr, 2025).

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Table 4

Identified Digital Literacy Competencies in the AI Era

Competency	Description	Critical Understanding	Ability
AI Knowledge and Understanding	General knowledge of the topic of AI products, technology, and application.	Knows the basic concepts of the AI with regard to its history, development, and field of use in different industries.	The skill to translate AI concepts and technologies in real-life.
Ability to Evaluate AI-generated Content	Assessing the trustworthiness, naturalness, and biasness of the AI-generated content.	Knows how AI content is generated, algorithms, and data sources and understands the existing biases of systems generating content.	Understanding how to analyze AI-generated content, can detect biases, evaluate how reliable and accurate AI can be.
AI Social Impact Recognition	The realization of the effects of AI on society, as well as on ethical aspects, job automation, privacy-related concerns, and human rights.	Is aware of the potential long-term effects of AI on society, such as economic, cultural, and ethical ones.	Knowledge in explaining and interpreting the social effect of AI, both beneficial and adverse.
AI Technology Utilization	Hands-on: How to use AI tools and applications to find solutions and be more efficient.	Knows about the application of AI technologies in practice (such as automation, data analysis, decision making, etc).	Knowledge in working with AI applications to complete tasks, complex issues, and improve productivity.
Ethical Behaviour in AI	The understanding of the principles and expectations regarding dealing with AI technology.	Perceives the ethical challenges of AI, including AI privacy, equity, and responsibility in the machine-made choice.	Capacity to behave in a socially accountable manner when designing, using and engaging with AI technologies.
Digital Collaboration with AI	Teamwork skills to operate AI and other computer programs.	Recognizes the significance of human-AI co-operation and ethical implications of collaboration with the automated systems.	Flexibility, i.e., the capability to work well with AI systems and combine human and machine intelligence to attain the best outcomes.
AI Policy and Governance Awareness	The AI regulations, privacy laws and governance frameworks applicable in the implementation and use of AI.	Knows current and future policies, standards, and legal implications of AI and their ethical consequences.	Knowledge to go through, adhere to, and promote AI policies and governance in the AI ecosystem.

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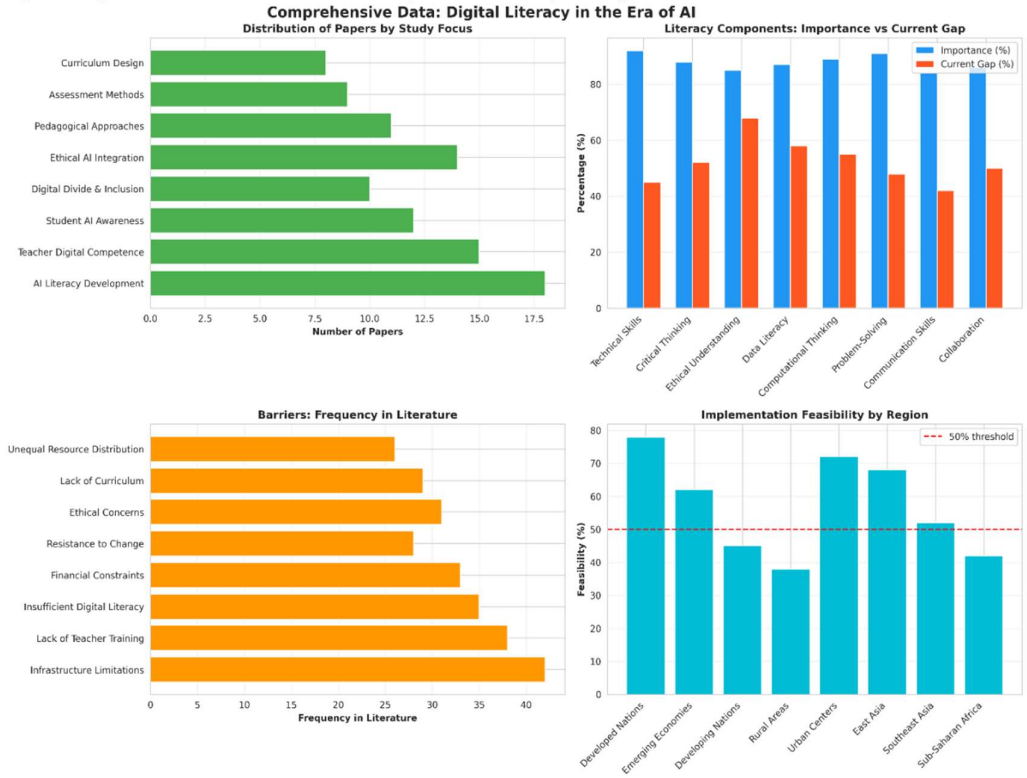
Figure 4

