Chapter 1

GenAI Digital Literacies

EXPANDING BEYOND TRADITIONAL DIGITAL LITERACY SKILLS

I earned my PhD in reading education from Syracuse University in 1999. My dissertation explored K–12 teachers' perspectives on how the internet influenced literacy and literacy instruction in their classrooms. It was published in Reading Research Quarterly, if you'd like to read it (Karchmer, 2001). I became interested in this topic because, in the late 1990s, a growing body of evidence suggested that technological proficiency would be essential for our children's futures (e.g., Drucker, 1994; The New London Group, 1996). The global economy shifted toward an information-based model emphasizing quick, collaborative communication, requiring new literacy competencies beyond reading and writing traditional print texts.

Back then, the call was clear: Students needed to be proficient in problem solving, critical thinking, digital reading, and digital writing. These skills were seen as necessary for navigating digital landscapes, working collaboratively, and communicating effectively across formats and contexts.

More than two decades later, I am still researching, writing, and preaching about the same core literacy skills, but the context has now changed dramatically. The emergence of generative artificial intelligence (GenAI) has broadened the scope of digital literacies beyond foundational skills. Students are no longer just locating and evaluating information created by others—they are interacting with content generated in real time by algorithms based on patterns learned from massive data sets. This change introduces new complexities, such as refining artificial

intelligence (AI)-generated responses, recognizing embedded biases, and evaluating credibility not based on who wrote it but how it was created.

While GenAI is a fundamentally different tool from the early internet, the literacy skills required to engage with it meaningfully remain strikingly familiar. What has changed is the need to extend those foundational skills—problem solving, critical thinking, digital reading, and digital writing—into new territory. As educators, we are not abandoning what we have long valued but rather expanding it to meet the demands of a new digital landscape.

Building Blocks of Deep Learning: Four Literacy Skills

Literacy skills are the building blocks for understanding and interacting with the world. They extend far beyond decoding and reading fluently to include problem solving, critical thinking, and reading and writing texts. These skills lay the groundwork for lifelong learning. Through literacy, individuals pose meaningful questions, engage in thoughtful discourse, and construct knowledge that transcends surface-level understanding.

Literacy skills do not function in isolation; they are deeply interwoven with how individuals engage in their fields of study and professions. A historian evaluates sources and builds arguments based on evidence, while a scientist examines data and communicates findings clearly. Professionals engage in persuasive discussions in business, and in law, precise language can influence a case's outcome. This perspective aligns with McConachie and Petrosky's (2010) definition of disciplinary literacy, which emphasizes that learning within a discipline requires students to read, write, think, and solve problems using the terminology of that profession. The teacher's role is to design intentional literacy instruction that is closely connected to disciplinary practices. The next section of this chapter explores each of the literacy skills mentioned above. It demonstrates how they can be effectively integrated into middle and high school teaching and learning.

Problem Solving

Students need problem-solving skills to tackle challenges, consider different perspectives, and formulate well-reasoned solutions. Research indicates that students engaged in inquiry-based learning have a greater capacity to adapt prior knowledge to solve new problems and develop stronger reasoning abilities (Glazewski & Hmelo-Silver, 2019). Instruction that includes problem solving goes beyond rote learning and prompts students to refine their thinking through iteration, questioning, and reflection.

Teachers can support problem solving by designing real-world challenges that require students to apply their knowledge in new contexts (see Table 1.1). Instead

TABLE 1.1. Classroom Applications: Problem Solving

Discipline	Classroom application
Environmental science	Investigate solutions for reducing plastic waste in a local community by analyzing current waste management systems and proposing actionable improvements.
Forensic science	Determine the most effective method for lifting fingerprints in an investigation.
Pre-algebra	Solve a real-world budgeting problem by calculating costs, comparing financial options, and determining the most cost-effective solutions.
English language arts	Rewrite the ending of a novel by analyzing character motivations, identifying narrative gaps, and proposing a solution that resolves conflicting themes.
Marketing	Analyze a struggling brand by diagnosing the reasons for its decline, researching consumer behavior, and developing a data-driven marketing pivot to improve its market presence.

of following step-by-step instructions, students benefit from open-ended tasks that allow for multiple approaches and solutions.

