What should we measure in AI literacy education?

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Abstract

Artificial Intelligence (AI) literacy is recognized as a critical skill set for learners, but educators and researchers face a fundamental question: what should we measure to determine if students are truly AI literate? This workshop paper addresses the need to define clear learning points in AI literacy education across three key engagement levels: understanding AI, practical application of AI, and critical analysis of AI. We conducted interviews with four experienced AI literacy instructors to explore how they assess student learning and readiness for advanced engagement. The findings show that teachers struggle to define exactly what to measure, and it shows lacking standardized outcomes or metrics for AI literacy. Nevertheless, a consensus emerged around three broad areas that their 6–8 week courses target: (1) foundational understanding of AI concepts, (2) hands-on use and creation of AI, and (3) critical evaluation of AI's societal impact. We discuss how these engagement levels can be associated with specific learning outcomes and measurable indicators. By defining and articulating learning points at each level, this work lays the groundwork for developing assessments and analytics that can track AI literacy progress. These insights contribute to the Society of Learning Analytics and Knowledge community by highlighting what to measure in AI literacy education and informing the design of future assessment frameworks and educational strategies.

Keywords

AI literacy, learning outcomes, engagement levels, assessment, learning analytics, digital literacy

1. Introduction

AI technologies make AI literacy an essential competence for students and workers alike. Educational systems worldwide are beginning to integrate AI literacy into curricula by recognizing it as key to future readiness [12]. However, alongside growing adoption also creates a challenge to define what it means to be AI literate and how to measure it. While definitions of AI literacy are starting to emerge, there remains "no consistent, measurable framework to know whether someone is truly ready to use AI effectively and responsibly" [12]. In other words, educators lack agreed-upon learning outcomes and assessment criteria for AI literacy and this creates uncertainty about how to track student progress.

Learning analytics research positions measurement as a prerequisite for improving learning. It is the field is commonly defined as the "measurement, collection, analysis and reporting" of data about learners and their contexts for understanding and optimizing learning environments [1]. In AI literacy education, this implies that analytics can only be meaningful if the construct being measured is specified with sufficient precision. When learning goals remain broad, the resulting data traces (i.e. tool logs, quiz scores, project artifacts, or discourse records) risk becoming weak proxies, difficult to interpret and hard to compare across classrooms or programs [4]. A LAK-oriented approach therefore requires defining measurable learning points that link observable evidence (what students do and produce) to the intended competencies (what students know, can do, and can justify).

At the same time, the AI literacy literature has advanced competency frameworks faster than it has advanced assessmentable learning progressions. Long and Magerko's foundational work proposes a concrete set of AI literacy competencies [10], while Ng et al. (2021) review explicitly calls for future work on competency development and assessment criteria [11]. Practice-facing frameworks also define

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AI literacy in terms of learners' ability to understand, evaluate, and use AI safely and effectively, but they leave open questions about how to establish readiness thresholds and ensure validity and fairness across diverse learners and contexts. This gap is consequential for AI literacy courses that blend conceptual understanding, tool-mediated performance, and socio-ethical reasoning. Without agreed measurement targets, teachers are left to improvise indicators of progress, and researchers lack stable constructs for designing analytics that can generalize beyond a single classroom [6, 7].

2. Literature review

Recent literature converges on the idea that AI literacy encompasses a combination of conceptual knowledge, practical skills, and critical perspectives. For example, the U.S. Department of Education's proposed definition of AI literacy includes technical knowledge, durable skills, and future-ready attitudes that enable learners to engage with and create AI, manage and design AI systems, and critically evaluate AI's benefits and risks [13]. Policy experts define "AI literacy" as the ability to understand, use, and critically engage with AI systems in an informed and responsible manner [2]. These definitions highlight three engagement levels: (1) understanding how AI works, (2) using or creating with AI tools, and (3) critically reflecting on AI's implications. In a review of educational AI literacy frameworks, Ng et al. (2021) identified four common aspects of AI literacy: "Know & understand AI", "Use & apply AI", "Evaluate & create AI", and "AI ethics", corresponding to foundational knowledge, applied skills, higher-order evaluation/creation, and ethical considerations [11].

