

An Investigation of Artificial Intelligence (AI) Literacy Competency for Library and Information Science (LIS) Students in China

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ABSTRACT

Artificial intelligence is driving a new industrial revolution sweeping all aspects of human life, including technology, economy, science, politics, and art, like an unstoppable wave. This paper adopts a literature analysis methodology and extensively searches Chinese and foreign academic databases to analyse the relevant literature. A set of dimensions for AI literacy among LIS undergraduates has been developed in four first-level dimensions (AI knowledge, AI skills, AI attitude, AI ethics) and twelve second-level dimensions. Finally, this paper proposes continuing in-depth research on AI literacy and joining forces with multiple parties to promote universal education in AI literacy skills.

INTRODUCTION

Recently, much discussion and debate has been sparked in this regard by the rapid increase in Artificial Intelligence; even prominent personalities like Elon Musk and Bill Gates have shown their worries about the threats from Artificial Intelligence to human existence (Weng et al., 2024). The increasing prevalence of AI in various domains, including medicine, law, and education, has led to the recognition of AI as a transformative, if not disruptive, force in these fields. It acknowledges AI as a transformer, if not disruptive, game changer (Wood & Evans, 2018). McCarthy (2007) first introduced the concept of AI in 1955 and defined it as the science and engineering of making intelligent machines. The Oxford Dictionary defines AI as the theory and development of computer systems capable of performing tasks normally requiring human intelligence, such as perception, speech recognition, decision-making, and interlanguage translation. In recent years, the focus of AI development has shifted from mechanisms for formalizing knowledge to various machine learning techniques, including statistical models and deep learning networks (Rolan et al., 2019).

AI technologies are widely used in many industries, including information sciences, and have resulted in many revolutionary changes in these industries. In libraries, AI is applied to back-office operations, user services, supporting data scientists, analyzing, predicting and influencing user behavior (Cox & Mazumdar, 2022). Luo Xing Hua (2023) believes that AI will concentrate on intelligent search, mobile visual search, innovative libraries, intelligent data services, and knowledge engineering in the future. Kunshan City Archives in Jiangsu Province uses an AI intelligent proofreading system to solve the problems of low efficiency, omission, and misdiagnosis arising from the manual inspection work of data resources. Luzhou Laojiao Archives uses new technologies such as the Internet of Things and big data to realize the automatic capturing of metadata of electronic documents, automatic identification of the storage period, and automation of archival entries (Wang and Yuan, 2022). Gregory introduced the four case studies of AI programs undertaken by Australian archives and government agencies, providing an overview of needs, activities, outcomes and the future (Rolan et al., 2019).

The significance of AI literacy is gaining increasing attention, evolving from the established domains of information literacy and digital literacy into a distinct and independent concept. It has become a focal point in discussions and research efforts between governments and academic institutions. The term AI literacy was first introduced by Konishi (2015), who argued that it extends beyond technical proficiency to encompass the capacity to consider and adapt to future technological advancements critically. A widely cited definition is provided by Long and Magerko (2020), who conceptualize AI literacy as “a set of competencies that enables individuals to evaluate AI technologies critically; communicate and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace”.

Ensuring the employability of graduates represents a fundamental responsibility of higher education institutions. As AI technology continues to permeate diverse industries, there is a growing demand for employees who possess robust AI literacy. To address this need, universities can enhance the employability and productivity of their graduates by offering comprehensive AI literacy programs and emphasize practical applications of AI to students from a variety of academic disciplines (Ng, Leung, et al., 2022). However, current AI literacy education in higher education often falls short, particularly for undergraduates in non-computer science and non-engineering fields. Existing curricula frequently lack tailored guidelines for specific disciplines, exhibit an overemphasis on programming and technical aspects, and provide insufficient coverage of the ethical considerations and foundational algorithms underpinning AI technologies.

Promoting AI literacy and enhancing organizational and societal competence in AI are increasingly integral components of contemporary library services. These initiatives align closely with established library practices and the professional identity of librarians, particularly within university, school, and public library contexts, where they are positioned to take a leading role in fostering AI literacy (Cox & Andrew, 2024). Librarians equipped with strong AI literacy skills can leverage AI tools to facilitate advanced knowledge acquisition and processing, deliver personalized and user-centered services, streamline routine administrative tasks, and support strategic library decision-making and forecasting.

