



**Citation:** Biagini, G. (2024). Assessing the assessments: toward a multidimensional approach to AI literacy. *Media Education* 15(1): 91-101. doi: 10.36253/me-15831

**Received:** February, 2024

**Accepted:** April, 2024

**Published:** May, 2024

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**Data Availability Statement:** All relevant data are within the paper and its Supporting Information files.

**Competing Interests:** The Author(s) declare(s) no conflict of interest.

## Assessing the assessments: toward a multidimensional approach to AI literacy

### Valutando la valutazione: verso un approccio multidisciplinare alla literacy dell'intelligenza artificiale

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**Abstract.** This scoping review explores the field of artificial intelligence (AI) literacy, focusing on the tools available for evaluating individuals' self-perception of their AI literacy. In an era where AI technologies increasingly infiltrate various aspects of daily life, from healthcare diagnostics to personalized digital platforms, the need for a comprehensive understanding of AI literacy has never been more critical. This literacy extends beyond mere technical competence to include ethical considerations, critical thinking, and socio-emotional skills, reflecting the complex interplay between AI technologies and societal norms. The review synthesizes findings from diverse studies, highlighting the development and validation processes of several key instruments designed to measure AI literacy across different dimensions. These tools – ranging from the Artificial Intelligence Literacy Questionnaire (AILQ) to the General Attitudes towards Artificial Intelligence Scale (GA AIS) – embody the nature of AI literacy, encompassing affective, behavioral, cognitive, and ethical components. Each instrument offers unique insights into how individuals perceive their abilities to understand, engage with, and ethically apply AI technologies. By examining these assessment tools, the review sheds light on the current landscape of AI literacy measurement, underscoring the importance of self-perception in educational strategies, personal growth, and ethical decision-making. The findings suggest a critical need for educational interventions and policy formulations that address the gaps between perceived and actual AI literacy, promoting a more inclusive, critically aware, and competent engagement with AI technologies.

**Keywords:** AI Literacy, self-perception, scale, questionnaire.

**Riassunto.** Questa scoping review esplora il campo della *literacy* dell'intelligenza artificiale (IA), concentrandosi sugli strumenti disponibili per valutarne l'autopercezione. In un'epoca in cui le tecnologie di IA si infiltrano sempre più in vari aspetti della vita quotidiana, dalla diagnostica sanitaria alle piattaforme digitali personalizzate, la necessità di una comprensione completa della *literacy* in IA non è mai stata così cruciale. Questa alfabetizzazione va oltre la mera competenza tecnica ed include considerazioni etiche, pensiero critico e competenze socio-emozionali, riflettendo l'interazione complessa tra le tecnologie di IA e le norme sociali. La review sintetizza i risultati di diversi studi, evidenziando i processi di sviluppo e di validazione di diversi strumenti progettati per

misurare la *literacy* su diverse dimensioni. Questi strumenti – che vanno dal Questionario sull’Alfabetizzazione in Intelligenza Artificiale (AILQ) alla Scala delle Attitudini Generali verso l’Intelligenza Artificiale (GAAIS) – incarnano la natura complessa dell’argomento, abbracciando componenti affettive, comportamentali, cognitive ed etiche. Ogni strumento offre spunti su come gli individui percepiscono le loro capacità di comprendere, interagire e applicare eticamente le tecnologie di IA. Esaminando questi strumenti, la revisione analizza il panorama attuale degli strumenti di misurazione della *literacy* in IA, sottolineando l’importanza dell’autopercezione nella crescita personale e nella presa di decisioni etiche. I risultati suggeriscono un bisogno di interventi educativi e di policy che affrontino le lacune tra la *literacy* percepita e quella reale, promuovendo un coinvolgimento più inclusivo, consapevole e competente con le tecnologie di IA.

**Parole chiave:** AI Literacy, autopercezione, scale di misurazione, questionario.

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## 1. INTRODUCTION

In an era defined by rapid technological advancements, the ability to navigate, understand, and leverage digital tools has become indispensable. The advent of digital technologies and the internet has reshaped how we communicate, work, learn, and interact with the world around us. This digital transformation has not only reshaped the landscape of professional and personal lives but has also raised important questions about the adequacy of our skills and competencies in the face of evolving technological demands. As we move deeper into the 21st century, the assessment of these skills and the self-perception of digital competencies have emerged as critical areas of inquiry. Understanding how individuals assess their own abilities to engage with technology, and the accuracy of these self-assessments, has significant implications for education, workforce development, and societal participation (Saracco, 2020).

