EDUCATIONAL TECHNOLOGY & AI GUIDANCE FOR MATH LEADERS

HARNESSING TECHNOLOGY.
LEADING WITH CONFIDENCE.

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Leadership in Mathematics Education

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1 INTRODUCTION

Purpose of the Guide

The goal of this guide is to support mathematics education leaders—at the school, district, and state levels—in making informed, instructional decisions about educational technology and artificial intelligence (AI). This is not a how-to manual for using specific tools. Instead, it offers a framework for leadership: one that prioritizes equity, reasoning, and teacher agency at a time when technology is rapidly reshaping classrooms.

At its core, this guide is about preserving and advancing high-quality mathematics instruction in an era when external tools—particularly AI systems—are increasingly positioned as solutions to instructional challenges.

Math leaders are uniquely positioned to ask the critical questions:

- How does this tool deepen student thinking?
- How does this tool align with what we know about how students learn mathematics?
- How does this tool amplify teacher insight or override it?

This guide exists to support those questions and to ensure that math leadership stays at the center of conversations about technology.

Why Guidance Is Needed Now

The speed of technological change has outpaced the systems designed to evaluate and implement it. Many schools and districts are making decisions about AI tools without fully understanding how these systems work, what data they collect, or how they affect classroom instruction. In some cases, tools are adopted based on marketing claims rather than instructional alignment.

Meanwhile, educators are being asked to integrate platforms that may subtly shift their role—from instructional designers to facilitators of prestructured, algorithm-driven content. Without careful guidance, this shift risks undermining the goals of rigorous, equitable math instruction.

Math education has always required thoughtful, responsive teaching. AI does not change that. But it does raise new questions:

- What does it mean to "personalize" math learning?
- How do we ensure that AI-generated feedback supports reasoning, not just correctness?
- How do we prepare teachers and students to interact with AI in ways that build mathematical identity and agency?

This guide provides the foundation for navigating these questions with clarity and purpose.

The Evolving Role of Educational Technology and AI in Math Education

Technology in math education is not new. As outlined in Section 2 of this guide, educators have long used tools—from graphing calculators to adaptive software—to support learning. What has changed is not true autonomy but rather the illusion of agency these tools present. Because they communicate fluently in our meaning-making system—language—they can appear to have personality and intent, making them easier to anthropomorphize than earlier tools.

Today's AI-driven platforms can:

- Generate math tasks, explanations, and assessments in real time
- Analyze student responses and generate recommendations that can influence instructional decisions
- Simulate tutoring or feedback
- Influence the pacing, content, and representation of mathematics

This shift represents more than an evolution in technology. It signals a new phase of educational decision-making—one in which machine-driven outputs must be filtered through a human lens of instructional integrity. The role of the math leader is to ensure that AI and other technologies serve the learning goals of students—not the other way around.

How to Use This Guide

This guide is designed to be practical, flexible, and grounded in classroom reality. It can be used in a variety of ways:

- Individually, to reflect on your own leadership decisions and technology adoption practices
- With leadership teams, to guide collaborative discussions about tool evaluation and policy development
- In professional learning, as a framework for building AI literacy among teachers and instructional coaches

This guide includes:

- Core concepts grounded in research and practice
- Leadership guidance aligned to NCSM and NCTM instructional frameworks
- Rubrics, tools, and protocols that can be used in real-time decision-making
- Resources for deeper learning and ongoing professional development

You do not need to read cover to cover to benefit. Start with the sections most relevant to your current work. Revisit others as your district's needs evolve. Use the guidance rubric (Section 8) as a living tool to revisit each year as your context changes.

Above all, use this guide to stay grounded in what matters most:

Students thinking deeply. Teachers leading with integrity. Technology used in the service of learning.

2 UNDERSTANDING THE LANDSCAPE

Brief History of Educational Technology in Math Classrooms

Educational technology has long been positioned as a lever for equity and efficiency in mathematics education. From early drill-and-practice software to full-scale learning management systems, technology has often been promoted as a way to "modernize" math instruction. Yet the actual impact on teaching and learning has been mixed.