Distribution of Comprehensive Data in AI Digital Literacy Adoption



Discussion

The results highlight that digital literacy during the age of AI goes beyond technical expertise and requires a subtle sense of AI implication to the society and the ethical concern. The reason is that, regardless of the impact of the AI-based recommendation engines on the information consumption, the power to critically assess the AI-generated content and overcome the algorithmic bias is essential (Risteska, 2023). Such an enlarged definition of digital literacy is crucial to responsible digital citizenship (Damanik et al., 2025).

Digital literacy and access to technology inequality, commonly described as the digital divide is still a major challenge. Unless inclusive AI literacy initiatives are created and implemented, underserved communities will face even greater marginalization (Mathur, 2025). The significance of continuous professional growth of educators is constantly emphasized because their ability to successfully use AI tools directly influences the performance of students (Ma et al., 2025; Zheng, 2025).

Although AI presents vast possibilities of individual learning and improved educative experiences, its successful implementation will depend on a multi-faceted approach. This involves curriculum redesign, multi-stakeholder partnership and perpetual emphasis on human cantered design principles (Kang, 2025; Mathur, 2025). Ethical issues to address include data privacy and algorithmic fairness because it is essential to make sure that AI is a means of empowerment and not an instrument of exacerbating existing disparities (Kaur, 2024).

Table 5

Comparison of Digital Literacy Frameworks in Pre-AI and AI Eras

Aspect	Pre-AI Era Frameworks	AI Era Frameworks
Scope	Focus on basic computing skills, internet navigation, and digital communication.	Extends to understanding AI concepts, critical evaluation of AI outputs, and ethical AI use.
Key Skills	Information retrieval, basic software proficiency, online communication	Algorithmic literacy, data privacy management, critical thinking about AI biases, AI tool utilization.

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Aspect	Pre-AI Era Frameworks	AI Era Frameworks
	etiquette.	
Ethical Focus	General internet safety, cyberbullying awareness, copyright basics.	Algorithmic fairness, data privacy, responsible AI development, human-AI collaboration ethics (Risteska, 2023), (Kaur, 2024).
Content Interaction	Consumption and basic production of digital content.	Critical evaluation of AI-generated content, discerning deepfakes, ethical AI content creation (Risteska, 2023).

Conclusion

The era of Artificial Intelligence makes the concept of digital literacy fundamentally different as it no longer deals with simple technical proficiency but with a more critical grasp of the potential of AI and its applicability, as well as its ethical and social outcomes. This is an in-depth review of why the entire demographic, one including students and practitioners alike, is in fierce need of developing superior digital literacy skills in order to exist in a world dominated by AI. The most prominent issues are the existence of digital divide, lack of training and resources, and the omnipresent problem of algorithmic bias and privacy of data. These must be defeated with the help of certain interventions, proper policy framework and continuous renewal of educational syllabuses. The advantages of AI in personalizing the learning process and training critical thinking are constantly on the side, when the latter should be introduced in an ethical, rather than a discriminatory, way. Ultimately, the question of establishing digital literacy in the era of AI is not merely the process of embracing technology but rather ensuring that people can use AI in a responsible, critical, and creative manner in order to ensure that the development of technology is a constituent of the equitable and informed society.

Recommendations

In order to overcome the negotiation challenges and opportunities that artificial intelligence presents to us, there are a few strategic recommendations that are highly significant in developing good digital literacy in the society. The recommendations are aimed at addressing the gaps that are there and developing a future proof populous.

Enact and introduce AI literacy syllabuses at every level of education, including primary schools and higher education institutions, with a focus on critical thinking, the ethical use of AI, and practical AI implementation (Michaeli et al., 2023; Widodo et al., 2025). These curricula must be created in a manner that explains what students can learn and what they should learn about AI to give an insight into key concepts and related competencies (Michaeli et al., 2023).

Fund further education and training of teachers to improve their AI awareness and provide them with the pedagogical techniques that they will use to incorporate AI into the human resources as effectively as possible (Ma et al., 2025; Zheng, 2025). It should involve training AI-based learning media, which is essential considering that a number of lecturers are yet to learn the use of AI technology (Nuryadi et al., 2025).