Among these transformative technologies, Artificial Intelligence (AI), due to its pervasive presence, is rapidly becoming a constant feature of the 21st century. As AI systems increasingly permeate various aspects of life – from personalized recommendations on streaming platforms to diagnostic assistance in healthcare – (Laupichler et al., 2023; Southworth et al., 2023) understanding the fundamentals of AI is crucial not only for those working in tech-centric roles but also for the general population to make informed decisions (Kandhofer et al., 2016; Ng et al., 2021; Long & Magerko, 2020; UNESCO, 2022).

The competence related to this skill is defined as AI Literacy, yet its concept remains in its infancy. Initially, the term was based on fundamental knowledge of AI and the proper use of this technology. More recently, researchers have proposed adding more depth to the concept than merely being able to use AI-driven devices and software. Instead, AI literacy involves both lower and higher-order thinking skills to comprehend the knowledge and skills behind AI technologies and to

facilitate work tasks (e.g., creation, collaboration, evaluation) (Chiu et al., 2020; Ng et al., 2021). Authors have emphasized the idea that people cannot fully understand this technology if they perceive it merely as a set of knowledge and skills; AI also involves attitudes and moral decision-making, which are crucial for developing AI literacy and its responsible use (Chiu et al., 2020; Ng et al., 2021; Druga et al., 2022). AI literacy can be seen as a multidimensional construct, encompassing a broad set of knowledge, skills, and competencies that enable individuals to engage effectively with AI technologies. This includes technical understanding, such as how algorithms function and how AI systems are trained, as well as a grasp of the societal impacts, such as ethical considerations and the implications of AI on privacy and employment.

## 2. BACKGROUND

### 2.1 Defining AI Literacy in the modern context

The concept of literacy has evolved significantly from its traditional association with reading and writing (Carolus et al., 2023). In the context of AI, literacy extends beyond merely the ability to use technology; it implies a deeper comprehension of how AI tools are developed, their limitations, their potential biases, and the contexts in which they are applied. According to the framework proposed by Ng et al. (2021), AI literacy also involves a sense of empowerment to use AI responsibly and a critical mindset for evaluating AI systems’ influence on society and individuals’ lives.

Moreover, AI literacy aims to democratize understanding and access to AI technology, ensuring that diverse groups have the opportunity to learn about and critically engage with these systems. This concept aligns with the agenda of many educational initiatives that aim to provide students with the necessary tools to become responsible digital citizens in the modern world (Carolus

et al., 2023). Therefore, defining AI literacy encompasses recognizing its importance for an informed citizenship, which is essential for societal participation in the age of digital transformation.

To capture this evolving concept, researchers have highlighted the urgency to develop AI Literacy scales that reflect the multifaceted nature of such expertise (Ng et al., 2023; Laupichler et al., 2023; Carolus et al., 2023; Pinsky, M., & Benlian, A., 2023; Biagini et al., 2023; Wang et al., 2022; Wang & Wang, 2022; Sindermann et al., 2021; Schepman & Rodway, 2020). These scales aim to measure an individual's awareness, knowledge, attitude, and ability related to AI – ranging from a basic understanding of AI concepts to more advanced capacities such as identifying AI biases and understanding the implications of AI applications. Through this comprehensive approach, we can better understand the AI literacy landscape and identify areas where education and policy interventions are most needed. However, there are still limited validated questionnaires that address all its dimensions, hence the need for a review.

## 2.2 AI literacy self-perception

Self-perception refers to individuals' assessment of their own knowledge, skills, and competencies in a given domain. In the context of AI literacy, it encompasses the evaluation by individuals of their capability to comprehend and engage with AI technologies. Understanding self-perception is crucial for numerous reasons (Bandura, 1997), particularly in informing education strategies, personalizing learning experiences, and fostering a deeper, more reflective engagement with AI. To begin with, self-perception in personal literacies influences motivation and learning outcomes (Bandura, 1997). Beliefs about one's abilities have a direct impact on the effort expended in learning, perseverance when faced with challenges, and, ultimately, success in mastering new content. Individuals who perceive themselves as competent in the AI domain are more likely to seek out challenges, exhibit resilience, and experience efficacy in their learning pursuits, all of which are critical in the fast-evolving field of AI. Another important aspect is the alignment of self-perceived AI literacy with actual competence (Kruger, J., & Dunning, D., 1999). The discrepancies between self-assessment and actual proficiency can lead to overconfidence or a lack of confidence. Both can be detrimental: For example, overconfidence may cause individuals to overlook learning opportunities or to fail to heed ethical implications of AI deployment, while a lack of confidence can result in reluctance to engage with AI tools or technologies, hindering poten-