Despite agreement on what AI literacy entails, current literature points to a lack of clarity on how to assess these competencies in practice. Interviews with experts and educators have emphasized "the absence of clear outcomes and measurement systems for AI literacy" and noted that no widely accepted definition of proficiency or guidance on how to assess AI-related skills yet exists [2, 3, 9, 14]. In their systematic review, Ng et al., 2021 found that researchers have experimented with diverse evaluation methods from knowledge tests and quizzes to surveys, projects, and interviews to gauge students' AI understanding [11]. However, these efforts are fragmented, and there is not yet a standardized instrument or set of metrics for AI literacy. This leaves teachers largely on their own to determine if students are "AI literate." Accoridng to Karimov et al. (2025), teachers are generally now aware that what skills they are lacking and this also affects their teaching [8]. Consequently, classroom educators may be unsure which learning indicators (e.g. factual knowledge, ability to use an AI tool, ethical reasoning skills) best demonstrate that a student is ready to progress. The literature so far has focused on defining competencies and curriculum designs for AI literacy, but it misses unified guidance on measurable learning outcomes [10]. This gap is acknowledged as a critical hurdle in integrating AI literacy into education systems.

Given this context, it is important to identify concrete learning points (specific skills or understandings) that educators should develop and measure in AI literacy programs. Clearly defined learning points across the different engagement levels of AI literacy would support the development of assessments, enable learning analytics to track student progress, and ensure students are prepared to use AI. Without such definitions, as one commentator notes, educators risk "urging students to use AI" without "agreeing on what we mean by AI literacy or how to assess it" [12]. This study addresses this need by consulting front-line AI literacy teachers about what they teach and how they analyze student learning. By drawing on practitioners' experiences, we aim to bridge the gap between high-level AI literacy frameworks and the on-the-ground reality of measuring student readiness. The central question guiding this work is: What should we measure in AI literacy education across the key areas of understanding, practical application, and critical engagement with AI?

3. Methodology

To investigate this question, we conducted a qualitative study using semi-structured interviews with AI literacy instructors. We targeted educators who have been teaching AI literacy to for at least two

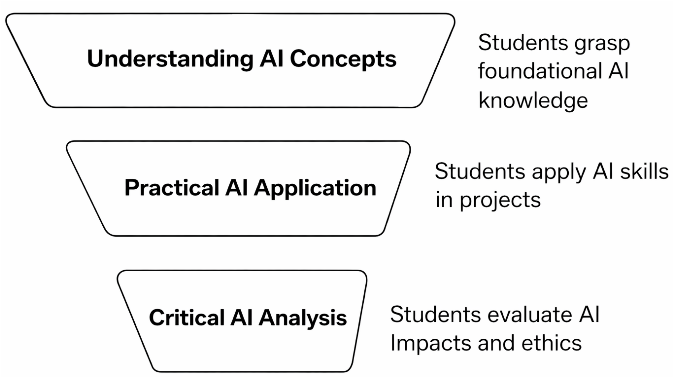

Figure 1: Stages of AI literacy development

years and the reason for that was their experience would provide rich insights into learning outcomes and assessment practices. Four teachers (n=4) were recruited from different educational institutions that offer AI or emerging technology electives. Among them, two taught at the private organizations that teach AI literacy to upskill professionals who have intermediate/senior level positions and two at the high school level. All of these teachers had integrated AI topics into a 6–8 week course module on technology or computer science.

Each teacher participated in a one-on-one interview of approximately 45 minutes. Interviews were conducted via video call, audio-recorded, and transcribed with consent. We used an interview protocol with open-ended questions focusing on:

- Curriculum content: what AI concepts and skills they teach;
- Learning objectives: what they expect students to learn or be able to do by the end;
- Assessment and evidence: how they evaluate or verify that learning has occurred;
- Challenges: any difficulties in measuring student learning or ensuring students are "ready" for more advanced AI topics.

We employed thematic analysis to identify common patterns and themes in the interview data. Transcripts were coded by firstly using open coding to mark salient points mentioned by teachers (such as particular skills emphasized, or assessment strategies used). Through iterative discussion, the codes were grouped into higher-level themes. A clear pattern emerged around the major areas of engagement that teachers addressed (and attempted to assess) in their courses. Recurring challenges were also noted teachers mentioned regarding assessment. Given the small sample size, the analysis is exploratory with the aim to generate insights and hypotheses rather than generalizable statistics. Nevertheless, consistency in responses across the four educators provides a degree of qualitative saturation for the core themes identified.

4. Results

Despite different contexts, the interviewed teachers shared similar perspectives on what they teach in AI literacy and the difficulties of measuring student learning. Two main findings are highlighted: (1) Teachers struggle to define which learning outcomes matter most and lack clear criteria for student readiness, and (2) In practice, their curricula include on three engagement levels (understanding AI, applying AI, and critically analyzing AI) which encompass the key learning points they aim to impart. Below, we detail these findings and the specific learning points associated with each engagement level.