Critical Thinking

Critical thinking incorporates a range of cognitive skills, including interpreting, analyzing, synthesizing, reasoning, and evaluating information. Research consistently demonstrates that critical thinking can be explicitly taught and developed through instruction, encouraging educators to integrate it into their teaching practices (Dwyer, 2023).

Explicit critical thinking instruction provides structured opportunities for students to evaluate sources, test ideas, justify claims, and analyze reasoning (see Table 1.2). Strategies like structured debates, case study evaluations, and Socratic seminars encourage students to question assumptions and apply reasoning meaningfully. Embedding critical thinking into discipline-specific instruction helps students move beyond memorization, requiring them to analyze situations in relevant, authentic, and transferable ways across contexts.

Reading Texts

Reading comprehension is more than recognizing words on a page. It requires analyzing, synthesizing, and interpreting meaning within texts. Students must learn to navigate sophisticated material, identify key ideas, and make connections

TABLE 1.2. Classroom Applications: Critical Thinking

Discipline	Classroom application
World languages	Compare how cultural perspectives influence language by analyzing translations of idiomatic expressions, identifying shifts in meaning, and explaining the significance of linguistic nuance.
Music theory	Critically assess how a musical composition conveys emotion by analyzing the interplay of harmony, rhythm, and dynamics, and arguing how different interpretations affect the listener's perception.
Psychology	Critique psychology research studies by evaluating the experimental design, identifying ethical concerns, and determining whether the conclusions are supported by the data.
History	Assess the reliability of primary and secondary sources on a historical event by identifying author biases, cross-referencing accounts, and determining which sources provide the most accurate representation of the past.
Government and civics	Investigate the impact of media bias on public opinion by comparing news coverage from different political perspectives and evaluating the role of language in shaping narratives.

across concepts (Shanahan & Shanahan, 2008). Research shows that exposure to longer texts may build students' reasoning skills, deepen content knowledge, and strengthen their ability to synthesize information when scaffolds are put in place to help them remain on task (Reynolds & Fisher, 2022).

Explicit instruction in reading comprehension involves modeling close reading strategies, teaching disciplinary reading approaches, and guiding students to extract meaning from dense or technical materials (see Table 1.3). Strategies such as annotation, questioning the text, text-based discussions, and comparative analysis help students engage with challenging material and develop deeper transferable literacy skills across disciplines (Lewis & Strong, 2020).

Writing Texts

Writing is a powerful tool for learning and communication. Students who can clearly express their ideas in writing demonstrate a deep understanding of content, strong reasoning skills, and the ability to support arguments with evidence (Graham et al., 2018). Writing is not just a way to record information. It is a process that helps students refine their thinking, organize complex ideas, and engage in meaning making across disciplines (Bazerman et al., 2017).

Explicit instruction in writing involves teaching students how to construct well-organized, evidence-based, and discipline-specific texts. Strategies such as outlining, revising cycles, writing for different audiences, and effectively integrating

sources help students develop stronger writing skills (see Table 1.4). When writing regularly, students build the capacity to explain their reasoning, analyze concepts, and communicate effectively in both academic and real-world contexts (Graham et al., 2018).

Applying Multiple Literacy Skills across Disciplines

Outlining each of the literacy skills above was meant to underscore their significance in student learning. However, each skill works in conjunction with at least one other skill, if not more. For example, when students are expected to think critically about content, they will likely engage with texts as part of the process. Similarly, problem solving often involves synthesizing information from various sources, connecting ideas, and effectively communicating solutions through writing.

Mehta and Fine's (2019) concept of deep learning applies directly to this literacy discussion. It is a powerful teaching approach that combines mastery, identity, and creativity in the classroom. For teachers, this means designing lessons that challenge students to use multiple literacy skills simultaneously. When students engage in these rich, multifaceted activities, they are not just memorizing facts but developing expertise, seeing themselves as capable learners in the subject, and applying their knowledge creatively.