tial advancements and personal growth. Moreover, self-perception plays a key role in the democratization of AI. It is essential for fostering inclusive participation across different demographics (UNESCO 2021; DiSalvo et al., 2017). A person's background, culture, and experiences shape their interaction with technology, and thus, their self-perception in terms of AI literacy. Acknowledging and understanding this personalized view of AI aptitude enables educators and policymakers to design interventions that are culturally sensitive and effective in reaching a broader audience. Additionally, studies have indicated that self-perception in AI literacy affects ethical decision-making (Druga et al., 2023). Individuals who consider themselves well-versed in AI are more likely to critically evaluate the social and ethical dimensions of AI technologies, contributing to the development of responsible AI practices. In contrast, those with lower self-perceived literacy may lack the confidence to question or understand the implications of AI systems, possibly leading to uncritical acceptance of AI outputs (Biagini et al., 2023). In the pursuit of advancing AI literacy, it is therefore imperative to not only develop tools that assess an individual's conceptual and practical knowledge but also ones that measure their self-perception of AI literacy. This dual focus enables the identification of gaps between perceived and actual understanding. Furthermore, it provides insights into how individuals position themselves in relation to AI, which is integral for crafting effective educational interventions and promoting a critically aware and competent AI literate public.

## 2.3 AI Literacy assessment tools

In the field of AI literacy, scholars employ a diverse range of quantitative and qualitative methods to assess students' knowledge on the domain, including pre- and post-knowledge tests, self-reported questionnaires (Chiu et al., 2021; Kong et al., 2022; Lin et al., 2021; Ng et al., 2023), surveys (Druga et al., 2022), curriculum guides (Ng et al., 2023), interview tools, and project rubrics (Ng et al., 2022; Zhang et al., 2022).

The development of curricula aimed at enhancing AI literacy has led to the creation of comprehensive assessment/self-assessment tools (e.g., Carolus et al., 2023; Chai et al., 2020; Chiu et al., 2021; Dai et al., 2020; Kong et al., 2023; Laupichler et al., 2023; Ng et al., 2023; Pinski & Benlian, 2023; Wang et al., 2022), focusing on a variety of factors such as confidence, readiness, relevance, behavioral intention, learning perceptions, motivation, attitudes, career aspirations, engagement, hands-on interactivity, futuristic and interdisciplinary thinking, social good, and ethical learning.

However, even if several scales have been developed, mostly are tailored to evaluate specific interventions, therefore, their content often remains closely aligned with the evaluated intervention, limiting their broader applicability (Carolus et al., 2023).

Furthermore, despite the breadth of these assessments, few have undergone validation or retesting for reliability across different settings and the factorial structure of used instruments in educational settings has rarely been examined in large samples, leading to a lack of differentiation among various aspects of AI literacy.

Critically, the predominant focus of these instruments on cognitive and ethical dimensions, with less attention to attitudinal and behavioral aspects essential for AI learning, signifies a gap in the comprehensive assessment of AI literacy, especially considering the diversity of age ranges targeted. This oversight is problematic, as a thorough understanding of AI literacy requires exploring socio-emotional and higher cognitive dimensions beyond mere technical proficiency.

To adequately measure AI literacy across a broader spectrum of use cases it is essential to develop assessment tools that not only cover general criteria but also allow for the modular incorporation of context-specific aspects. Such an approach would address the current limitations by ensuring a more generalized and differentiated assessment of AI literacy, capturing its multifaceted nature.

#### 2.4 The present study

Recognizing the importance of assessment in AI literacy, this study seeks to identify and evaluate the tools designed to measure individuals' self-assessment of their AI knowledge and competencies. By exploring the characteristics of these tools, including their purpose, target audience, and validation processes, the research aims to provide a comprehensive overview of the methodologies currently employed in this domain. Furthermore, this study delves into the specific aspects of AI that these instruments aim to measure, seeking to understand the breadth and depth of AI concepts and skills captured by such evaluations. Through an examination of existing evaluation tools, this study aims to highlight the critical dimensions of AI literacy as perceived by individuals themselves. The research questions (RQ) addressed in this study are as follows:

RQ1: Which are the tools for evaluating AI literacy self-perception?

RQ2: Which characteristics (e.g., purpose, target, validation process) and what specific aspects of AI are measured by these questionnaires?

