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Scaling Artificial Intelligence Literacy

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Scaling Artificial Intelligence Literacy

Full research paper

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Abstract

The specific facets of artificial intelligence (AI) and the human-like nature of generative AI present challenges, such as the changing dynamics of agency, that must be addressed. With rapid technological advancements and increasing speed of AI adoption, non-experts need to become AI literate. However, a comprehensive summary of the manifold elements of AI literacy has not yet been elaborated. This work follows the tradition of taxonomy development in information systems research. Thus, an AI literacy taxonomy is developed based on a literature review and supplementary content from AI online courses and validated through interviews with AI leaders. The artifact is organized into knowledge and skills dimensions regarding technical specialties, technology management, business function, and interpersonal aspects. It differentiates between comprehension, use, and specialization constructs, which align with cognitive processes. In total, 21 dimensions and 58 characteristics specify AI literacy, providing a holistic overview of its complex nature.

Keywords Artificial Intelligence, Generative Artificial Intelligence, AI Literacy, Digital Literacy, Literature Review

1 Introduction

In various contexts – whether through social media usage, interactions with voice assistants in customer service hotlines, or exchanges with conversational artificial intelligence (AI) like ChatGPT – the accessibility of AI and its integration into our daily lives underscore the increasing necessity for skills in managing user-facing technology, known as socio-technical competencies (Long and Magerko 2020; Sarker 2021; Stolpe and Hallström 2024). These skills are essential not only for developers but also for users, who are evolving from so-called AI immigrants to AI natives (Wang et al. 2023). The three distinct facets of AI, namely increased autonomy, learning ability, and inscrutability, pose challenges for non-experts in human-AI interaction (Berente et al. 2021; Pinski et al. 2023). The nature of cognitive computing systems, which include human-like abilities and differ from traditional technologies by adapting to situations and perceiving their environment, creates unique challenges. These systems also foster a new era of human-machine interaction, further contributing to the complexity of these issues. (Pinski and Benlian 2023; Schuetz and Venkatesh 2020) This development highlights that literacy in handling AI is among the critical competencies required in the 21st century (Celik 2023; Knoth et al. 2024; Long and Magerko 2020; Wang et al. 2023).

The information systems (IS) research community recognizes the importance of the discourse around AI literacy and has called for greater familiarity with AI competencies, a need heightened by the recent emergence of generative AI (genAI) models (Knoth et al. 2024). Scholars divided this research stream into two main areas, focusing on different age groups: one emphasizing the teaching of AI literacy in schools and universities (e.g., Chiu et al. 2024; Fleischmann et al. 2024) and another one concentrating on AI literacy education for non-experts in the professional world (e.g., Chandra et al. 2024; Pinski et al. 2024). The latter has been underexplored and given lower priority than educational settings (Cetindamar et al. 2024; Pinski et al. 2024). Despite the recognition of its relevance, the precise definition of AI literacy remains to be determined. The ambiguity is reflected in numerous calls for future research suggestions, which this contribution seeks to respond to. For instance, Ng et al. (2021) argue that understanding technological advancements and being equipped with abilities for the AI era are inadequately addressed. Pinski et al. (2023) specify the need to explore how to promote AI competencies among individuals without a technical background, including the definition of relevant skills. Similarly, Chandra et al. (2024) explicitly state that AI literacy is fundamentally underexplored despite its significant importance. Cetindamar et al. (2024) advocate applying diverse methodologies to enhance understanding of AI literacy. Therefore, this publication aligns with the emerging research stream on fostering AI literacy among individuals with limited technical expertise (Long and Magerko 2020).

In this study, AI literacy will be conceptualized generically, following the approach of Knoth et al. (2024) rather than being tailored to a specific context. AI literacy is thus defined as a socio-technical competence that explains which knowledge and skills to acquire at a high level. To accomplish this, a taxonomy is developed as a typical artifact of a design science research (DSR) project within IS research (Nickerson et al. 2013). The extended taxonomy development process (ETDP) by Kundisch et al. (2022), which incorporates the DSR steps of Peffers et al. (2007), is employed. The development of the AI literacy taxonomy is based on a structured literature review (Webster and Watson 2002), established in iterative cycles and enhanced with content from widespread AI literacy online courses (DeepLearning.AI 2024; Google Cloud Training 2024; IBM 2024). The taxonomy is validated through interviews with experienced AI leaders.

The conceptualized AI literacy taxonomy is structured into three constructs: comprehend, use, and specialize, which summarize the revised taxonomy of Bloom (Krathwohl 2002). These constructs are further divided into the four IS-professional knowledge/skills categories proposed by Lee et al. (1995) followed by specific dimensions, totaling 21, with corresponding characteristics, totaling 58. This taxonomy contributes to existing knowledge by addressing the need for and concretizing the necessary competencies in AI literacy (Almatrafi et al. 2024).

2 Research Context

2.1 The Rise of Artificial Intelligence

The pace and implications of shifts across many areas of our daily lives due to AI's ongoing development, optimization, and expansion are immense (Feuerriegel et al. 2024; Ooi 2023). The significant milestones illustrate how the intervals between advancements are shrinking: In 1950, a publication first posed the question of whether machines can think and introduced a method to assess a machine's human-like thinking (Turing 1950). In 1997, a computer defeated the world chess champion in a chess

game, demonstrating that machines could possess human capabilities (Hsu 2002). The ability of AI to combine complex language processing with knowledge retrieval in question-answering was demonstrated in 2011 when IBM Watson won the television game Jeopardy (Ferrucci 2012). Variational autoencoders, introduced in 2013, advanced the development of deep learning (DL) (Kingma and Welling 2013), and in 2014, generative adversarial nets (GAN) were proposed for the first time (Goodfellow et al. 2014). Three years later, in 2017, the transformer architecture was introduced, enabling advances in natural language processing (Vaswani et al. 2017). Initial steps with generative pre-trained transformers (GPT) began in 2018, notably with the introduction of Google's bidirectional encoder representations from transformers (BERT) (Devlin et al. 2018). In 2020, researchers presented retrieval-augmented generation (RAG), combining strengths from pre-trained and generative AI models (Lewis et al. 2020). Ultimately, in 2022, OpenAI launched ChatGPT, a large language model (LLM) that reached over 100 million registered users worldwide within two months after its launch (Hu 2023).