4.1. Teachers' struggle to define key learning outcomes

All four educators expressed uncertainty about how to determine whether a student is adequately "AI literate" at the end of their course. In the absence of standard guidelines or assessments, teachers

Table 1
Core engagement levels in AI literacy courses: assessment approaches and common challenges

Core engagement level	Learning data & assessment approaches	Common assessment challenges
Understanding AI	Short quizzes on terminology/concepts; written explanations; concept maps	Easy to quiz, but depth is hard to ensure (risk of memorized definitions); "foundational knowledge" varies by context/program
Practical application of AI	Project artifacts and performance evidence; rubric-scored projects; process observations (troubleshooting); peer/group evaluations	Project evaluation can be subjective; wide variation in project complexity; difficult to assess individual contribution in group work
Critical analysis of AI	Reflection essays; discussion/debate participation; rubrics for ethical reasoning in presentations	Hard to standardize; often relies on subjective judgment; difficult to measure "critical thinking" with simple tests; indicators include quality of questions and shifts in perspective

often rely on intuition and informal observations. One teacher noted that "there isn't a final exam or certification for AI literacy like there is for math or language; I have to judge from class participation and projects". Another admitted that they "struggle to define what mastery looks like" in AI literacy, because the subject encompasses conceptual, technical, and ethical dimensions. Teachers in this study mentioned the gap of not having widely accepted definition of proficiency or guidance on how to assess AI-related skills. They described creating their own ad-hoc indicators of success, for example, expecting students to explain AI concepts in their own words, or to build a simple AI-driven application, but they differed in which indicators they prioritized. Each teacher emphasized a different facet of AI literacy as the toughest to evaluate: one highlighted ethical reasoning (How to tell if a student can critically analyze AI's impact?), while another emphasized technical understanding (Can the student really explain how the algorithm works?). All teachers agreed that they would benefit from a clearer framework or checklist of learning outcomes. "We're all kind of making it up as we go along," one instructor mention this by highlighting the need for consensus on what to measure.

4.2. Core engagement levels and learning points in AI literacy courses

Despite the above challenges, a consensus emerged regarding the scope of content in AI literacy education. All interviewed teachers, regardless of their background, structured their 6–8 week courses to address three core engagement levels of AI literacy. These can be thought of as what of AI literacy that students engage with: (a) Understanding AI concepts, (b) Practically using or creating with AI, and (c) Critically analyzing AI (see Figure 1). Each level includes distinct learning points that teachers aim for students to achieve. Teachers were gathering different types of learning data for each level, from quiz scores to project artifacts to discussion participation, to monitor student progress (see Table 1). The three engagement levels and their associated learning points are detailed below:

Understanding AI: Conceptual foundations. All teachers begin by ensuring students develop a fundamental understanding of what AI is and how it works. Key learning points include knowing common AI applications in daily life (e.g. recommender systems, voice assistants), understanding basic concepts like machine learning, algorithms, and data training, and recognizing how data is processed in AI systems. One teacher described this as "the first step... the foundation for building understandings of AI". Students are taught core terminology and simple explanations of techniques (for instance, understanding that AI can learn patterns from examples). To assess this conceptual understanding, teachers used short quizzes on terminology, ask students to "explain an AI system in their own words," or have them draw concept maps of an AI's components. Mastery at this level is indicated by students being able to correctly identify examples of AI, articulate basic mechanisms (e.g. "AI makes predictions based on data"), and distinguish AI from traditional software. However, what counts as "foundational knowledge" can vary by context. Some programs teach technically detailed than others. In this study, teachers noted that student understanding of AI was generally the easiest to quiz or test, but ensuring depth of understanding (beyond memorized definitions) remained a concern.

Practical Application of AI: Hands-on skills and creation. The second engagement level centers on students actively using AI tools or developing simple AI projects. In all courses, after understanding the basics, students spend significant time experimenting with AI in practice. They might train a basic model (for example, using a machine learning tool such as Google's Teachable Machine, with provided datasets) or use an AI application to solve a problem (such as creating a chatbot or an image classifier). The goal is for students to become confident power users of AI, and even transition from consumers to creators of AI technology. Key skills include knowing how to choose appropriate AI tools for a task, understanding the steps to build or configure an AI model in the introductory level and interpreting the results of an AI system. One teacher had students use a visual programming environment to build a simple AI (e.g. training a model to recognize rock-paper-scissors gestures), while another had students prepare a custom GPT inside ChatGPT. To measure learning at this practical level, teachers primarily collected project artifacts and performance data. For instance, they assessed project outcomes (Did the AI application the student-built function as intended? Did the student follow correct steps?), looked at process skills (Can the student troubleshoot an AI model that isn't working?), and even peer evaluations during group projects. Sometimes rubrics were used to score how well students applied AI concepts in practice. All teachers agreed that this level is critical and by the end of the course, students should "become creators, not just consumers of AI". A student's ability to independently experiment with an AI tool or adapt it to a new problem was seen as evidence of practical AI literacy. However, evaluating these projects could be subjective. Teachers noted varying complexity in student work and the challenge of fairly assessing individual contributions in group settings.