### 3. METHODS

To answer the research questions regarding the available tools and their characteristic for evaluating AI literacy self-perception, a comprehensive review of academic literature was conducted. This investigation aimed to identify and assess the variety of instruments currently in use for gauging an individual's self-perceived competence and understanding of artificial intelligence concepts and applications. Through this examination, a total of nine distinct tools were identified, encompassing a range of approaches from self-assessment questionnaires to interactive digital platforms. Each tool was evaluated based on its characteristics (e.g., purpose, target, validation process).

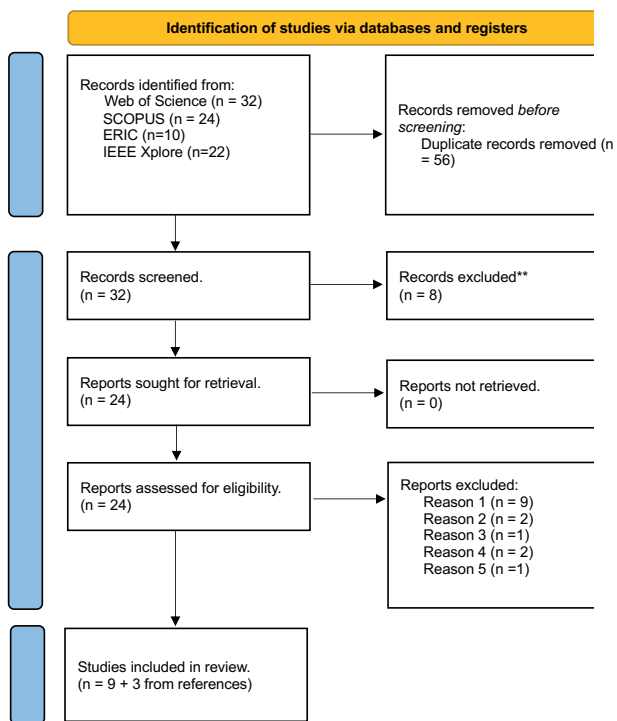
The approach utilized for this study was a scoping review (Grant & Booth, 2009), adhering to the framework established by the PRISMA guidelines (Moher et al., 2009). Since, although not a systematic review of the literature, the scoping review shares its characteristics of transparency, reproducibility and systematicity aiming to reduce mistakes and bias and thus, yielding more trustworthy outcomes (Cooper et al., 2019). The subsequent sections provide a concise overview and record the principal procedures applied in this method of research.

The process of the review was divided into five distinct phases: a) defining the problem and the research queries, b) identifying relevant literature, c) evaluating the search outcomes, d) categorizing, decoding, and summarizing the findings, and e) disseminating the review findings. The search encompassed several academic databases, including Web of Science (Clarivate), ERIC (Institute of Education Sciences), IEEE Xplore (IEEE), and SCOPUS (Elsevier), and was conducted in March 2023. It is worth noting that the volume of literature on AI literacy scales is comparatively limited. Hence, this research aims to provide a comprehensive overview of the current literature. The focus was on articles explicitly mentioning "AI literacy scales or questionnaire" or "artificial intelligence literacy scales or questionnaire" in the title, abstract, or text. A subsequent search was conducted in September 2023, filtering out non-conforming articles based on the established exclusion criteria.

Five exclusion criteria were formulated and applied during the abstract and full-text report reviews (refer to Table 1). The criteria were as follows: works that utilized the term AI literacy scale or questionnaire but concentrated on a different subject were omitted (criterion 1). Editorials and books were not included due to their non-peer-reviewed nature (criterion 2). Articles that mentioned "AI literacy scale or questionnaire" but pertained to AI's application in specific fields unrelated to educa-

**Table 1.** Exclusion criteria for the scoping review.

Criterion number	Criterion Name	Criterion Explanation
1	Missing focus on tools for AI literacy assessment	Works that utilized the term scale but concentrated on a different subject were omitted (e.g., pre-post course evaluation)
2	Peer Review	Editorials and books were not included due to their non-peer-reviewed nature
3	Technical articles/Specific Context	Articles that mentioned “AI literacy” but pertained to AI’s application in specific fields unrelated to education were disregarded
4	Foreign Language	Reports published in languages other than English or Italian



**Figure 1.** Prisma Flowchart. \*\*All records were excluded manually. No automation tools were used at this stage.

tion were disregarded (criterion 3). Finally, publications not in English or Italian were excluded to prevent misinterpretation due to language barriers, as these were the languages the authors were proficient in (criterion 4).