Such acceleration in AI advancements highlights the necessity of focusing on literacy to enable a reflective and informed approach to its use. A universally accepted definition of AI and its sub-concepts does not exist; instead, the perception of these concepts is multifaceted and inconsistent (Berente et al. 2021). Figure 1 aims to establish a common high-level understanding, which serves as a foundation for discussing the necessity and implications of AI literacy. AI literacy subsequently includes literacy about ML, DL, and genAI, which are core elements in the fourth industrial revolution (Sarker 2021).

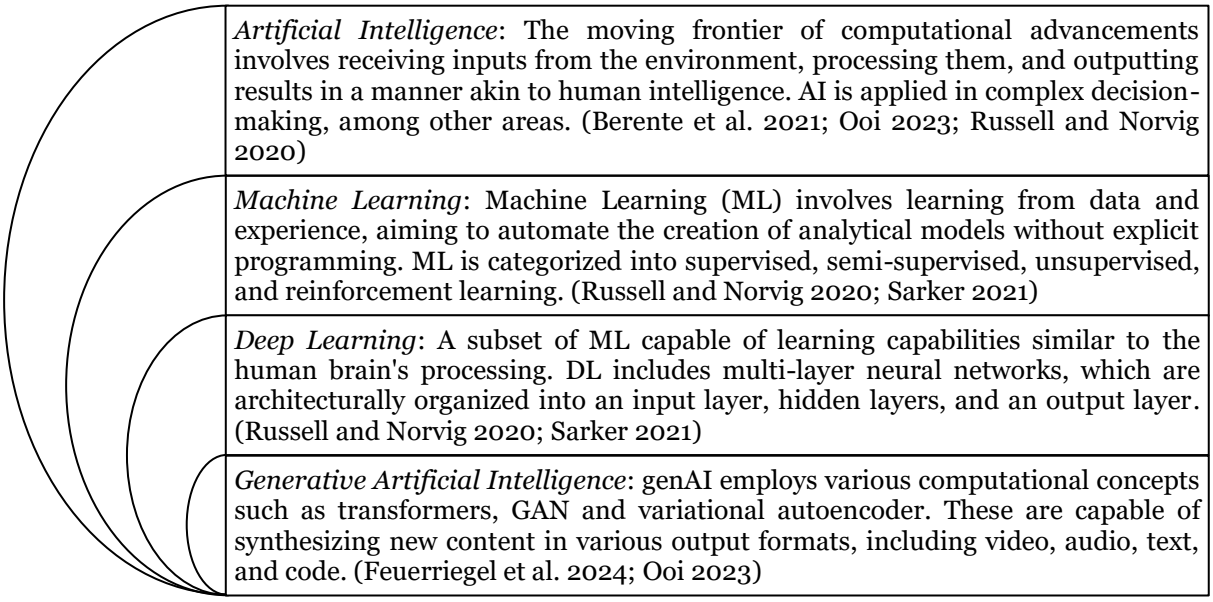


Figure 1. Glossary for Artificial Intelligence and its Key Subsets

2.2 Changes in Skills and Knowledge Requirements

Originally, literacy implied the ability to read and write; however, with technological advancements, the concept of literacy has expanded (Kong et al. 2021). The accelerated developments outlined in Chapter 2.1 emphasize the importance of acquiring competencies beyond high-level technical knowledge. There is a consensus that AI literacy is particularly relevant for non-experts who have not undergone formal training in AI (Knoth et al. 2024). In addition to ethical aspects, understanding potential biases and the ability to evaluate where the use of AI is meaningful and where it is not must also be fostered, to name just a few examples. This comprehensive understanding feeds into the definition of AI literacy (Table 1), which is considered to be a complex phenomenon (Long and Magerko 2020).

Term	**Definition**
AI Literacy	Human socio-technical competencies encompass exploiting AI efficiently and ethically and understanding human-AI interaction (Celik 2023; Pinski and Benlian 2023). Moreover, the reflective application and evaluation of AI in any context in a responsible manner, along with the ability to collaborate and augment human capabilities, are central (Chiu et al. 2024; Long and Magerko 2020; Pinski et al. 2024). Fundamental literacy is critical to cultivating awareness of one's use (Wang et al. 2023).

Table 1. Understanding of AI Literacy

The literature identifies other literacies interlinked with AI literacy; Table 2 provides an overview of those literacies that must also be considered when reflecting on AI literacy.

Term	**Definition**
Information Literacy	Information literacy encompasses the reflective access, evaluation, organization, integration, and use of relevant information (Spitzer et al. 1998).
Digital Literacy	Digital literacy entails dynamic interaction with integrated interactive media in an immediate manner (Gilster 1997). In the current context, these interactive media are specified as computational devices. (Long and Magerko 2020)
Data Literacy	Data literacy includes understanding data types, privacy issues, and potential biases. It is crucial to understand the processes related to data flows, such as data collection and preprocessing, in order to effectively interpret data. (Chandra et al. 2024)

Table 2. Literacies related to AI Literacy

In summary, a comprehensive understanding enables responsible and informed involvement in an information-rich, technologically advanced world. This leads to the core objectives of literacy, which include these key elements: AI literacy seeks to 1) empower individuals by 2) building knowledge for informed decision-making, 3) fostering understanding of ethical discussions, and 4) promoting inclusive access (Chandra et al. 2024). The latter's relevance is evident in the so-called digital divide, which acknowledges that unequal access to technologies results in inequalities in literacy (Celik 2023).