Critical Analysis of AI: Ethical and societal understanding. The third engagement level involves building a critical, reflective mindset about AI. Teachers want students to not only know and use AI, but to question and evaluate AI systems and their impact on society. In the latter part of the course, class activities shift to discussions and research on topics such as AI's role in society, current progress and future trends in AI, and ethical issues (bias, privacy, transparency, etc.). Students learn about real-world cases where AI systems have led to controversy or harm (for example, biased facial recognition or AI errors in medical diagnoses) to illustrate why ethical scrutiny is needed. They are encouraged to ask questions like "Where did these AI models come from? Is the data accurate and fair? What are the implications if we use AI in a certain context?". One teacher described having students debate a prompt about AI replacing human jobs, requiring them to consider both the benefits and risks of AI advancement. Another had students read an article about AI in policing and write a reflection on fairness and accountability. The expected learning outcomes at this level include the ability to articulate ethical concerns, evaluate the trustworthiness of AI outputs (e.g. recognizing that AI can be wrong or biased), and take informed stances on how AI should or should not be used. To measure this, teachers gathered more qualitative data. They graded reflection essays, monitored participation in discussions or debates, and used rubrics for ethical reasoning in project presentations (for example, awarding points if a student's project consideration included potential misuse or bias of their AI application). All teachers felt this critical engagement was essential for AI literacy. Students should leave with an understanding of AI's limitations and the "broader questions of safe, responsible, and effective use of AI". Yet, assessing critical thinking can be difficult; teachers often relied on subjective judgment of how insightful or thorough a student's analysis was. This is an area where they especially felt the lack of standardized assessment: "How do you measure if a student is thinking critically about AI? It's not a simple test," one interviewee commented. They typically looked for indicators like students raising thoughtful questions or demonstrating a change in perspective during the course.

Across these three engagement levels, teachers collected a variety of learning data to informally analyze student progress: quiz scores and concept checks (for understanding), project deliverables and code/instructions (for practical skills), and written or oral reflections (for critical analysis). The multi-faceted nature of AI literacy meant that no single assessment could cover all dimensions, and thus teachers triangulated evidence. For example, a student who might struggle with the technical project could still show strong critical awareness in an essay, and vice versa. This finding highlights the complexity of measuring AI literacy because it includes cognitive, technical, and ethical domains and reinforces why a combination of assessments is likely necessary.

5. Discussion

This study shows both the challenges and opportunities in defining what to measure in AI literacy education. The interviews with teachers highlight a key challenge that without a consensus or framework, educators are left to interpret AI literacy outcomes on their own. This leadsto inconsistent goals and assessments. This aligns with observations in recent reports that education systems are "missing a foundational step" by not yet agreeing on clear definitions and assessment practices for AI literacy. The consequence is that one program's notion of "AI proficient" may differ from another's and this potentially results in uneven preparedness among students. Our finding that teachers struggled to define what matters reflects this broader ambiguity. It also points to an urgent need for capacity-building. Educators could benefit from professional development and resources to help them set concrete learning objectives and evaluation methods for AI literacy. Initiatives like the TeachAI's AI Literacy Framework (mentioned by some participants and also noted in policy discussions) may offer guidance, but such frameworks must translate into practical tools for classroom assessment.

At the same time, our results are encouraging in that they show a convergence on three core engagement levels that are also well-supported in the literature. The focus on understanding, applying, and critically analyzing AI was common to all teachers we interviewed, and these correspond closely to the competencies identified by AI literacy researchers [5]. Practitioners in the field have gravitated to teaching a balanced blend of knowledge, skills, and critical thinking even in the absence of formal standards. This convergence provides a starting point for defining measurable outcomes. For each engagement level, we can begin to articulate specific learning objectives e.g., "Students can describe how an AI model uses data to make predictions" (Understanding); "Students can build or utilize an AI tool to solve a simple problem" (Practical Application); "Students can evaluate the ethical implications of an AI use case and argue a position" (Critical Analysis). Such objectives can then be aligned with assessment strategies. The interviews in this study suggest some practical measures. Concept quizzes or concept diagrams for understanding, project-based assessments for application, and written reflections or debates for critical analysis. Developing rubrics and standardized tasks around these could be an immediate next step. For example, a rubric for the critical analysis skill might include criteria for identifying biases in an AI system or considering multiple stakeholder perspectives.