The journey of study selection begins with the identification of studies from several databases: 32 from Web of Science, 24 from SCOPUS, 10 from ERIC, and 22 from IEEE Xplore, totalling 88 records. From this pool, records are pre-screened, resulting in the removal of 56 duplicate records. This leaves 32 records to be screened. After screening, 8 records are excluded. This results in 24 reports being sought for retrieval. Of the 24 reports that are retrieved and assessed for eligibility, a number are excluded for the exclusion criteria leaving 9 studies

that are included in the review based on this assessment. Figure 1 contains the details of the process.

#### 4. RESULTS

To address the research question regarding the identification of tools for evaluating self-perception of AI literacy, our investigation uncovered a variety of instruments designed to measure individuals’ understanding and competence in artificial intelligence. Here we briefly describe them:

1) The AILQ Survey (Ng et al., 2023): The study introduces the Artificial Intelligence Literacy Questionnaire (AILQ), a comprehensive tool developed to assess the AI literacy of secondary students. It underscores the necessity of evaluating AI literacy across four key dimensions: affective learning (which includes intrinsic motivation and self-efficacy/confidence), behavioural learning (encompassing behavioural commitment and collaboration), cognitive learning (covering knowledge acquisition, application, evaluation, and creation), and ethical learning. These dimensions reflect a holistic approach to understanding AI literacy, incorporating not only technical knowledge and skills but also ethical considerations and socio-emotional aspects such as collaboration and engagement. The AILQ was designed and validated through a multi-step process, including theoretical review, expert judgment, interviews, a pilot study, and confirmatory factor analysis, ensuring its reliability and validity. The validation process involved a pilot study with 363 secondary school students to examine the psychometric properties of the AILQ. This process confirmed a four-factor structure of the AILQ, demonstrating its good reliability and validity as a measurement scale. This tool is distinguished by its comprehensive coverage of the ABCE (Affective, Behavioural, Cognitive, and Ethical) learning framework, making it a novel contribution to the field. The questionnaire is designed to capture a wide range of competencies, from

basic understanding to higher-order thinking skills, and includes items specifically aimed at assessing students' confidence, self-efficacy, motivation, and ethical understanding related to AI.

2) The "Scale for the Assessment of Non-Experts' AI Literacy" (SNAIL) (Laupichler et al., 2023) is a tool designed to measure the AI literacy among non-experts, a demographic defined as individuals lacking formal education in AI or computer science. This tool emerged from the need to provide a valid and reliable assessment of AI competencies. The development process of SNAIL involved distributing an initial set of AI literacy items through an online questionnaire to a diverse group of non-experts. Subsequent analysis, leveraging exploratory factor analysis, unveiled a three-factor structure encapsulating the latent dimensions of AI competencies: Technical Understanding, Critical Appraisal, and Practical Application. The final iteration of the SNAIL questionnaire comprises 31 items, crafted to assess individuals' or groups' AI literacy. It also serves as a tool for evaluating the efficacy of AI literacy instructional courses.

3) Meta AI Literacy Scale (MAILS) (Carolus et al., 2023) was designed to offer a robust and flexible assessment tool for AI literacy that is deeply grounded in the literature. It combines traditional AI literacy facets with psychological competencies, making it applicable across various professional settings. The scale's modularity allows for its facets to be used independently, tailoring the assessment to specific goals and use cases. Its main target are adults, with the potential for broader application given its foundation in universal competencies and psychological constructs. The scale was developed through the analysis of data collected online from 300 participants. It underwent both exploratory and confirmatory factor analyses to confirm its factorial structure. This validation process ensured that MAILS effectively measures AI literacy and psychological competencies related to problem-solving, learning, and emotion regulation in the context of AI. The scale's design is based on Ng and colleagues' (Ng et al., 2021) conceptualization of AI literacy, therefore Use & Apply AI, Understand AI, Detect AI, AI Ethics, with the addition of Create AI and is enriched with psychological competencies to address the pervasive changes brought by AI systems like, AI Self-efficacy in learning and problem solving, AI Self-management, further divided into AI Self-efficacy (covering AI Problem-solving and AI Learning) and AI Self-competency (including AI Persuasion literacy and AI Emotion regulation).