In a time when AI is increasingly becoming integrated into our daily lives and professional environments (Davenport and Ronanki 2018), it is pivotal to address the changes in skills and knowledge requirements (Wang et al. 2023). In this context, the phenomenon known as the 'AI effect' is present: once an AI application is accepted in a specific context, the differentiation between human and machine interaction becomes less pronounced, mainly due to seamless integration, making it difficult to distinguish between non-AI and AI systems (Celik 2023; Stolpe and Hallström 2024). An example of such differentiation represents communication with robots, where users often interact with social logic and reflect less on the fact that they are engaging with a machine (Wang et al. 2023). Researchers describe this evolution as a 'society permeated' by AI (Knoth et al. 2024). Consequently, regardless of our affinity for technology, we encounter AI daily. Thus, extending the fundamental skills and knowledge requirements previously defined for IS professionals to non-experts is advisable. Lee et al. (1995) identified four different areas that provide a holistic high-level understanding of what must be addressed: technical specialties, technology management, business functional, as well as interpersonal and management knowledge / skills. Further, it is necessary to understand how human cognitive processes work. The present approach considers the sequential cognitive process, clustered into six phases: remembering, understanding, applying, analyzing, evaluating, and creating (Krathwohl 2002).

The human-AI collaboration, addressed in the growing research stream of IS research, is intensified by the 'manifold human features' (Pinski et al. 2024). It has been noted that increased AI competence positively affects human-AI interaction (Wang et al. 2023). This confirms the importance of AI literacy. In any case, the relationship between users and AI is altered or intensified; however, this does not initially imply a widespread workforce replacement but rather an enhanced collaboration (Pinski et al. 2023). Consequently, the need for individuals without a technical background to acquire basic AI literacy becomes even more pronounced. AI literacy can be supportive in increasing productivity, facilitating communication, and boosting creativity (Chandra et al. 2024). Further need for literacy is underscored by the distinct facets of AI, which must not be overlooked (Berente et al. 2021). The autonomy of AI, mainly through autonomous decision-making, enables actions without human involvement (Baird and Maruping 2021). Additionally, the learning ability of AI enables an increase in complexity, making comprehensibility more difficult. Lastly, inscrutability is evident in the opacity of AI outputs, making interpretability further challenging (Berente et al. 2021).

The conclusion is that becoming informed is critical. Online courses are popular today, with many focusing explicitly on teaching AI literacy (e.g., DeepLearning.AI 2024; Google Cloud Training 2024; IBM 2024). This evolution emphasizes that AI literacy is considered a core competency in the digital age, enabling individuals to harness AI's potential and engage with it reflectively (Chandra et al. 2024). Knoth et al. even describe AI literacy as 'a fundamental skill, similar to other essential skills for lifelong learning' (2024).

3 Research Method

3.1 Specification of the Taxonomy Design Process

To conceptualize AI literacy, a taxonomy is developed by applying the extended taxonomy design process (ETDP) by Kundisch et al. (2022), based on the taxonomy development method by Nickerson et al. (2013). This approach is rooted in Design Science Research (DSR), with the taxonomy serving as the research artifact (Peffers et al. 2007), embedded within the so-called problem and solution space (vom Brocke et al. 2020). Taxonomies, as models, are a common artifact in IS research and can be iteratively developed through the ETDP (Kundisch et al. 2022). Three properties are assigned to them: 1) a representation of the existing compact understanding, 2) a reduction of the essential elements, and 3) a pragmatic description of the phenomenon (Kundisch et al. 2022). Based on this, it can be concluded that the research endeavor is adequately addressed in the present case. Taxonomies are characterized by five qualitative attributes: conciseness, robustness, comprehensiveness, extensibility, and explanatory power (Nickerson et al. 2013). Meeting this standard requires systematic rigor (vom Brocke et al. 2009). Table 3 details the coherent approach.

Stage (Kundisch et al. 2022)	**Specification in the Given Taxonomy Development Context**
Identification of the problem and motivation	Elaborated in Chapter 1: - The observed phenomenon with the targeted user group reveals no common understanding of AI literacy for non-experts. - The intended purpose is to obtain a holistic comprehension of AI literacy and thoroughly understand its various characteristics.
Definition of objectives of the solution: Determine meta-characteristics and ending conditions	Meta-characteristics: - These refer to the four critical skills and knowledge requirements categories according to Lee et al. (1995), which emphasize IS competencies in a business environment, see Chapter 2.2. After the first iteration, the meta-characteristics were separated into two levels for enhanced clarity and consistency: the categories according to the initial framework and the sub-clustering of these into dimensions (see Table 5). Ending Conditions: - Following Nickerson et al.'s (2013) recommendations, the ending conditions include subjective criteria, such as the taxonomy being concise, robust, comprehensive, extendible, and explanatory, as well as objective criteria, including the uniqueness of dimensions and characteristics.
Design and Development	Empirical-to-conceptual iterations: - First iteration: Coding the 15 publications (Chapter 3.2) resulted in 51 characteristics inductively allocated to the four meta-characteristics. - Second iteration: The specification of the meta-characteristics involved subdividing the four categories into 18 dimensions, which were then mapped to the corresponding characteristics. - Third iteration: Dividing the model into three constructs inspired by the revised version of Bloom's taxonomy (Krathwohl 2002) enhances the logic. A simplified view was achieved by merging remember and understand into comprehend, apply and analyze into use, and evaluate and create into specialize. Thus, each construct includes the meta-characteristics along with their respective dimensions and characteristics. Conceptual-to-empirical iteration: - Fourth iteration: The conceptualization of additional dimensions and characteristics incorporating the specificities of genAI creates a more comprehensive model. Refinement was achieved by including insights from the top three rated courses on Coursera, an online learning platform. The considered courses are 1) Introduction to Generative AI (Google Cloud Training 2024), 2) Generative AI for Everyone (DeepLearning.AI 2024), and 3) Generative AI: Introduction and Application (IBM 2024). Coding these courses added three new dimensions within the technology management knowledge/skills category, all of

	which relate to a tool-based perspective. The revised taxonomy consists of 21 distinct dimensions and 58 characteristics.
Demonstration	Objective ending conditions were assessed according to the taxonomy design recommendations of Kundisch et al. (2022).
Evaluation	Two semi-structured interviews with experienced digital leaders were conducted, using open questions to confirm subjective ending conditions for promoting AI literacy. The interviewees included a senior digital strategist and innovation manager, as well as an AI solution architect from a large retail company. The structure of the taxonomy was fully confirmed; one addition was made regarding the characteristics of the dimensions 'AI-driven optimization'. Their proposed inclusion of quality improvement followed a careful review of the literature.
Communication	Chapter 4 contains the results.