Encourage multistakeholder cooperation between governments, educational institutions, industry, and communities to create inclusive AI literacy programs, especially to underserved people to reduce the digital divide (Kang, 2025: Mathur, 2025). To have an inclusive and sustainable vision of the society, the technology governance should be transparent and human-cantered (Gustini et al., 2025).

Ensure the promotion of policies that deal with the ethical aspects of AI by protecting against data privacy, algorithmic transparency, and reducing bias, which will subsequently result in a responsible AI ecosystem (Kaur, 2024; Risteska, 2023). It is also necessary to overcome the limitations of infrastructure and poorly developed regulations by increasing digital literacy of the population and governmental personnel (Didin et al., 2024).

Assist in research and development of user-friendly AI applications and sites that can be approached and used by different learning requirements and, cultural backgrounds, as well as guarantee successful learning processes (Zebua, 2024). It will also be able to address such challenges as resistance to change and unequal access to technology (Zebua, 2024).

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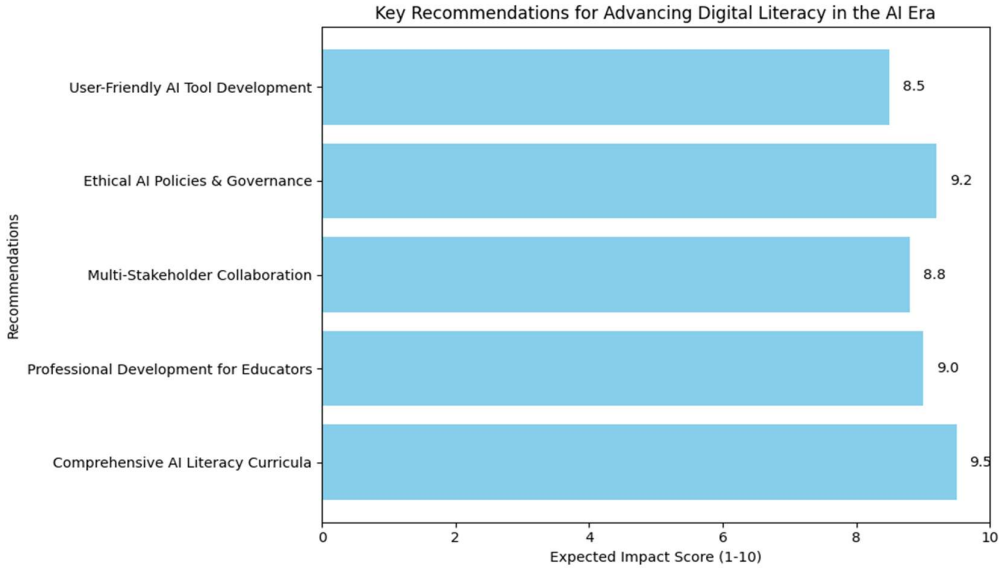
Figure 5

Key Recommendations for Advancing Digital Literacy



Future Directions

Longitudinal studies need to be conducted in future studies to determine how AI literacy programs affect the personal and social growth of individuals and examine the effectiveness of different pedagogical strategies and policy initiatives (Ma et al., 2025). It will give priceless information about the effectiveness of strategies that are still maintained and build the further development of educational projects. It is the urgent need to learn more about the development of culturally responsive and contextually adaptive AI literacy structures, especially in context of diverse populations and developing nations. Such research is expected to consider the various access to technological and educational infrastructure and make it inclusive and relevant (Damanik et al., 2025; Sanr, 2025).

The multifaceted ethical aspects of AI also need to be expanded upon and investigate how the relationship between human beings and AI affects the human psyche, what the digital identity represents, and how to successfully promote ethical choices in the world with AI in its centre (Kaur, 2024; Voicu, 2025). This includes the research studies on how AI may be applied towards increasing student autonomy (Ma et al., 2025). Finally, the issue of how AI literacy can be integrated with other essential 21st century skills, such as computational thinking, creativity, and problem-solving, will have to be considered to create an all-encompassing education framework that will be able to prepare learners to address the challenges of the future to a greater extent (Farchan, 2025). This also contains the research of the opportunities to enhance digital literacy of university students in the era of AI, which reacts to the emerging needs of the higher education (Kang, 2025).

Contributions of the Authors

Each author made a substantial contribution to the work reported and took part in the ideation, development, and final approval of the manuscript.

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Statement of Data Availability

The corresponding author can provide the data used in this study upon request.

Conflict of Interest

The authors declare no conflict of interest.

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