RESEARCH BACKGROUND

AI literacy has become one of the major development trends of academic libraries in 2024. Academic libraries gradually integrate AI literacy into their service systems and educational functions. They are committed to improving readers' awareness, understanding and application of artificial intelligence to better adapt to this intelligent academic research environment. With the help of AI technology, they will further promote the in-depth development and extensive exchange of academic research and knowledge dissemination (Committee, 2024).

Research on AI literacy in China is still in its infancy, and there are even fewer studies on AI literacy in LIS majors, with less than five known literatures. The main shortcomings of the research are: (1) the

terminology of AI literacy is not unified, and the concept is generalized; (2) there is no significant difference in the design of the AI literacy framework; (3) the research subjects of AI literacy education are mainly focused on K12, teachers and the general public, and the degree of subdivision is not sufficient (Shi&Mao, 2024).

Graduates with AI literacy are more employable and productive, able to use AI to solve practical problems they encounter at work, and many companies are increasingly valuing employees' AI capabilities. Today's companies are increasingly valuing the AI capabilities of their employees, which can provide new approaches and opportunities for issues such as business development planning and management operations (Ng, Leung, et al., 2022). Some universities have started offering AI courses to students from different professional backgrounds to address the skills gap and expand learning opportunities for all learners. For example, some courses may focus on something other than mathematical formulas and programming, as most students do not need to learn the underlying mathematical and technical principles behind AI technology (Long & Magerko, 2020). Some courses focus on supporting professionals in specific industries (e.g., healthcare, business, law) to manipulate AI-driven systems and machines and understand the ethical issues and limitations behind the technology (Xu & Babaian, 2021) (Hwang et al., 2022).

Countries have successfully formulated policies and regulations on promoting artificial intelligence literacy in recent years. In 2019, BEIJING consensus on artificial intelligence and education proposed taking institutional measures to improve AI literacy at all levels of society. UNESCO proposed the development of AI capabilities and AI literacy at the 2021 International Forum on AI and Education. The same year, the Recommendation on the Ethics of Artificial Intelligence included raising public awareness and literacy about AI and data as one of its ten core principles. In 2017, the Scottish Government pledged to improve public understanding of how AI affects their lives and society. In 2023, the United States enacted the Artificial Intelligence Literacy Act.

OBJECTIVE

This study aims to analyze the concept of AI literacy, examine the existing frameworks of AI literacy, and develop a set of dimensions for AI literacy specifically tailored to LIS undergraduate students in China.

METHOD

This study employed a literature analysis method, systematically reviewing English and Chinese academic databases, including Science Direct, Scopus, ProQuest, WOS, Google Scholar, and the Chinese literature database National Knowledge Infrastructure (CNKI). The Keywords "AI literacy" and "artificial intelligence literacy" were used to identify relevant articles. Articles are screened by reading the abstract in detail and skimming the body. Inclusion criteria: (1) the studies should provide descriptions of the underlying theory and methods. (2) the studies focused on AI literacy.(3) the studies focuses on non-engineering and non-computer science undergraduates, with a supplemental study of K-12 and citizens. (4) the studies focuses on improving students' AI literacy competencies. (5) Other articles found in the Internet using the snowballing method that satisfied the above criteria. Exclusion criteria: (1) non-English/Chinese. (2) non-scientific articles. (3) Duplicate articles. (4) the studies focuses on the use of AI technology to aid education. (5) the studies focuses on improve teachers' AI literacy. The above screening resulting in a dataset of 110 papers. The inclusion of both English and Chinese literature strengthens the study's comprehensiveness. Snowballing, a strategy of using references and citations to expand literature coverage, further enhances the depth of the research.

DISCUSSION

This section first explores several existing definitions of AI literacy, categorizing them into two key components: competence and understanding. Subsequently, various AI literacy frameworks developed

based on these definitions are discussed. Finally, five dimensions of AI literacy, tailored explicitly for LIS students, are synthesized from prior research.

Definitions and Perspectives

Digital tools have led to new literacy concepts, such as digital and media literacy. With the rapid development of artificial intelligence (AI), AI literacy has also gained prominence. AI literacy is often viewed as an extension of established literacies like information and digital literacy (Shi & Mao, 2024). It emphasizes learning and teaching AI technologies, while related fields like AI in Education (AIED) focus on applying AI tools for educational purposes (Ng, Leung, et al., 2022). The definitions of AI literacy are diverse and can generally be categorized into two primary perspectives: a set of abilities and a perception.