Table 3. Taxonomy Development Process

3.2 Literature Search Process and Its Analysis

The literature search process is based on the recommendations of vom Brocke et al. (2009) and Webster and Watson (2002). Table 4 summarizes the design and development process concerning identifying publications used for the first three iterations of the taxonomy (see Table 3). Multiple databases were deliberately accessed to complement the records from the initial step, which focused on IS research. The combined keyword strategy, including both the entire term 'artificial intelligence' and the abbreviation 'AI', was employed to account for the frequent use of the acronym. Publications were excluded during the abstract and full-text review if they, among others, focused solely on a specific industry.

Phase	**Description**	**Sum**
Identification	Records identified with the search term 'Artificial Intelligence' Literacy OR AI Literacy in proceedings of the International Conference on Information Systems (ICIS) and European Conference on Information Systems (ECIS) from 2022 to 2024.	82
	Records identified with the search term 'Artificial Intelligence' Literacy OR AI Literacy in databases EBSCOhost, ProQuest, and Web of Science, peer-reviewed only and limited to full-text availability.	969
	Potential papers	1051
Screening	Eligible papers after removing duplicates	907
	Eligible papers after reviewing the abstract	69
	Eligible papers after full-text examination	11
	+Backward-search	3
	+Forward-search	1
Analyzing	Included publications considered for open/axial/selective coding	15

Table 4. Literature Search Process

Atlas.ti was used as a supporting software for qualitative research analysis. 158 open codes were generated from the empirical-to-conceptual iterations and 56 from the conceptual-to-empirical iteration. Axial coding was applied to identify relationships, followed by selective coding to identify themes from the axial codes, thereby achieving systematic rigor (Strauss and Corbin 1998).

4 Results

4.1 Holistic AI Literacy Taxonomy

From the highlighted need driven by the accelerated advancements in Chapter 2.1 and the changes in skills and knowledge requirements emphasized in Chapter 2.2, a comprehensive AI literacy taxonomy (Table 5) emerges from the applied research method detailed in Chapter 3.

	Categories	Dimensions	Characteristics			
Comprehend	Technical specialties knowledge/ skills	AI Basics	Conceptual Understanding of AI	Conceptual Understanding of ML	Conceptual Understanding of DL	Conceptual Understanding of genAI
		Data Fundamentals	Types of Data	Data Sources	Data Quality	
	Technology management knowledge/ skills	AI Tools and Systems	Overview of Tools	Application Contexts		
		Ethical Principles	Ethical Foundations	Legal Frameworks	Societal Impacts	
	Business functional knowledge/ skills	AI Business Fundamentals	Identification of AI Potentials	Industry-Specific Use Case Understanding		
	Interpersonal and management knowledge/ skills	Understanding Human Role in AI	Decision-Making Processes	Interaction with AI-Systems		
		Fostering AI Engagement	Awareness	Interest	Persistence	
Use	Technical specialties knowledge/ skills	Applied AI Concepts	Understanding AI Architecture	Comparison of Different Models		
		Data Management	Data Processing	Data Maintenance		
	Technology management knowledge/ skills	Utilizing AI Tools	Selection of AI Tools	Operational Competency		
		Ethical AI Use	Data Privacy	Transparency	Responsible Use	
	Business functional knowledge/ skills	AI-Driven Optimization	Evaluation of Use Cases for Efficiency Gains	Evaluation of Use Cases for Cost Savings	Evaluation of Use Cases for Quality Enhancements	
	Interpersonal and management knowledge/ skills	AI Agency	Exercise Agency	Decision-Making Authority		
		AI Implementation	Contextual Understanding	Adoption Motivation	Abstraction	
Specialize	Technical specialties knowledge/ skills	AI Model Assessment	Evaluation of Model Results	Monitoring of Model Results	Interpretation of Model Results	
		Advanced Data Handling	Data Analysis	Complex Data Processing	Data Integration	
	Technology management knowledge/ skills	Amplifying Potential of AI Tools	Specific Context Extensions	Mastering AI Capabilities		
		AI Governance	Compliance	Inter-disciplinarity	Explainability	Expansion of Ethical Guidelines
	Business functional knowledge / skills	AI Strategy	Data-Driven Decision Making	Scalability of AI Solutions	Integration into Corporate Strategy	Domain-Specific Applications
	Interpersonal and management knowledge / skills	Advanced AI Collaboration	Co-Create with AI	Task-Augmentation		
		Reflective AI Practices	Critical Thinking	Self-Reflection	Contextual Problem-Solving	Responsibility

Table 5. AI Literacy Taxonomy

The design of the taxonomy, with its four specifications constructs, categories, dimensions, and characteristics, allows for analysis from different perspectives. For those primarily interested in an

initial exploration of AI to gain a broad understanding, the rows of the 'comprehend' construct serve as a guide. If active use and engagement with AI are wished for, the constructs 'comprehend' and 'use' with their associated categories, dimensions, and characteristics are relevant. The comprehensive AI literacy framework, including the 'specialize' construct, should be considered if specialization is the goal. A second perspective is to view the taxonomy regarding its relevance to specific roles. For instance, if the focus is on technical specialties knowledge, the dimensions and characteristics within the 'comprehend', 'use', and 'specialize' constructs related to this category should be considered relevant. In this specific case, the dimensions to be considered are 'AI Basics', 'Data Fundamentals', 'Applied AI Concepts', 'Data Management', 'AI Model Assessment', and 'Advanced Data Handling'. Such a structure creates a comprehensive yet flexibly applicable taxonomy that aims to meet various needs. This approach aligns with Chandra et al. (2024), who note that different levels of understanding of AI characterize the continuum of AI literacy. Other authors, such as Almatrafi et al. (2024), also emphasize that competency development should range from fundamental AI understanding to multiple levels of interaction and evaluation.