Teachers integrating multiple literacy skills within a single lesson create a deeper, more meaningful learning experience. Students are more likely to retain

TABLE 1.3. Classroom Applications: Reading Texts

Discipline	Classroom application
World languages	Translate and analyze a literary text from another language by identifying cultural influences, recognizing linguistic structures, and comparing interpretations across different translations.
Music theory	Analyze a composer's written explanation of their work by identifying stylistic choices, comparing them to the actual composition, and evaluating how theory translates into practice.
English language arts	Compare the rhetorical strategies in two argumentative essays by identifying tone, structure, and evidence use, and evaluating the effectiveness of each argument.
Mathematics	Interpret a mathematical proof by breaking down each logical step, identifying assumptions, and explaining the reasoning in simpler terms.
Graphic design	Analyze a multimodal advertisement or artwork by evaluating how text, images, colors, and layout work together to convey meaning, influence perception, and communicate a message effectively.

TABLE 1.4. Classroom Applications: Writing Complex Texts

Discipline	Classroom application
Journalism	Write an investigative article on a school or community issue by conducting interviews, gathering evidence, and structuring a compelling narrative.
Anatomy	Write a research summary explaining how a specific organ system functions, integrating peer-reviewed scientific sources and real-world applications.
Engineering	Document the design process for a prototype, detailing problem-solving approaches, technical specifications, and iterative improvements.
Music and performing arts	Develop a critical review of a musical or theatrical performance, analyzing how different artistic elements contribute to storytelling and emotional impact.
Biology	Write an explanatory essay on the process of photosynthesis, using simple analogies and diagrams to communicate key concepts to a younger audience.

and apply what they have learned in new situations, which is the hallmark of true understanding. Table 1.5 provides cross-disciplinary examples of classroom applications to illustrate how to frame lessons incorporating multiple literacy skills.

Applying Literacy Skills in a Digital World

As literacy skills remain central to students' engagement with information, it is essential to consider how their application has evolved in response to digital technologies. Digital literacy instruction gained traction after the Common Core State Standards (CCSS) Initiative (National Governors Association Center for Best Practices & Council of Chief State School Officers [NGA & CCSSO], 2010) emphasized that, to be college and career ready, students in grades 6–12 must be able to read, write, and interpret digital texts and media.

Traditionally, digital literacy instruction has focused on skills such as navigating online environments, evaluating sources for credibility, composing multimodal texts, and engaging responsibly with digital content (Coiro, 2021; Smith et al., 2021). These competencies remain essential, but they are no longer sufficient.

With the rise of GenAI, students are no longer just retrieving and analyzing human-created content. They interact with dynamically generated responses produced in real time based on human-generated prompts. This presents new challenges: understanding how AI-generated content is constructed, identifying potential biases or inaccuracies, refining outputs, and integrating those responses thoughtfully into their own thinking and writing.

TABLE 1.5. Classroom Applications: Multiple Literacy Skills

Disciplines	Classroom application	Multiple literacy skills
World languages and geography	Students study a region where multiple languages are spoken, analyzing how geography influences language use and writing a bilingual travel guide incorporating cultural insights.	• Critical thinking • Reading texts • Writing texts
Business and psychology	Students research consumer behavior and create a persuasive marketing campaign based on psychological principles of decision making and advertising.	• Critical thinking • Problem solving • Reading texts • Writing texts
Science and journalism	Students conduct a simple environmental science experiment, interpret their results, and write a news article explaining the findings for a general audience.	• Critical thinking • Problem solving • Reading texts • Writing texts
STEM and ethics	Students investigate the ethical implications of artificial intelligence in healthcare, evaluating scientific reports, patient privacy laws, and medical ethics frameworks before drafting a policy recommendation.	• Critical thinking • Reading texts • Writing texts

Note. STEM, science, technology, engineering, and mathematics.

Digital literacy education must, therefore, evolve. Building on foundational skills, students must now learn to co-construct knowledge with AI tools and interrogate how generative systems function. Was a response shaped by biased training data? Does it reinforce stereotypes? How does it compare to human-authored content in the same discipline? These kinds of critical questions define AI digital literacy, a framework that helps students navigate AI's generative and iterative nature as both creators and critical thinkers.

Try It Out Investigating AI Bias through Image Generation

Try the activity described in Table 1.6 and see what you uncover when you prompt a GenAI to generate an image. My input was:

> Create an image of a farming conference with a room full of farmers listening to a speaker. The speaker stands at the front of the room, and the audience listens intently to the presenter's speech.