AI Literacy as a Set of Abilities

AI literacy is often described as a set of competencies that enables individuals to evaluate AI technologies critically, communicate and collaborate effectively with AI, and use AI as a tool online, at home, and in the workplace." (Long & Magerko, 2020). Ng, Luo et al. (2022) conceptualize AI literacy as "a new set of technological attitudes, abilities, and competencies" that allow individuals to use AI ethically and effectively in everyday life. Similarly, Wang et al. (2023) propose that AI literacy encompasses the awareness and understanding of AI technology, the ability to apply and critically evaluate AI systems, and the capacity to acknowledge responsibilities while respecting reciprocal rights. Pinski and Benlian (2023) further broaden this definition, describing general AI literacy "as the socio-technical competence consisting of knowledge regarding human and AI actors inhuman-AI interaction, knowledge of the AI process steps, that is input, processing, and output, and experience in AI interaction."

AI Literacy as a Perception

Chiu et al. (2024) define AI literacy as the ability to articulate how AI technology's function, evaluate their societal impacts, and use them ethically and responsibly across various settings. AI literacy is defined by a basic understanding of the benefits, risks and opportunities of AI and how it impacts daily lives (Enhancing AI Literacy for the United States of American.Pdf, n.d.). Hermann (2022) emphasises AI literacy as the ability to comprehend data collection methods, inference mechanisms, biases, and AI's broader societal impacts while retaining individual agency in decision-making.

When no specific group is defined, AI literacy generally refers to AI literacy for the general public or AI literacy for all, which is geared towards a non-specialist audience (Yin, 2024). Therefore, most definitions of AI literacy do not necessarily involve technical expertise and do not emphasise the development of AI applications on one's own (Laupichler et al., 2022).

AI Literacy and the Library and Information Science Perspective

The library and information science community believes that AI literacy includes the following elements: (1) A basic understanding of how AI and ML (Machine Learning) work, their underlying logic and their limitations. (2) Understanding the potential societal impacts of AI, especially in human rights. (3) Personal data management skills. (4) Media and Information literacy. (IFLA Statement on Libraries and Artificial Intelligence, n.d.)

AI Literacy Frameworks

Many frameworks for AI literacy have been developed and continue to be refined. A prominent method for classifying reasoning skills and levels of cognitive thinking is Bloom's Taxonomy. This

framework consists of six hierarchical levels: Know, Understand, Apply, Analyze, Evaluate, and Create. Each level builds upon the previous one, requiring students to achieve mastery at each stage to progress to higher levels of complexity and critical thinking.

According to Bloom's taxonomy, the three aspects of AI literacy, namely, Know and understand AI, Use and apply AI, and Evaluate and create AI, are classified according to cognitive levels. Know and understand AI is classified into the bottom two levels; Use and apply AI is classified into the apply level; and evaluate and create AI is classified into the top three levels (Figure 1).

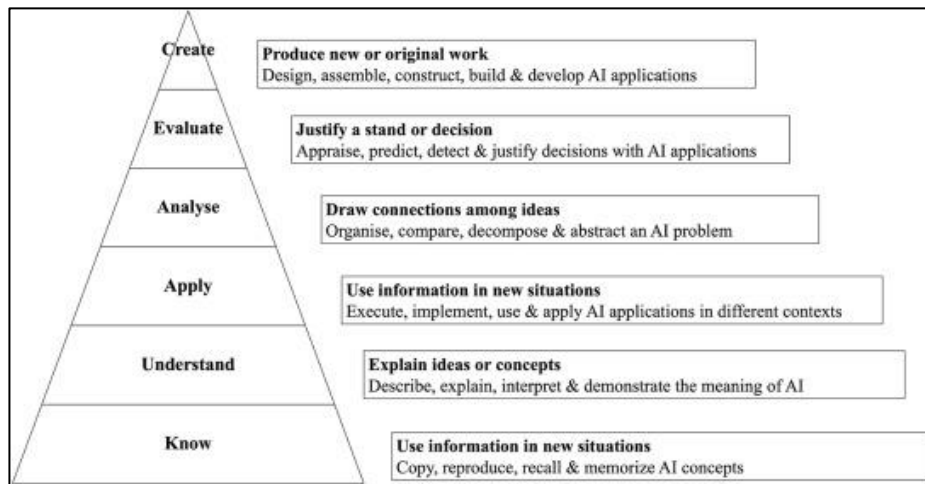


Figure 1: Bloom's Taxonomy and AI literacy (Ng et al., 2021)