4.2 Comprehend Construct: Initiating the Sequential Cognitive Process

AI Basics: To build a foundation in AI literacy, understanding the basic concepts related to AI as a frontier, ML, and the subdomain of DL is indispensable (Chandra et al. 2024). This involves acquiring a general conceptual understanding (Knoth et al. 2024; Stolpe and Hallström 2024), including comprehending AI's distinct characteristics (Pinski and Benlian 2023). Considering the advanced generation capabilities of genAI, acquiring a fundamental conceptual understanding becomes even more significant (IBM 2024).

Data Fundamentals: Knoth et al. (2024) highlight the necessity of distinguishing between different types of data, such as images, text, or other forms; the nature of data can be crucial for its subsequent use. Moreover, especially concerning RAG, it is essential to understand where data can be sourced from (Google Cloud Training 2024). The internal and external capabilities that Koukouvinou et al. (2023) identify as an aspect of data knowledge understanding align with this need. The data quality characteristic includes awareness of potential output biases (Chandra et al. 2024).

AI Tools and Systems: Given the increasing use of LLMs, gaining an overview of the rapidly evolving tool landscape is necessary. Whether it is ChatGPT, Copilot, or Midjourney, to name a few examples, these tools serve different purposes and can range from standalone solutions to an interconnected ecosystem of AI applications. Thus, having a comprehensive understanding is valuable for assessing where AI can offer benefits and where it may or may not add value. (DeepLearning.AI 2024)

Ethical Principles: A key determinant of AI literacy is the understanding of ethical foundations such as fairness and accountability, which should be seen as fundamental principles for AI usage (Celik 2023; Chandra et al. 2024; Pinski and Benlian 2023). Additionally, understanding data privacy issues, including legal implications, is crucial to ensure that an AI-literate person uses the technology appropriately and correctly (Wang et al. 2023). The societal impact, including psychological implications like trust issues (Chandra et al. 2024), socio-emotional and socio-cultural abilities (Knoth et al. 2024), must be taken into account when considering ethical principles in an AI-infused world. Furthermore, socio-ethical understanding, such as the role of humans in AI, is relevant to the societal impact (Stolpe and Hallström 2024).

AI Business Fundamentals: The ability to prioritize the business need and then identify functionally valuable use cases is essential. This approach enables the creation of future scenarios where AI can contribute to problem-solving (Knoth et al. 2024). It is required to focus on the specific AI needs of an industry or sector, as these can vary significantly and must always be considered within their respective contexts (IBM 2024; Knoth et al. 2024).

Understanding Human Role in AI: The enhanced collaboration between humans and AI (Chandra et al. 2024) necessitates understanding the input, processing, and output in decision-making processes (Almatrafi et al. 2024). There is a need for supervision and the involvement of human actors, often referred to as a 'human in the loop' when interacting with AI systems (Pinski and Benlian 2023). This is particularly important as we interact with AI daily, sometimes even unconsciously (IBM 2024; Stolpe and Hallström 2024).

Fostering AI Engagement: Awareness involves the identification of AI during the use of AI-related applications (Wang et al. 2023) and is understood as a cognitive process (Celik 2023). Personal motivation in expanding knowledge and continuous learning includes the intention and effective engagement with AI (Celik 2023). Positive factors such as self-learning ability (Cetindamar et al. 2024), emotional attitudes (Almatrafi et al. 2024), intrinsic motivation, and self-efficacy (Knoth et al. 2024) all

contribute to this process. Persistence manifests as resilience (Knoth et al. 2024) and continuous learning engagement (Stolpe and Hallström 2024).

4.3 Use Construct: Advancing in the Sequential Cognitive Process

Applied AI Concepts: The computational concepts mentioned in Chapter 2.1, such as transformers, GAN, and variational autoencoders, are relevant at a high level to contextualize the outputs even for non-experts (IBM 2024). Additionally, in Google's introductory course, the importance of the ability to describe different (gen)AI model types is highlighted (Google Cloud Training 2024).

Data Management: In managing data flows, a distinction should generally be made between, on the one hand, knowledge related to processing, which includes preparation or pre-processing and the selection of appropriate datasets (Chandra et al. 2024; Long and Magerko 2020), and, on the other hand, maintenance. The latter involves addressing the limitations of datasets (Long and Magerko 2020).

Utilizing AI Tools: Selecting appropriate AI tools involves identifying and exploring suitable applications for a particular business context (DeepLearning.AI 2024). In addition to proficiency in choosing, operational competencies are indispensable to maximize the benefits of the technical elements. For LLMs, this mainly includes prompt engineering (DeepLearning.AI 2024; Google Cloud Training 2024; IBM 2024). The more effectively the context is provided, particularly for such AI applications, the greater the benefit derived (DeepLearning.AI 2024).

Ethical AI Use: In dealing with AI, it is imperative to protect the privacy of personal data (Knoth et al. 2024). It is necessary to heighten this awareness, understand the disclosure of decision-making processes in AI systems (Ng et al. 2021), and address the black box problem (Long and Magerko 2020) regarding transparency. Responsible use includes accountability (Celik 2023; Chandra et al. 2024) and awareness of personal responsibilities (Wang et al. 2023).

AI-Driven Optimization: Evaluating use cases from a business functional perspective is relevant to grasping the potential benefits of AI-infused processes and products. Currently, there are three main drivers: 1) efficiency gains that can be achieved through workflow optimization (Chandra et al. 2024), 2) cost savings that can be realized through productivity gains (Fleischmann et al. 2024), and 3) improvements in the quality achieved in processes, products, or services (Interviewee 2).