Figure 1.1 shows the image produced by Gemini. A closer look reveals several embedded biases: nearly all attendees are White males, the speaker is a White male, and the outfit of choice consists of jeans and a baseball cap.

The biases revealed in this single image highlight a deeper truth: engaging with AI tools requires more than technical proficiency. It demands a critical literacy mindset. As AI becomes more embedded in students' learning experiences,

we must expand our understanding of digital literacy to account for how algorithms generate, shape, and present knowledge.

Table 1.7 illustrates how existing digital literacy skills are being extended and reimagined to prepare students for thoughtful, critical engagement with AI-generated content. When these changes are regularly integrated into instruction, students improve upon the skills necessary to critically engage with AI tools by questioning AI-generated outputs and utilizing AI for deeper learning.

TABLE 1.6. Investigating AI Bias through Image Generation

Step	Action	Purpose
1	Choose a GenAI image tool (e.g., Gemini, DALL·E, Bing Image Creator).	Familiarize yourself with a tool students may encounter or use in the classroom.
2	Use this customizable prompt: "Create an image of a [type of] conference with a room full of [type of people] listening to a speaker."	
3	Examine the generated image carefully.	Look for patterns in gender, race, attire, setting, and roles (e.g., who is speaking vs. who is listening).
4	Reflect on the following questions: • Who is represented? • Who is missing? • What assumptions might the AI have made? • How could you revise the prompt to encourage more inclusive outputs?	Begin developing a critical lens toward how GenAI constructs meaning—and how it can subtly reinforce social norms and biases.

FIGURE 1.1. Farm conference image generated by Gemini.

TABLE 1.7. Traditional versus AI-Digital Literacy Skills

Literacy skill	Traditional digital literacy skills	AI digital literacy skills
Problem solving	• Navigating search engines effectively • Identifying relevant online sources • Applying technology tools to solve content-related problems	• Prompt engineering (iterative refinement of AI responses) • Evaluating AI-generated solutions for accuracy and logic • Debugging AI-generated errors or inconsistencies
Critical thinking	• Assessing credibility of online sources • Recognizing bias and misinformation • Ethical considerations in digital spaces (digital citizenship, plagiarism)	• Detecting hallucinations in AI-generated content • Identifying bias embedded in AI models • Applying AI ethics in decision making (academic integrity, responsible use)
Reading texts	• Summarizing digital texts • Evaluating multimodal content (text, images, videos) • Recognizing an author's perspective and intent	• Analyzing AI-generated summaries for completeness and accuracy • Interpreting AI-generated multimodal content critically • Refining AI-generated explanations to align with disciplinary knowledge
Writing texts	• Organizing ideas through digital composition • Revising and editing using digital tools • Citing and integrating online sources appropriately	• Using AI tools for iterative revision and feedback • Developing AI-assisted outlines while maintaining originality • Fact-checking AI-generated research before incorporating it into writing

Cognitive Flexibility in an AI-Driven Learning Environment

Like the "ill-structured" digital environments of the internet (Coiro & Dobler, 2007, p. 246), GenAI tools do not operate within a fixed, linear system. Instead, they create a dynamic, interactive space where meaning must be assembled, negotiated, and critically applied. AI-generated responses are unpredictable and highly context dependent, varying based on how a question is framed, the specificity of the prompt, and the iterations made during refinement. GenAI content is shaped by algorithms rather than absolute truth—therefore, users must recognize when outputs plagiarize a source, reinforce stereotypes, or oversimplify complex information. More importantly, they must develop cognitive flexibility—"the ability to hold multiple elements of a task in mind and actively switch between them" (Cartwright, 2023, p. xv)—to adjust their approach accordingly. Without this adaptive thinking, students risk passively accepting AI-generated content without questioning its validity or ethical implications.

Developing cognitive flexibility is particularly critical in middle and high school classrooms, where students are expected to engage in higher-order thinking skills, such as analysis, evaluation, and synthesis. At the secondary level, disciplinary literacy demands more than basic comprehension. It requires students to engage in subject-specific reasoning that acknowledges multiple perspectives, conflicting interpretations, and evolving knowledge within each field.