Long and Magerko (2020) developed a set of competencies by exploring five themes: What is AI? What can AI do? How does AI work? How should AI be used? and how do people perceive AI?

Table 1. AI literacy competencies framework (Long & Magerko, 2020)

Competency	Interpretation
Recognizing AI	Distinguish between technological artifacts that use and do not use AI
Understanding Intelligence	Critically analyze and discuss features that make an entity "intelligent", including discussing differences between human, animal, and machine intelligence
Interdisciplinarity	Recognize that there are many ways to think about and develop "intelligent" machines. Identify a variety of technologies that use AI, including technology spanning cognitive systems, robotics, and ML
General vs. Narrow	Distinguish between general and narrow AI
AI's Strengths & Weaknesses	Identify problem types that AI excels at and problems that are more challenging for AI. Use this information to determine when it is appropriate to use AI and when to leverage human skills
Imagine Future AI	Imagine possible future applications of AI and consider the effects of such applications on the world
Representations	Understand what a knowledge representation is and describe some examples of knowledge representations
Decision-Making	Recognize and describe examples of how computers reason and make decisions
ML Steps	Understand the steps involved in machine learning and the practices and challenges that each step entails
Human Role in AI	Recognize that humans play an important role in programming, choosing models, and fine-tuning AI systems
Data Literacy	Understand basic data literacy concepts such as those outlined in

Learning from Data	Recognize that computers often learn from data (including one's own data)
Critically Interpreting Data	Understand that data cannot be taken at face-value and requires interpretation. Describe how the training examples provided in an initial dataset can affect the results of an algorithm
Action & Reaction	Understand that some AI systems have the ability to physically act on the world. This action can be directed by higher-level reasoning (e.g. walking along a planned path) or it can be reactive (e.g. jumping backwards to avoid a sensed obstacle)
Sensors	Understand what sensors are, recognize that computers perceive the world using sensors, and identify sensors on a variety of devices. Recognize that different sensors support different types of representation and reasoning about the world
Ethics	Identify and describe different perspectives on the key ethical issues surrounding AI (i.e. privacy, employment, misinformation, the singularity, ethical decision making, diversity, bias, transparency, accountability)
Programmability	Understand that agents are programmable

AI literacy consists of four key dimensions. The cognitive dimension refers to knowledge about basic AI concepts. The metacognitive dimension describes the ability to apply AI tools in problem-solving. The affective dimension covers the psychological readiness of citizens to work with AI. The social dimension covers how well-informed citizens can use AI to address societal challenges (Figure 2).

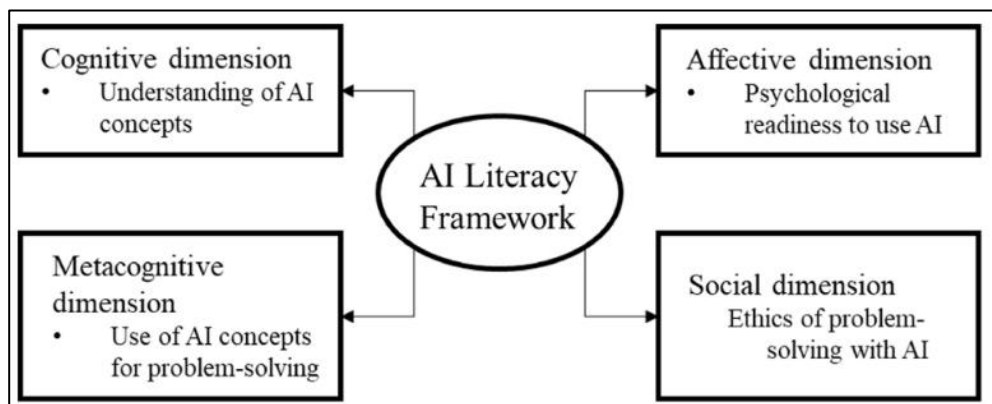


Figure 2: Four dimensions of the AI literacy framework (Kong et al., 2024)