4) Pinsky et al. scale (Pinsky, M., & Benlian, A., 2023): This study embarked on a comprehensive approach, starting with a systematic literature review

and expert interviews to define and conceptualize general AI literacy. This work led to the creation of an initial item set aimed at capturing the essence of individuals' socio-technical competencies in interacting with AI technologies (based on IS research and human-AI collaboration). To refine and validate this item set, the research team engaged in two rounds of card sorting involving a total of eleven judges, followed by a pre-test with 50 participants. This process culminated in a validated measurement instrument comprising five dimensions and 13 items, offering empirical support for the measurement model. The instrument elucidates general AI literacy through seven restructured dimensions, categorized into AI actor knowledge (explicit literacy), AI steps knowledge (explicit literacy), and AI experience (tacit literacy), thus providing a nuanced understanding of the competencies relevant to human-AI interaction. By structuring human-AI competencies in such a detailed manner, the instrument lays the groundwork for future research directions in IS, inviting inquiries into the multifaceted relationships between AI literacy and its effects on organizational and technological outcomes.

5) LTE's Scale (Biagini et al., 2023): The LTE Scale is a tool designed to evaluate users' skills in engaging with artificial intelligence (AI), spanning across knowledge-related, operational, critical, and ethical dimensions. This 40-item assessment scale is crafted to enhance comprehension of self-reported AI literacy, drawing inspiration from the foundational notions of digital literacy outlined by Calvani et al. (2009) and the AI Literacy framework proposed by Cuomo et al. (2022). The development process of this scale was guided by DeVellis' strategic recommendations, initially generating an item pool of 118 potential entries. This pool was refined through expert insights, culminating in a robust set of items that underwent rigorous validation through Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). The theoretical underpinning of the LTE Scale, rooted in four distinct constructs, reflects a comprehensive conceptualization of AI literacy, aligning with the multifaceted nature of this domain. This approach not only attests to the scale's empirical robustness – evidenced by a high reliability score and construct validity – but also recommends its application as an integral tool rather than isolating its constructs, thus embracing the inherent multidimensionality of AI literacy. The LTE Scale distinguishes itself in the scenarios of AI literacy assessment tools by offering a holistic perspective that acknowledges and evaluates the intricate complexity of AI literacy.

6) The AI Literacy Scale (AILS) (Wang et al., 2022): This innovative scale is designed to capture the essence of AI literacy through the core constructs of awareness, use, evaluation, and ethics, distilled into a concise 12-item instrument from an initial pool of 65 items through a rigorous three-step content validation process. By identifying these constructs and validating the scale across two diverse data samples, the study establishes AILS as a reliable and valid tool for quantitatively measuring AI literacy. AILS's development was inspired by the foundational work in digital literacy by Balfe, Sharple, and Wilson, and Calvani et al. (2009), suggesting a parallel framework could be effectively applied to AI literacy. The scale underwent a thorough six-step methodological approach, ensuring its reliability and validity, and confirmed the appropriateness of the four-construct model for conceptualizing AI literacy. Despite some constructs having average variance extracted (AVE) values slightly below the usual threshold, the scale demonstrated sufficient convergent validity, supporting its utility in research and practice. The study's findings underscore the significant relationship between AI literacy, as measured by AILS, and key variables such as digital literacy, attitudes towards robots, and daily AI usage, highlighting the scale's predictive relevance for understanding users' interactions with AI technologies. Notably, the study advocates for the use of AILS as a comprehensive instrument rather than focusing on individual constructs, reflecting the multifaceted nature of AI literacy. This approach aligns with the recognition that AI literacy extends beyond the competence in using specific applications, emphasizing the need to assess users' general AI competence.

7) The AI Anxiety Scale (AIAS) (Wang & Wang, 2022): This paper introduces the AIAS as a standardized tool designed to measure the general public's anxiety towards AI development, a phenomenon increasingly prevalent as AI technologies become more integrated into daily life. The AIAS development process was comprehensive, involving the conceptualization of the AIA construct, item generation, and rigorous validation through data analysis from 301 respondents. This process ensured the AIAS's reliability and validity across various dimensions, including criterion-related, content, discriminant, convergent, and nomological validity. The finalized 21-item scale offers a understanding of AIA, providing a robust metric for comparing individual AIA levels against broader norms. The AIAS's diverse sample basis enhances its applicability for developing related standards and offers a precise tool for assessing AIA more accurately than existing measures. The AIAS's development contributes to theoretical and practical

discussions on AIA, emphasizing the need for multidimensional analysis and targeted interventions to mitigate anxiety. For practitioners, the AIAS underscores the importance of understanding various anxiety dimensions—such as learning, job replacement, sociotechnical blindness, and AI configuration—to tailor corrective measures. For educators, the AIAS can guide the development of teaching strategies that stimulate interest in AI, thereby reducing anxiety and enhancing learning outcomes.