For example, imagine a high school history student using GenAI to research the causes of the French Revolution. The AI-generated response may provide an overview of key events yet omit marginalized voices, oversimplify socioeconomic complexities, or reflect biases in its training data. A student lacking cognitive flexibility might accept this response uncritically, assuming history as a fixed set of facts rather than a discipline that requires analysis and interpretation. An AI-literate student, however, would recognize the limitations of the AI-generated content and challenge the reliability of its claims, seek additional sources, and critically evaluate how the AI constructed its historical narrative. Rather than refining their query, they would question the underlying assumptions embedded in the AI's response and consider how historical argumentation, evidence, and multiple viewpoints shape understanding.

This same need for adaptive reasoning extends to other disciplines. A science student using GenAI to generate a hypothesis for a lab experiment should assess whether the technology's reasoning aligns with scientific principles. Since GenAI cannot conduct experiments or troubleshoot methodological errors, students must apply their own disciplinary knowledge to determine the validity of AI-generated hypotheses. Similarly, in mathematics, AI-generated solutions may appear correct at first glance. Yet, students must justify their answers, verify steps, and ensure AI's reasoning aligns with mathematical methods rather than blindly accepting computational outputs.

Cognitive flexibility is especially important when students engage with AI-generated multimodal texts across disciplines. In today's classrooms, students increasingly consume AI-generated presentations, infographics, and interactive media. To critically engage with these texts, students must determine how different modes of communication (e.g., text, audio, visuals, animations) contribute to meaning. For instance, when analyzing an AI-generated environmental science video, they must ask:

- Does the spoken narration provide the most critical insights, or does the on-screen text emphasize key ideas?
- Do the images and animations influence how the event is perceived?
- How do the modes work together and present a balanced or biased view?

Without cognitive flexibility, students may over-rely on a single mode, misinterpreting key ideas or overlooking how different forms of communication interact to shape understanding (Karchmer-Klein & Shinas, 2019; Kress, 1998). Just as

students must evaluate written sources for credibility, they must learn to decode, compare, and critique AI-generated multimodal compositions. This skill is essential as AI-generated media becomes increasingly prevalent in education, journalism, and other professional fields.

Classroom Application: GenAI Digital Literacy and Cognitive Flexibility

Effectively integrating GenAI into learning requires students to develop AI digital literacy and cognitive flexibility, skills that enable them to engage with AI-generated content rather than passively accept it critically. Digital literacy skills help students assess sources, interpret multimodal texts, and apply disciplinary reasoning. At the same time, cognitive flexibility ensures they can challenge, adjust, and rethink AI outputs when faced with inaccuracies, biases, or missing perspectives. Tables 1.8 and 1.9 illustrate lessons that emphasize cognitive flexibility in multimodal learning, increasing students' awareness of how meaning is constructed across various modes (e.g., text, images, audio). These activities do not require AI skills. Instead, their purpose is to home in on cognitive flexibility—in other words, the ability to adapt to digital environments. These lessons lay the foundation for more complex AI integration in later chapters by reinforcing essential literacy practices that prepare students to analyze and question more sophisticated AI-generated content.

TABLE 1.8. Lesson Idea for Building Cognitive Flexibility in English Language Arts

	Middle school English language arts: Evaluating AI-generated stories
Learning objective	Practice cognitive flexibility by determining which mode holds the most meaning of the story.
Activity 1	Students use Canva's AI Video Generator to create a book trailer for a novel they have read. The AI-generated trailer includes text overlays, images, music, and audio narration.
Activity 2	A classmate watches the AI-generated trailer and responds to the following questions: • Does the narration carry the most critical information, or do the text and visuals do more of the storytelling? • If the text were removed, would the visuals and audio still convey the story's tone and theme? • Are the different modes working together, or is one mode doing most of the work?
How this builds cognitive flexibility	• Builds awareness that digital texts are composed of multiple modes. • Builds awareness of the need for flexibility when interpreting and integrating meaning across different modes of communication.