Early waves of math edtech (1980s–2000s):

- **Skill-based software** (e.g., Math Blaster, Accelerated Math) focused heavily on automaticity and isolated procedures.
- **Graphing calculators** became essential tools in secondary math, enabling visualization and modeling but requiring thoughtful integration.
- **Smartboards and interactive whiteboards** promised engagement but often reinforced teacher-centered instruction.
- **Online homework systems** like MyMathLab and Khan Academy gave students flexible access to practice—but often outside the context of classroom discussion or feedback.

During these decades, most tools were designed to support teacher delivery or student practice, but rarely to transform the nature of the mathematical thinking being done. Even collaborative tools or video platforms tended to reinforce a consumption-based model of learning.

What persisted:

- A tendency to conflate engagement with interaction, rather than thinking
- An emphasis on efficiency, coverage, and data—sometimes at the cost of conceptual depth
- Unequal access to technology, particularly in underserved schools and districts

What's Changed With the Emergence of AI

The current wave of educational technology is marked by a significant shift: the integration of artificial intelligence into tools that now not only deliver content but also generate content, analyze student performance, and make decisions that shape instruction.

According to the U.S. Department of Education's (2024) *AI Integration Toolkit*, AI in education includes:

- **Predictive systems** that assess readiness or suggest interventions
- **Generative tools** that create lessons, assessments, or feedback (e.g., MagicSchool, Khanmigo, Curipod)

- **Adaptive learning environments** that change difficulty or pacing in real time
- **Conversational agents** or chatbots that simulate tutoring or feedback
- **Analytics dashboards** powered by machine learning, identifying patterns across student data

What sets AI apart from earlier technologies is its complexity and ability to generate unpredictable outputs. Unlike static platforms, AI-powered tools:

- Produce recommendations and outputs based on patterns and algorithms
- Generate new content that did not previously exist
- Operate behind the scenes, making their reasoning difficult for teachers to see or question

This raises serious implications for:

- **Teacher agency:** Will AI suggestions override professional judgment?
- **Student identity:** Will students internalize system-generated labels or feedback?
- **Instructional integrity:** Will tools support conceptual learning or reduce math to a checklist? Given that large language models are trained on large data sets—and that much of edtech has historically emphasized procedural fluency over conceptual understanding—there is a real risk of AI reinforcing suboptimal instructional practices if the models are not carefully trained or thoughtfully applied.
- **Professional community:** Will reliance on AI weaken collaboration among educators, reducing the valuable mentorship and pedagogical dialogue that occurs when teachers learn from one another?

As Digital Promise's (2024) *AI Literacy Framework* notes, "AI is not just another tool. It reshapes the relationship between people and technology, especially in learning environments."

For math leaders, this means that traditional edtech evaluation practices are no longer sufficient. Understanding how AI systems are trained, how they generate responses, and how they may encode bias is now part of responsible instructional leadership.

Common Features and Types of Technologies in Math Education Today

To lead effectively in this space, math leaders need a working understanding of the main categories of technology currently used in math classrooms. Each tool type brings different benefits, limitations, and implications for instruction.

(Note: The following examples are provided as reference points that leaders may recognize. Their inclusion does not imply endorsement, and tools evolve rapidly. Categories are the focus, not specific products.)

1. Collaborative and Representational Tools

Examples you may have experience with: Desmos, GeoGebra, Pear Deck

These tools emphasize mathematical modeling, visualization, and discourse.

Implications:

- Strong alignment with NCTM's (2014) *Principles to Actions* and effective teaching practices
- Support student reasoning, exploration, and construction of ideas
- Often underutilized in favor of systems that promise faster, more procedural results

2. Adaptive Practice Platforms

Examples you may have experience with: DreamBox, ALEKS, IXL

These tools adjust content in real time based on student performance. They often emphasize procedural fluency, automaticity, and standards alignment.