AI literacy includes three essential characteristics: strategic, task-related, and individual. The strategic features involve a deep understanding of AI theories and foundational concepts that allow individuals to understand the big picture about AI in different contexts. Task-related characteristics focus on the skills and knowledge necessary to effectively engage with AI systems, enabling individuals to utilize AI tools and technologies to accomplish specific tasks. Individual characteristics stress attitudes that individuals should cultivate toward these AI technologies and their use, thus allowing them to reflectively form a considered view about the place of AI in society (Figure 3).

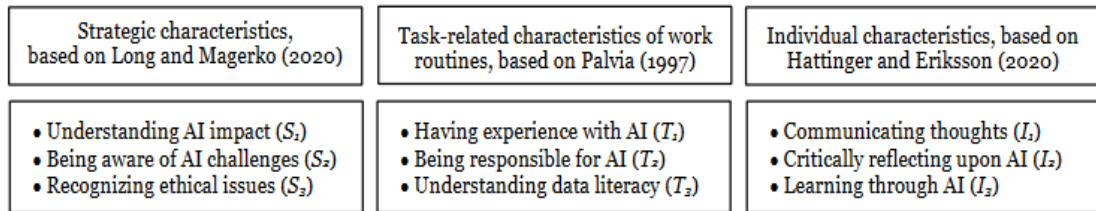


Figure 3: Critical AI literacy (Heyder & Posegga, 2021)

AI Literacy set of Dimensions for LIS Students

Based on the KSAVE (Knowledge, Skill, Attitude, Value, Ethic) theory (Rethinking ICT Literacy: From Computer Skills to Social Network Settings - ScienceDirect, n.d.) and Bloom's taxonomy, along with research findings from scholars such as Huang Ruhua (Huang et al., 2024), LI et al. (2024), Zhang et al. (2022), and Zheng et al. (2021), a preliminary set of dimensions for AI literacy among LIS undergraduate students has been developed (see Table 2).

Table 2: AI literacy competencies framework of LIS student

First Dimension	Second Dimension	Explanation
AI Knowledge	Basics	Basic understanding of AI concepts, principles, technologies, applications, history, and future developments, and their impact on society and humanity
	Specialized Knowledge	Understanding of scientific advances, industry trends, specific applications, and future developments of AI in the context of library, intelligence, and archives
	Scientific Research Knowledge	Knowledge of AI applications and developments in scientific research
AI Skills	Use of Skills	Capability to apply AI effectively in study, life, and research to enhance efficiency and problem-solving.
	Analytical and Evaluation Skills	Ability to critically assess AI-provided information and make informed judgments
	Developing and Creating Skills	Using AI to develop technology and innovate content Design, develop, and iterate on AI applications
AI Attitude	Lifelong Learning	Commitment to continuously acquiring AI knowledge relevant to work, life, and research needs
	Critical Thinking	Maintaining independent judgment and critical thinking
	Innovative and Creative Thinking	Leveraging personal creativity to drive innovation
AI Ethics	Equity and Inclusion	Avoiding discriminatory bias
		Respecting cultural diversity
		Supporting disadvantaged groups
	Manageable and Reliable	AI design is transparent and interpretable

		Compliance with AI accountability
	Law and Ethics	Compliance with laws and norms such as the Privacy Protection Act, Intellectual Property Act, and the Code of Academic Ethics
		Adherence to socially acceptable ethical norms and values

CONCLUSION

AI literacy education for students majoring in library and information science in China will be significantly helpful in improving the employment satisfaction and competitiveness of graduates and promoting industrial upgrading. Several important issues need to be discussed regarding this matter. First is the continuity of the theoretical research on AI literacy, in which clarification must be made regarding its relations with other dimensions of information technology literacy. Additionally, elaborating on the literacy frameworks indicates the meaning of each dimension in the system and establishes the priority for its development. Moreover, cooperation between libraries, governments, society, enterprises, and universities is needed to ensure they all work together to educate students on AI literacy. Since AI is an interdisciplinary subject, support from professionals of different academic backgrounds is highly required to implement AI literacy education effectively.

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