TABLE 1.9. Lesson Idea for Building Cognitive Flexibility Using Documentaries

High school history: Analyzing authenticity and trust in *The Frozen Planet*	
Learning objective	Practice cognitive flexibility by analyzing how different modes contribute to meaning in a documentary Assess how editing choices can shape viewers' understanding
Activity 1	Students watch the scene from *The Frozen Planet* documentary depicting the birth of polar bear cubs, which was later revealed to have been filmed in a zoo rather than in the wild.
Activity 2	In pairs, students discuss the following questions: • How does David Attenborough's narration contribute to the sense of realism? • What role do the visuals play in shaping the audience's perception of the event? • Does the film's use of real and staged footage change how the event is understood? • How might a viewer's trust in the documentary be affected upon learning the truth about the scene's production?
How this builds cognitive flexibility	Encourages students to: • Analyze how multimodal elements interact to construct meaning • Recognize the role of editing in shaping perception • Question how trust is built (or broken) in documentary filmmaking

Conclusion

At their core, literacy skills—problem solving, critical thinking, reading, and writing—have long been essential for student learning across disciplines. These interwoven skills empower learners to ask meaningful questions, analyze information, construct arguments, and communicate clearly. This chapter has outlined that they are not simply academic competencies but the foundation for deep, transferable learning.

The rise of the internet introduced nonlinear, multimodal, and often ambiguous information environments. Students had to develop digital literacy skills to navigate online texts, evaluate credibility, synthesize sources, and compose across formats. This transformation also demanded cognitive flexibility: the ability to adapt their thinking to make sense of complex, ever-changing digital content.

Today, the emergence of GenAI represents the next major expansion in this progression. Students are no longer just evaluating static digital content. They engage with dynamically generated responses, co-creating content through prompts and interacting with tools that simulate human reasoning. These developments do not replace traditional literacy skills—rather, they extend and recontextualize them. Students must now apply their problem-solving, critical thinking, reading, and writing skills in interactive, algorithm-driven environments where

knowledge is constructed in real time. And, cognitive flexibility remains essential in this AI-infused world. Students must learn to interrogate how AI content is created, identify embedded assumptions, and refine their thinking through iteration and critical reflection. This is what it means to be literate in the age of GenAI: to collaborate with AI tools thoughtfully, using them to deepen understanding rather than shortcut learning.

The following chapters build upon this foundation, exploring the intersection of GenAI literacy with disciplinary literacy practices. Through practical strategies and ready-to-use classroom examples, we examine how educators can guide students to become critical thinkers who are capable of problem solving and proficient in reading and writing using GenAI.

Teacher Reflection Questions

Use the questions below to reflect on your current approach to digital literacy instruction and consider how GenAI might reshape how students read, write, think critically, and solve problems in your classroom.

1. How do I currently teach problem solving, critical thinking, and reading and writing complex texts in my classroom? How are these skills integrated into my everyday instruction?
2. How might digital tools, including online platforms and AI-powered resources, influence students' ability to apply these literacy skills effectively? What benefits or challenges have I observed?
3. How do digital tools enhance or complicate my literacy instruction? What strategies can I use to ensure they support rather than distract from learning?
4. How comfortable am I with teaching digital literacies in my current context? What professional learning or support would help me grow in this area?

ETHICAL DILEMMA AND DISCUSSION PROMPTS

Ethical Dilemma: Choice or Confusion?

You have spent the semester teaching your high school students how to use GenAI tools to support their learning. For a culminating project, you offer them the option to use AI to help plan, research, and present their final argument on a controversial topic of their choice. Some students embrace the freedom, while others feel overwhelmed by the sheer number of AI tools and the constant decisions they must make.

- Which tool is best for research?
- Should they start with AI or draft their ideas first?
- How much should they edit AI responses before using them?

One student tells you, "There are too many choices. I don't even know where to start." Another says, "I just asked AI for everything. It was easier than figuring out what I wanted to say." You notice that some students thrive with the flexibility, while others seem stuck in analysis paralysis or, worse, defaulting to full AI dependence. You're torn. You want to give students agency, but you're beginning to wonder whether the freedom to choose tools, formats, and processes hinders learning for some students who lack the cognitive flexibility to manage complex tasks.

Discussion Prompts

1. How do we balance student autonomy with appropriate structure in AI-enhanced learning environments?
2. When does choice empower students and when does it overwhelm them?
3. How do we support the development of cognitive flexibility without asking students to juggle too many moving parts too soon?