Implications:

- Can provide targeted practice at scale
- May limit reasoning and discourse if used in isolation
- Risk reinforcing a deficit model when students are tracked into remediation

3. Instructional Planning and Generative AI Tools

Examples you may have experience with: MagicSchool AI, Diffit, Eduaide.ai

These tools create instructional materials—lesson plans, exit tickets, leveled tasks—based on user prompts.

Implications:

- Can enhance teacher efficiency and differentiation
- Output quality depends heavily on teacher input and the model's training data
- May reflect biases in how tasks are framed, leveled, or presented
- Reinforces the importance of human oversight to ensure materials support conceptual learning rather than defaulting to procedural checklists

4. Assessment and Feedback Tools

Examples you may have experience with: Formative, Edulastic, Khanmigo

Tools in this category collect and analyze student responses, sometimes offering automated feedback or pathways based on results.

Implications:

- Can support formative insight, but only if teachers engage meaningfully with the data
- Automated feedback may be shallow or misaligned with conceptual goals
- Raises questions about data transparency, algorithmic bias, and the perception of "machine-driven" judgments

The Takeaway for Math Leaders

Not all tools are created equal—and none are neutral. As AI continues to evolve, the math education community must resist pressures to adopt tools simply because they are innovative. Instead, leaders should ask:

- How does this tool position students—as thinkers or as responders?
- How does it position teachers—as facilitators or as executors of a program?
- How does it shape what counts as doing mathematics?

Understanding the landscape of educational technology is not about becoming a tech expert. It's about staying grounded in what matters most: equitable, student-centered, reasoning-rich instruction—while also discerning when tools genuinely support efficiency and creativity, as well as when they become distractions.

3 CORE CONSIDERATIONS FOR MATH LEADERS

Instructional Equity and Access

In conversations about educational technology and artificial intelligence, it's easy to center devices, platforms, and data. But for math leaders, the starting point must always be equity. That means asking:

Who benefits from this technology? Who is left out? And how does this tool support or disrupt access to meaningful mathematical learning and belonging?

Access Is More Than Bandwidth

Equity is often reduced to questions of Internet access, 1:1 devices, or login credentials. While those are essential baseline considerations, true access is about something deeper:

- Access to rich mathematical thinking
- Access to instruction that builds identity and agency
- Access to teachers who can respond to individual needs

"A student using a flashy AI platform with fast Internet might still be receiving low-rigor, procedural tasks with no opportunity for discussion, struggle, or connection."

A student using a flashy AI platform with fast Internet might still be receiving low-rigor, procedural tasks with no opportunity for discussion, struggle, or connection. Another student, using no tech at all, might be grappling with complex ideas in a group task with a skilled teacher. Only one of these students has true access.

Equity Means Representation, Voice, and Choice

Math leaders must ensure that any adopted technology aligns with culturally responsive practices. That includes asking:

- Whose voices and cultural knowledge are reflected in the problems and representations?
- Are multilingual learners supported, or filtered through "default English" experiences?
- Can students express their thinking in multiple ways, or are they confined to drop-downs and one-answer boxes?

When AI tools are trained on historical data—often full of bias—they can reproduce inequity at scale if leaders don't intervene with clear expectations for use, feedback, and review.

"AI tools are only as equitable as the systems and people using them."
—U.S. Department of Education, 2024

Equity Requires Human Interpretation

Many AI-powered math tools offer dashboards, flags, or intervention recommendations. But these tools cannot interpret student identity, context, or potential—only teachers can. A low score may reflect a lack of opportunity, not a lack of ability. A student struggling with a problem may be thinking deeply, not failing.

Leaders must position teachers as the primary interpreters of any AI-generated insight—and train them to ask critical questions like:

- What assumptions is this tool making about the student?
- What don't I see in this dashboard that I can learn from student work or conversation?
- Does this "intervention" align with our instructional vision?

Equity Is a Practice, Not a Feature

No AI tool can guarantee equity. It's not built into the code—it's built into how we use it.