AI Agency: In the context of the shifting human-AI relationship, collaboration appears similar to a principal-agent dynamic, where the human is not necessarily the agent at all times (Lee and Park 2023). It is vital to be aware of these dynamics to choose an informed approach. Fleischmann et al. (2024) also define exercising agency as an essential capability. After all, in collaboration, it is crucial to establish a clear understanding of decision-making authority (Lee and Park 2023) to ensure transparency and accountability.

AI Implementation: In AI implementation projects, it is critical to establish a context-specific understanding (Knoth et al. 2024). Additionally, adoption motivation manifests in adaptability and cognitive absorption, which serve as motivating factors in expressing intrinsic motivation (Celik 2023). Moreover, solving problems in a structured manner, aligned with computational thinking skills, aids in abstracting AI initiatives (Celik 2023; Ng et al. 2021; Stolpe and Hallström 2024).

4.4 Specialize Construct: Mastering the Sequential Cognitive Process

AI Model Assessment: Model evaluation addresses hallucinations (DeepLearning.AI 2024) and is considered one of the high-order thinking skills (Wang et al. 2023). Through continuous cross-checking (Lee and Park 2023), AI systems can be supervised, and if necessary, algorithms can be overwritten (Knoth et al. 2024). The ability to interpret model results enables critical assessments of the outputs (Pinski et al. 2024). Additionally, the skills of interpretation and synthesizing (Chandra et al. 2024), and thus the ability to examine, are closely linked to explainable AI (Cetindamar et al. 2024).

Advanced Data Handling: The specialization phase in data handling involves advanced data analysis, including quality checks and reliability measurements (Chandra et al. 2024). Additionally, complex data processing, also known as AI processing knowledge (Pinski and Benlian 2023), is essential, particularly for handling large datasets. Further, data integration within organizational value chains (Lee and Park 2023) is another central aspect of proficiency in data handling.

Amplifying Potential of AI Tools: Context-specific applications and dedicated enhancements can create increased value. An example of this is the integration of LLMs into larger software automation projects, such as optimizing email routing (DeepLearning.AI 2024). Additionally, the potential of genAI

capabilities, such as text and music generation, should be fully leveraged with meaningful use cases (IBM 2024).

AI Governance: Compliance with legal and regulatory requirements (Chandra et al. 2024) is essential. Accordingly, integrating various disciplines is critical to overcoming cultural and linguistic barriers (Chandra et al. 2024), and combining multiple technologies is necessary (Long and Magerko 2020). When addressing ethical issues, the emphasis should be on transparency to ensure clarity in AI systems' decision-making processes (Knoth et al. 2024); at the same time, ethical guidelines should be considered living documents, continuously expanded through ethical behavior, also referred to as ethical courage (Knoth et al. 2024).

AI Strategy: Based in part on AI-provided information, business decisions can be made (Lee and Park 2023), thus achieving data-drivenness. The scalability of AI solutions includes systems thinking across individual applications (Stolpe and Hallström 2024), which must be rooted in strategic thinking. Integrating AI into the real-world challenges companies face aligns with this approach (Almatrafi et al. 2024). Ultimately, an AI strategy also includes the application of AI in emerging scenarios (Knoth et al. 2024) and domain-specific contexts (Pinski and Benlian 2023).

Advanced AI Collaboration: Co-creation involves seamless collaboration in day-to-day activities (Almatrafi et al. 2024) to achieve solutions through joint human-machine efforts (Cetindamar et al. 2024). Task augmentation embodies the enhancement of human capabilities through AI technologies, affecting areas such as creativity, innovation (Chandra et al. 2024), and programming (Long and Magerko 2020).

Reflective AI Practices: Achieving holistic proficiency enables a reflective approach to AI use (Pinski et al. 2024). Additionally, critical thinking allows one to question the trustworthiness of AI-generated results, which is an important trait (Chandra et al. 2024). A self-reflective mindset (Chiu et al. 2024) enables the recognition of the strengths and weaknesses of AI (Almatrafi et al. 2024) and the incorporation of contextual considerations (Stolpe and Hallström 2024) in situational problem-solving. Finally, it is the responsibility of each individual to become informed. (Chandra et al. 2024).

5 Discussion

Informal AI literacy, as advocated by Pinski et al. (2023), has demonstrably positive effects, whether on performance or reflective capacity, to name a few examples. However, AI literacy for non-experts cannot be clearly distinguished from AI literacy for experts, as the boundaries of basic knowledge are not well-defined. Therefore, the present three-tier taxonomy aims to address different needs. For some, AI literacy includes technology-related capabilities (Cetindamar et al. 2024), while for others, the primary focus is on application predominantly (Wang et al. 2023). As outlined in Chapter 4, the dimensions and characteristics of the comprehend construct are understood as the foundational basis of AI literacy. When all three constructs – comprehend, use, and specialize – are considered, the maturity level of AI literacy is naturally higher. In addition to providing a flexible level of detail that serves practical purposes, the theoretical contribution of this taxonomy lies in responding to the call for advancing AI literacy for society (Knoth et al. 2024). It offers a tangible overview of the necessary knowledge aspects and skills. Moreover, representing the findings in a taxonomy aims to adequately orient the focus towards practical skills, as called for by Chandra et al. (2024). The practical relevance lies in its potential usefulness for non-experts to evaluate their coverage of knowledge and skills related to AI. Furthermore, the taxonomy provides organizations with a framework they can leverage to support AI literacy initiatives and skill-up efforts.