8) The Attitude Towards Artificial Intelligence (ATAI) scale (Sindermann et al., 2021) represents an important advancement in the measurement of public attitudes towards AI, addressing the dichotomy of acceptance and fear associated with the proliferation of AI technologies in daily life. This study introduces the ATAI scale, crafted and validated across three languages: German, Chinese, and English, with participants from Germany, China, and the UK providing a broad cultural perspective on AI attitudes. The ATAI scale's development is a demonstration of the relationship individuals hold with AI, encapsulating both the optimism of embracing technological advancements and the skepticism concerning potential societal implications. Comprising five items, the ATAI scale delineates two distinct but interrelated dimensions: acceptance of AI and fear of AI, revealing a balanced factorial structure that resonates across diverse cultural contexts. This bifurcation allows for a nuanced understanding of attitudes towards AI, reflecting the complexity of human-machine interactions in the digital age. The scale's validation process, involving comparisons of willingness to interact with and use specific AI products like self-driving cars and social robots among others, underscores its practical relevance and applicability. The ATAI scale's cross-cultural validation signifies its robustness and universality, offering a reliable and concise measure of AI attitudes that transcends geographical and linguistic barriers. Notably, the scale's exploration of the fear dimension, particularly concerning AI's impact on employment, provides critical insights into prevailing anxieties and perceptions, despite varying emphases on job loss across different samples. This highlights the scale's sensitivity to contextual nuances and the importance of considering specific sample characteristics in future research applications.

9) The General Attitudes towards Artificial Intelligence Scale (GAAIS) (Schepman, A., & Rodway, P., 2020) is an instrument designed to measure public sentiment toward artificial intelligence (AI) through both positive and negative lenses. This scale underwent an exploratory factor analysis, unveiling two distinct subscales that encapsulate positive perceptions, reflecting societal and

**Table 2.** summary of all the tools examined during the review.

Tool Name	Authors	General Purpose	Main Target	Validation Process	Distinctive Features	Number of Items
AILQ	Ng et al., 2023	Assess secondary students' AI literacy across four dimensions.	Secondary students	Pilot study with 363 students in Hong Kong.	Focuses on affective, behavioural, cognitive, and ethical learning; validated in an educational context.	32
SNAIL	Laupichler et al., 2023	Assess non-experts' AI literacy across technical understanding, critical appraisal, and practical application.	Non-experts	Online questionnaire with exploratory factor analysis.	Caters to a broad audience without formal AI education; three-factor model.	31
MAILS	Carolus et al., 2023	Measure AI literacy integrating foundational competencies with psychological skills.	German-speaking adults	Data from 300 individuals analysed with EFA and CFA.	Includes psychological aspects like problem-solving and emotion regulation alongside AI competencies.	72 (60 + 12)
Pinsky&Benlian Scale	Pinsky, M., & Benlian, A., 2023	Measure general AI literacy in human-AI interaction contexts.	Researchers and practitioners in IS and AI	Literature review, expert interviews, card sorting with 11 judges, and pre-test with 50 participants.	Seven dimensions categorizing explicit and tacit AI literacy knowledge.	13
LTE's Scale	Biagini et al., 2023	Evaluate critical skills in AI use, covering knowledge, operation, criticism, and ethics.	Non-experts, Academics	Scoping assessment, expert review, EFA, and CFA with $\alpha=0.95$ , AVE=0.53.	Comprehensive approach to AI literacy; high reliability and construct validity.	40
AILS	Wang et al., 2022	Assess AI literacy among ordinary users, focusing on awareness, use, evaluation, and ethics.	ordinary users	Three-step content validation, survey with two data samples leading to a 12-item instrument.	Short, validated measure correlating AI literacy with digital literacy and attitudes towards robots.	12
AIAS	Wang, Y.-Y. & Wang, Y.-S., 2022	Measure anxiety towards AI development.	General public	Data from 301 respondents analyzed for multiple forms of validity.	Introduces the concept of AI anxiety (AIA) and its measurement; extensive validation process.	21
ATAI Scale	Sindermann et al., 2021	Assess attitudes towards AI across acceptance and fear dimensions.	Populations from Germany, China, and the UK	Participants completed the ATAI scale; factorial structure tested across samples.	Multilingual validation; two negatively associated factors.	5
GAAIS	Schepman, A., & Rodway, P., 2020	Develop a General Attitudes towards Artificial Intelligence Scale with positive and negative subscales.	General public	Exploratory Factor Analysis with cross-validation on attitudes towards specific AI applications.	Positive and negative subscales capturing emotions and utility versus concerns; good psychometric properties.	21