When math leaders center instructional equity, they ensure that technology adoption is:

- Rooted in student dignity
- Responsive to real needs
- Aligned with the belief that every student is capable of deep mathematical thinking

This isn't just a nice-to-have. It's the foundation of ethical leadership in the age of AI.

Student Agency and Engagement

Student agency is more than participation. It is the ability of students to make choices, take ownership of their learning, and see themselves as capable contributors to mathematical discourse and problem-solving. In a classroom where students have agency, they are not simply receiving knowledge—they are constructing it.

As AI tools become more embedded in mathematics instruction, math leaders must ask:

How does this tool shape what students do, decide, and believe about themselves as mathematical thinkers?

AI Can Empower or Undermine Student Agency

Many educational technologies advertise "engagement," but engagement without agency can be misleading. A student rapidly clicking through auto-generated tasks may appear busy, but are they reasoning? Are they making sense of mathematics? Or are they performing a sequence of actions designed to be consumed, not questioned?

When technology positions students as passive recipients—accepting solutions, responding to hints, or watching demonstrations—it can inadvertently narrow their intellectual role. Over time, this can erode confidence, persistence, and the development of a positive mathematical identity.

On the other hand, tools that invite exploration, support choice, and promote critique can serve as catalysts for deeper engagement. These tools do not bypass thinking; they support it.

AI and Classroom Discourse

Student agency is not only individual but also collective. Belonging and identity are built when students see themselves as part of a mathematical community where ideas are exchanged, challenged, and refined. AI can either strengthen or weaken this sense of community.

- **Promoting discourse:** AI can provide multiple solution pathways or representations that students debate and critique together, sparking rich classroom conversation.
- **Supporting collaboration:** Tools can scaffold group problem-solving by offering prompts, visualizations, or simulations that become shared objects of inquiry.
- **Risk of isolation:** When students interact only with a tool—clicking through tasks or receiving individualized feedback—their mathematical activity can become fragmented, with fewer opportunities to build affinity and connection with peers.

For math leaders, this means ensuring that AI is used not only to personalize learning for individuals but also to **amplify collective meaning-making**. Classrooms that center discourse and collaboration help students develop both agency and belonging, cultivating empowered communities of learners.

Designing for Agency in AI-Integrated Classrooms

Math leaders should ensure that technology use in classrooms:

- Encourages student sense-making, not just correct answers
- Provides opportunities for students to choose strategies, not just follow steps
- Invites reflection and justification, not just reaction
- Promotes students as collaborators with the tool, not consumers of it

This means shifting the role of AI from answer-generator to idea-provoker. For example:

- A student might use AI to generate multiple representations and then analyze which is most useful.
- An AI-generated explanation could be critiqued for accuracy and clarity as a class warm-up.
- Students might explore a modeling tool that allows them to test hypotheses, make predictions, and revise their thinking based on outcomes.

Each of these uses keeps the student in the role of the thinker.

Implications for Leadership

To support agency, math leaders must:

- Set clear expectations that students—not tools—do the reasoning in math classrooms
- Model and celebrate uses of AI that empower rather than automate
- Include student perspectives when evaluating the impact of a tool
- Ensure teachers have time and support to design learning experiences that promote agency alongside technology

When students are engaged as thinkers and decision-makers, they build not only mathematical skill but also mathematical identity, resilience, and voice—outcomes no AI system can produce on its own.

Teacher Autonomy and Professional Judgment

High-quality mathematics instruction requires professional decision-making. Teachers must draw on their knowledge of students, content, and pedagogy to make real-time adjustments that deepen understanding and sustain engagement. This instructional agility cannot be scripted—and it cannot be replaced by artificial intelligence.

As AI tools enter classrooms, math leaders must consider:

Are we adopting tools that support teacher expertise—or ones that silently override it?

The following tensions reflect common leadership decisions that affect teacher autonomy in the age of AI.