The literature review was conducted based on scientific publications. Notably, in the fourth iteration of the taxonomy development (see Table 3), this was supplemented with content from three online courses on genAI, as genAI, with its human-like capabilities and diverse tool landscape, necessitates specific skills and knowledge, where practice currently leads science. However, a limitation of such an approach, which primarily relies on a literature review, is that only a few additional contributions from practice were included, potentially overlooking different perceptions of AI literacy. Furthermore, the process is inherently influenced by the search strings used, which shape the search results. Given the lack of a unified understanding of literacy, as discussed in Chapter 2.2, an incomplete capture of the relevant literature may have occurred.

To address the fifth step necessary for a thorough literature review process, the following future research areas can be pursued as part of a research agenda (vom Brocke et al. 2009; Webster and Watson 2002): 1) To make AI literacy maturity within organizations tangible, the conceptualized taxonomy can be complemented with a corresponding self-assessment, inspired by Wang et al. (2023). 2) Additionally,

the individual characteristics of the AI taxonomy may have different weightings across various industries. Such a follow-up quantitative study would provide intriguing insights into which characteristics dominate for non-experts. 3) A further exploration aimed at closing gaps could involve establishing an AI taxonomy specifically for AI experts. Such an initiative would offer an exciting opportunity to define the competencies and skills required for experts comprehensively.

6 Conclusion

In summary, lifelong learning is non-negotiable. The outlined taxonomy development aims to conceptualize AI literacy to establish a framework that builds on extensive IS research on knowledge and skills in the IS field (Lee et al. 1995). By structuring the taxonomy along the simplified revised cognitive process of Bloom (Krathwohl 2002) and clustering the relevant dimensions and characteristics into the three constructs comprehend, use, and specialize, the adaptable taxonomy can meet various needs. By incorporating online courses on genAI in one of the development iterations, the AI literacy taxonomy also addresses the evolving human-machine interactions due to technological advancements. The AI literacy taxonomy for non-experts intends to provide a concrete, practical, and yet flexible framework, enabling individuals to become AI literate through accessible characteristics.

7 References

Almatrafi, O., Johri, A., and Lee, H. 2024. "A Systematic Review of AI Literacy Conceptualization, Constructs, and Implementation and Assessment Efforts (2019-2023)," *Computers and Education Open* (6).

Baird, A., and Maruping, L. M. 2021. "The Next Generation of Research on IS Use: A Theoretical Framework of Delegation to and from Agentic IS Artifacts," *MIS Quarterly* (45:1), pp. 315-341.

Berente, N., Gu, B., Recker, J., and Santhanam, R. 2021. "Managing Artificial Intelligence," *MIS Quarterly* (45:3), pp. 1433-1450.

Celik, I. 2023. "Exploring the Determinants of Artificial Intelligence (AI) Literacy: Digital Divide, Computational Thinking, Cognitive Absorption," *Telematics and Informatics* (83).

Cetindamar, D., Kitto, K., Wu, M., Zhang, Y., Abedin, B., and Knight, S. 2024. "Explicating AI Literacy of Employees at Digital Workplaces," *IEEE Transactions on Engineering Management* (71), pp. 810-823.

Chandra, P., Dubey, A., Sharma, S. K., and Karsoliya, S. 2024. "A Novel Conceptualization of AI Literacy and Empowering Employee Experience at Digital Workplace Using Generative AI and Augmented Analytics: A Survey," *Journal of Electrical Systems* (20:2), pp. 2582-2603.

Chiu, T. K. F., Ahmad, Z., Ismailov, M., and Temitayo Sanusi, I. 2024. "What are Artificial Intelligence Literacy and Competency? A Comprehensive Framework to Support them," *Computers and Education Open* (6).

Davenport, T. H., and Ronanki, R. 2018. "Artificial Intelligence for the Real World," *Harvard Business Review* (96:1), pp. 108-116.

DeepLearning.AI. 2024. "Generative AI for Everyone." (https://www.coursera.org/learn/generative-ai-for-everyone, accessed July 12, 2024)

Devlin, J., Chang, M. W., Lee, K., and Toutanova, K. 2018. "Bert: Pre-Training of Deep Bidirectional Transformers for Language Understanding," *arXiv preprint,* (1810.04805). (doi: 10.48550/arXiv.1810.04805).

Ferrucci, D. A. 2012. "Introduction to "This Is Watson"," *IBM Journal of Research and Development* (56:3-4).

Feuerriegel, S., Hartmann, J., Janiesch, C., and Zschech, P. 2024. "Generative AI," *Business & Information Systems Engineering* (66:1), pp. 111-126.

Fleischmann, C., Logemann, M. K., Heidewald, J., Cardon, P., Aritz, J., and Swartz, S. 2024. "Fostering GenAI Literacy in Higher Education for Future Workplace Preparedness: A Mixed-Methods Study," *Proceedings of the European Conference on Information Systems (ECIS) 2024*, (5).

Gilster, P. 1997. *Digital Literacy*. New York: Wiley Computer Publications.

Goodfellow, I. J., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A., and Bengio, Y. 2014. "Generative Adversarial Nets," *Communications of the Association for Computing Machinery (ACM)* (63:11), pp. 139-144.

Google Cloud Training. 2024. "Introduction to Generative AI." (https://www.coursera.org/learn/introduction-to-generative-ai, accessed July 12, 2024)

Hsu, F. H. 2002. *Behind Deep Blue: Building the Computer that Defeated the World Chess Champion*. Princeton and Oxford: Princeton University Press.

Hu, K. 2023. "ChatGPT Sets Record for Fastest-Growing User Base - Analyst Note," (https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/, accessed June 15, 2024)

IBM. 2024. "Generative AI: Introduction and Applications." (https://www.coursera.org/learn/generative-ai-introduction-and-applications, accessed July 12, 2024)

Kingma, D. P., and Welling, M. 2013. "Auto-Encoding Variational Bayes," *arXiv preprint,* (1312.6114). (doi: 10.48550/arXiv.1312.6114).

Knoth, N., Decker, M., Laupichler, M. C., Pinski, M., Buchholtz, N., Bata, K., and Schultz, B. 2024. "Developing a Holistic AI Literacy Assessment Matrix - Bridging Generic, Domain-Specific, and Ethical Competencies," *Computers and Education Open* (6).