personal utility, and negative perceptions, which highlight concerns surrounding AI. The GAAIS demonstrated strong psychometric properties, including good indices of reliability as well as convergent and discriminant validity when juxtaposed against existing measures. The GAAIS offers insight into the general public's attitudes toward specific AI applications by correlating comfortableness and perceived capability with general attitudes. The findings reveal a dichotomy: individuals are generally positive about AI's use in areas involving big data,

such as astronomy and pharmacology, appreciating its utility and impact. Conversely, applications requiring human judgment, like medical treatment and psychological counseling, elicit more negative reactions, driven by ethical concerns and discomfort. This scale's development and validation process underscores the complexity of public attitudes toward AI, revealing that comfort with AI applications is a more potent predictor of general attitudes than perceived capability. This suggests that while people may recognize the potential benefits of AI, their



comfort level, likely influenced by emotional and ethical considerations, plays a crucial role in shaping their overall attitudes. Next table summarises the results (Table 2).

## 5. DISCUSSION

The exploration of tools for evaluating AI literacy self-perception revealed a growing interest in understanding and measuring the multidimensional nature of AI literacy. This interest is reflected in the development of diverse assessment tools, each designed with specific constructs to capture the nuances of AI literacy from various perspectives. Notably, the tools offer unique insights into how individuals perceive their AI literacy, highlighting the complexity of this construct.

The AILQ (Ng et al., 2023) and the SNAIL (Laupichler et al., 2023) and LTE's Scale (Biagini et al., 2023) stand out for their comprehensive approaches, addressing not only cognitive and technical skills but also affective, behavioral, or ethical dimensions of AI literacy. Underlying the evolving understanding of AI literacy as not merely technical competency but encompassing critical thinking, ethical reasoning, and socio-emotional engagement with AI technologies. Socio-technical aspects are explored in depth by Pinsky and Benlian (2023) who contributed to the understanding of AI literacy by focusing on this kind of competencies required for human-AI interaction. Their work underlines the significance of both explicit and tacit literacies in navigating the AI technologies. Furthermore, the diversity in target audiences, from secondary students to non-experts and professionals, as seen in the MAIIS (Carolus et al., 2023) suggests a need for tailored approaches in AI literacy education and assessment. This variety reflects the universal relevance of AI literacy across different age groups and professional backgrounds, advocating for inclusive educational strategies that cater to diverse learning needs.

The introduction of tools like the AI Anxiety Scale (Wang, Y.-Y. & Wang, Y.-S., 2022) and the AILS by Wang et al. (2022) further enriches the perception of AI literacy assessment by incorporating the psychological aspects of learning and interaction with AI. These aspects, including anxiety and attitudes towards AI, play a significant role in shaping individuals' engagement with AI technologies. Finally, the ATAI Scale by Sindermann et al. (2021) and GAAIS by Schepman, A., & Rodway, P. (2020) explore public attitudes towards AI, distinguishing between acceptance and fear, as well as positive and negative perceptions. Understanding these psychological dimensions is crucial for designing interventions that not

only enhance AI literacy but also address the emotional and attitudinal barriers to effective AI engagement; the alignment, or lack, between self-perceived and actual AI literacy, as illuminated through these assessment tools, presents significant implications for educational practice and policy. It underscores the need for educational curricula and policies that foster not just the acquisition of AI knowledge and skills but also self-awareness and critical reflection on one's AI competencies. Such initiatives are essential for preparing a populace that is not only technologically proficient but also ethically informed and socially responsible in the age of AI.

## 6. CONCLUSION

In conclusion, this scoping review has identified and evaluated a range of tools designed to assess AI literacy self-perception, revealing a diverse array of methodologies aimed at capturing the nature of AI literacy. Through the examination of nine significant scales, our study highlights the importance of assessing not only technical knowledge and skills but also ethical understanding and socio-emotional competencies. The diversity of these tools reflects the evolving understanding of AI literacy as a multidimensional construct that encompasses cognitive, technical, affective, behavioral, and ethical dimensions. However, the review also points to a gap in the comprehensive assessment of all facets of AI literacy, indicating a need for further development of instruments that can accurately measure self-perception in this critical area. As AI continues to permeate various aspects of life, fostering a deep and reflective engagement with AI technologies through accurate self-assessment tools becomes imperative for enabling informed decisions and responsible use of AI. This study paves the way for future research to refine and expand the tools available for AI literacy assessment, ensuring that education strategies can effectively address the needs of a diverse and rapidly evolving digital world.

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