Tension 1: Efficiency Versus Responsiveness

AI systems often promise to save time: They score assessments, adjust pacing, and recommend next steps. But if teachers come to rely on those suggestions without interpreting them through the lens of their classroom knowledge, the result can be instructional outsourcing rather than efficiency.

What's at stake: Teachers may begin to defer to automated suggestions rather than using their judgment, particularly under pressure.

Leadership move: Build time and structures for teachers to review, question, and adapt AI-generated recommendations—framing the tool as input, not instruction.

Tension 2: Consistency Versus Customization

District leaders often seek consistency in instructional tools. But rigid, top-down technology mandates can constrain teachers' ability to modify materials, shift discourse, or adapt to student needs—especially when AI tools are locked into specific progressions or outputs.

What's at stake: Standardization can flatten creativity and limit a teacher's ability to respond to students in the moment.

Leadership move: Ensure adopted tools allow for flexibility and customization, and communicate that teacher adaptation is not only allowed but also expected. Teachers should remain the designers of learning, not just the facilitators of platforms.

Tension 3: Innovation Versus Instructional Integrity

New AI tools may introduce novel features—automated differentiation, generative lesson plans, personalized quizzes—but not all innovations are instructional improvements. Teachers may feel pressure to incorporate AI for the sake of being modern, even if the tool runs counter to their professional knowledge.

What's at stake: Teachers may feel disempowered or evaluated based on how well they implement a tool rather than how well they support student thinking.

Leadership move: Prioritize instructional alignment over novelty. Celebrate teachers who critically evaluate tools and make pedagogical decisions based on student learning—not marketing claims.

Preserving Professional Judgment

Autonomy is not about working in isolation. It is about trusting teachers to make informed choices within a shared vision of high-quality instruction. In AI-integrated classrooms, math leaders must actively protect that space by:

"When teachers are positioned as critical users—not passive implementers—AI becomes a support for instructional thinking, not a substitute for it."

- Providing time to analyze and reflect on tool outputs
- Offering professional learning focused on instructional decision-making, not just tech skills
- Creating opportunities for teachers to share adaptations, concerns, and insights about AI tools in use

When teachers are positioned as critical users—not passive implementers—AI becomes a support for instructional thinking, not a substitute for it.

Data Privacy, Ethics, and Transparency

Leadership Context

As AI and educational technology platforms become more embedded in classroom practice, they collect, analyze, and act on an increasing volume of student data—often in ways that are not immediately visible to teachers, students, or families. These systems may:

- Track problem-solving pathways
- Infer mastery based on response patterns
- Recommend or restrict content based on algorithms
- Store behavioral data over time

While these data can offer insights, they also introduce significant ethical and privacy concerns, especially in mathematics classrooms where student identity and confidence are often vulnerable.

What Math Leaders Need to Know

1. AI is not neutral.
Algorithms are trained on existing data, which often reflects systemic biases. These biases can manifest in:

- Mislabeling student ability
- Recommending interventions disproportionately
- Reinforcing deficit narratives about students from historically marginalized backgrounds

2. Transparency is rare.
Many platforms operate as "black boxes," offering little visibility into:

- How decisions are made
- What data are collected
- Who has access to that data

This lack of transparency limits a teacher's ability to interpret or question AI outputs and hinders efforts to ensure equitable instruction.

3. Legal compliance is not sufficient.
FERPA compliance and consent forms address minimum standards, but math leaders must go further—ensuring that AI systems are used in ways that are aligned with student dignity, instructional purpose, and informed consent.

Leadership Imperatives

→ **Ask deeper questions before adoption.**

- What specific data are collected, and for how long are they stored?
- How are algorithms making instructional decisions or labeling students?
- Can educators and families understand how a student's experience is shaped by the platform?

→ **Center teacher and family interpretation.**

- Equip teachers to critically analyze AI outputs rather than accept them at face value.
- Communicate clearly with families about how AI is being used, why, and with what safeguards.

→ **Protect student identity, not just student data.**

- Ensure the tool supports multiple ways for students to show understanding.
- Avoid overreliance on tools that classify or sort students based on opaque metrics.
- Prioritize tools that allow for student reflection and teacher mediation.