5.1. Continuing the study

Moving forward, our research will focus on operationalizing these learning points into concrete assessment tools and analytics. One direction is to design a comprehensive assessment framework that covers the trio of engagement levels. This could involve a combination of a knowledge test, a performance task, and a reflective evaluation. Prior work indicates that it's feasible to create reliable knowledge tests for AI literacy, and our data support complementing that with performance- based and portfolio assessments (especially to capture practical and critical skills). We plan to pilot an "AI Literacy Assessment Package" in collaboration with some of the interviewed teachers: for instance, a short multiple-choice/short-answer test on AI fundamentals, a guided project assignment with a scoring rubric for practical skill, and an ethical case-study essay prompt for critical thinking. Using learning analytics techniques, we will collect data from a larger sample of students completing these assessments to analyze how well each instrument discriminates levels of AI literacy. By correlating results (e.g., do students who score high on concept knowledge also perform well in critical analysis, or are these skills independent?), we aim to validate whether these engagement levels represent distinct dimensions of AI literacy proficiency.

We will also expand the study by involving more educators through surveys or collaborative design workshops. The goal is to refine the set of learning points and ensure they are comprehensive and applicable across different contexts. For example, while our current findings emerged from K-12 teachers, the three engagement levels likely apply to higher education and workforce training as well (with appropriate depth). Future work will explore those contexts and consider additional competencies (such as collaborative skills when working with AI or advanced topics like understanding AI system limitations in detail) that might become relevant at higher expertise levels.

5.2. Limitations

With only four teachers from self-selected programs, the findings may not capture the full diversity of AI literacy teaching experiences. Different schools or countries might emphasize other aspects. For instance, some might integrate AI topics into regular computer science classes or have culturally specific discussions in critical analysis. Therefore, the three engagement levels identified should be validated in broader settings. Nonetheless, the alignment between our findings and existing AI literacy frameworks lends credibility to their relevance. Moreover, thisstudy relied on self-reported practices; observing classrooms directly or analyzing student work could provide further evidence to substantiate what teachers reported. We intend to incorporate such data in the next phase of research.

6. Conclusion

As AI continues to reshape the landscape of education and work, there is a growing consensus that all learners need a basic level of AI literacy. This paper tackled a foundational question for the field of AI education: What should we measure to determine that someone has attained AI literacy? Through interviews with AI literacy educators, we identified three crucial engagement levels that summarize AI literacy learning: understanding AI concepts, practical application of AI, and critical analysis of AI's impact. For each of these, we outlined specific learning points and current teacher practices in improving and assessing those skills. Our findings highlight a clear gap that teachers currently lack standardized outcomes and assessments. But it is also a clear opportunity, as the areas of consensus provide a blueprint for building those very assessments.

In defining learning points across the conceptual, practical, and critical domains of AI literacy, this work contributes towards a framework for AI literacy assessment that can be adopted and refined by the education community. The implications for the Learning Analytics and Knowledge community are significant with defined learning outcomes, researchers and practitioners can develop analytics to track student interactions with AI tools, analyze conceptual understanding through intelligent tutoring systems, or measure growth in ethical reasoning via discourse analysis. Ultimately, the ability to measure AI literacy will enable educators to identify who needs support, track progress, and ensure equitable development of AI skills. Consistent measurement and standards can prevent a scenario where some students receive only superficial exposure to AI while others gain deep, actionable literacy.

In conclusion, clarifying "what to measure" is a critical step in advancing AI literacy education. By listening to teachers and aligning with scholarly frameworks, we have proposed a set of learning points that can report curriculum design and assessment. As we continue this research, we move closer to a future where AI literacy is not just an educational buzzword, but a well-defined, measurable competency. Such clarity will help ensure that every student is prepared to engage with AI thoughtfully, effectively, and ethically in the years to come. The stakes are high; AI literacy is fast becoming as indispensable as reading and math in the 21st century, and our educational practices must rise to the challenge by providing clear goals and evidence-based pathways to achieve them.

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Declaration on Generative AI

During the preparation of this work, the author used ChatGPT-5.2 in order to: Grammar and spelling check. Further, the author used ChatGPT-5.4 for figure 1 in order to: Generate images. After using these tool(s)/service(s), the author reviewed and edited the content as needed and takes full responsibility for the publication's content.