Kong, S., Cheung, W. M., and Zhang, G. 2021. "Evaluation of an Artificial Intelligence Literacy Course for University Students with Diverse Study Backgrounds," *Computers and Education: Artificial Intelligence* (2).

Koukouvinou, P., Ademaj, G., Sarker, S., and Holmström, J. 2023. "Ghost in the Machine: Theorizing Data Knowledge in the Age of Intelligent Technologies," *Proceedings of the International Conference on Information Systems (ICIS) 2023*, (22).

Krathwohl, D. R. 2002. "A Revision of Bloom's Taxonomy: An Overview," *Theory Into Practice* (41:4), pp. 212-218.

Kundisch, D., Muntermann, J., Oberländer, A. M., Rau, D., Röglinger, M., Schoormann, T., and Szopinski, D. 2022. "An Update for Taxonomy Designers. Methodological Guidance from Information Systems Research," *Business & Information Systems Engineering* (64:4), pp. 421-439.

Lee, D. M. S., Trauth, E. M., and Farwell, D. 1995. "Critical Skills and Knowledge Requirements of IS Professionals - a Joint Academic/Industry Investigation," *MIS Quarterly* (19:3), pp. 313-340.

Lee, J., and Park, J. 2023. "AI as "Another I": Journey Map of Working with Artificial Intelligence from AI-Phobia to AI-Preparedness," *Organizational Dynamics* (52:3).

Lewis, P., Petroni, F., Karpukhin, V., Goyal, N., Küttler, H., Lewis, M., Yih, W., Rocktäschel, T., Riedel, S. and Kiela, D. 2020. "Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks," *Advances in Neural Information Processing Systems* (33), pp. 9459-9474.

Long, D., and Magerko, B. 2020. "What Is AI Literacy? Competencies and Design Considerations," *Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI) 2020*.

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., and Kai, S. 2021. "Conceptualizing AI Literacy: An Exploratory Review," *Computers and Education: Artificial Intelligence* (2).

Nickerson, R. C., Varshney, U., and Muntermann, J. 2013. "A Method for Taxonomy Development and Its Application in Information Systems," *European Journal of Information Systems* (22:3), pp. 336-359.

Ooi, G., Tan, G. W., Al-Emran, M., Al-Sharafi, M. A., Capatina, A., Chakraborty, A., Dwivedi, Y. K., Huang, T., Kar, A. K., Lee, V., Loh, X., Micu, A., Mikalef, P., Mogaji, E., Pandey, N., Raman, R., Rana, N. P., Sarker, P., Sharma, A., Teng, C., Wamba, S. F., and Wong, L. 2023. "The Potential of Generative Artificial Intelligence across Disciplines: Perspectives and Future Directions," *Journal of Computer Information Systems*.

Peffers, K., Tuunanen, T., Rothenberger, M. A., and Chatterjee, S. 2007. "A Design Science Research Methodology for Information Systems Research," *Journal of Management Information Systems* (24:3), pp. 45-77.

Pinski, M., and Benlian, A. 2023. "AI Literacy - Towards Measuring Human Competency in Artificial Intelligence," *Proceedings of the 56th Hawaii International Conference on System Sciences (HICSS) 2023*, pp. 165-174.

Pinski, M., Haas, M., and Franz, A. 2023. "AiLingo - A Design Science Approach to Advancing Non-Expert Adults' AI Literacy," *Proceedings of the 56th Hawaii International Conference on System Sciences (HICSS) 2023*.

Pinski, M., Hofmann, T., and Benlian, A. 2024. "AI Literacy for the Top Management: An Upper Echelons Perspective on Corporate AI Orientation and Implementation Ability," *Electronic Markets* (34:1).

Russell, S. J., and Norvig, P. 2020. *Artificial Intelligence: A Modern Approach*. Harlow: Pearson.

Sarker, I. H. 2021. "Deep Learning: A Comprehensive Overview on Techniques, Taxonomy, Applications and Research Directions," *SN Computer Science* (2:6).

Schuetz, S., and Venkatesh, V. 2020. "Research Perspectives: The Rise of Human Machines: How Cognitive Computing Systems Challenge Assumptions of User-System Interaction," *Journal of the Association for Information Systems* (21:2), pp. 460-482.

Spitzer, K. L., Eisenberg, M. B., and Lowe, C. A. 1998. *Information Literacy: Essential Skills for the Information Age*. Syracuse University: ERIC Clearinghouse on Information and Technology.

Stolpe, K., and Hallström, J. 2024. "Artificial Intelligence Literacy for Technology Education," *Computers and Education Open* (6).

Strauss, A. L., and Corbin, J. M. 1998. *Basics of Qualitative Research Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks, CA: SAGE Publications.

Turing, A. M. 1950. "Computing Machinery and Intelligence," *Mind - A Quarterly Review of Psychology and Philosophy* (LIX:236), pp. 433-460.

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., Kaiser, L., and Polosukhin, I. 2017. "Attention Is All You Need," *arXiv preprint,* (1706.03762). (doi: 10.48550/arXiv.1706.03762).

vom Brocke, J., Simons, A., Niehaves, B., Niehaves, B., and Reimer, K. 2009. "Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process," *Proceedings of the European Conference on Information Systems (ECIS) 2009*, (161).

vom Brocke, J., Winter, R., Hevner, A., and Maedche, A. 2020. "Accumulation and Evolution of Design Knowledge in Design Science Research: A Journey through Time and Space," *Journal of the Association for Information Systems* (21:3), pp. 520-544.

Wang, B., Rau, P. P., and Yuan, T. Y. 2023. "Measuring User Competence in Using Artificial Intelligence: Validity and Reliability of Artificial Intelligence Literacy Scale," *Behaviour & Information Technology* (42:9), pp. 1324-1337.

Webster, J., and Watson, R. T. 2002. "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* (26:2), pp. xiii-xxiii.

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