Guiding Principle

Ethical AI use is not just about preventing harm—it's about designing for student empowerment.

Technology should never make decisions that a student or teacher could not explain or question. Math leaders must ensure that data use in mathematics remains transparent, purposeful, and human-centered.

Cultural Relevance and Alignment With Math Identities

A Classroom Moment

In a middle school math class, a student named Adriana is working on a problem-solving task. She asks the teacher if she can explain her reasoning using a diagram she created, rather than typing in the platform's response box. The teacher pauses. The AI system being used doesn't allow for Adriana's way of showing understanding—it only accepts a single, predetermined input format.

Adriana's thinking is rich. Her method is valid. But because the tool can't interpret her reasoning, it will likely mark her response as incorrect and move her to a remediation pathway.

This moment is not just a technical limitation. It's a loss of voice, identity, and agency. And it raises a critical leadership question:

> *Whose ways of thinking and expressing mathematics are valued in this system—and whose are left out?*

Why This Matters

Mathematics identity—the way students see themselves as doers and knowers of math—is shaped by the messages they receive every day. Technology plays a powerful role in those messages:

- What kinds of problems are presented?
- Who is represented in the contexts?
- What types of reasoning are accepted and valued?
- Are students invited to contribute, critique, and make sense—or just perform?

When AI tools are used without consideration of culture, language, and identity, they risk reproducing a narrow vision of mathematical success: fast, correct, procedural, and silent.

But when math leaders demand tools that allow for multiple representations, diverse linguistic inputs, and open-ended reasoning, they open space for students to bring their full selves to mathematics.

Leadership Moves

To ensure cultural relevance and support math identity development, leaders can:

- Vet tools for cultural relevance and representation: Do they include contexts, names, and ways of reasoning that reflect and affirm the identities of the students using them?
- Ask how tools support multiple ways of showing understanding, beyond multiple choice or formulaic responses
- Involve teachers and students in co-constructing AI use—inviting feedback and adaptation
- Ensure classroom instruction creates opportunities for students to build and express mathematical ideas, not just complete tasks

A New Narrative

> **"Culturally relevant mathematics education is not just about what we teach—it's about how students are seen."**

Imagine Adriana's classroom again. But this time, the AI tool supports flexible input. It invites the student to upload her diagram and explain her reasoning. The teacher reviews it, adds commentary, and uses it as a discussion launch point for the class the next day.

Now, the technology is not a barrier—it's a bridge.

Culturally relevant mathematics education is not just about what we teach—it's about how students are seen. AI can support or disrupt that vision. Math leaders shape which one it will be.

Long-Term Impact on Mathematical Reasoning and Problem-Solving

In mathematics education, the stakes are never just about today's lesson or this year's scores. The deeper goal is long-term: to develop students who can think flexibly, reason abstractly, and approach complex problems with confidence and curiosity.

AI tools, by design, are built to optimize performance—efficiency, speed, accuracy. But mathematics is not just about efficiency. It is about reasoning, perseverance, and constructing understanding over time. If technology shortcuts these experiences, we risk raising students who know how to select answers but not how to make sense of them.

What Kind of Thinkers Are We Cultivating?

Consider a student who grows up using AI-powered tools for every math assignment:

- The system generates explanations before they ask questions.
- It flags misconceptions before they can explore why they occurred.
- It moves them forward once they meet a mastery threshold—without reflection or synthesis.

That student may become proficient—but will they become a problem-solver? Will they know how to grapple with ambiguity, construct arguments, or make decisions about which strategies to use and why?

Mathematical reasoning is built through:

- Time
- Struggle
- Talk
- Revision
- Discovery

These are not processes that AI can replace. But they are processes that can be supported—if the tools are designed and used with intention.

The Role of the Math Leader

Math leaders are uniquely positioned to hold the long view. As others may chase new features or faster gains, it is the math leader who must ask:

- Does this tool support deep conceptual understanding over time?
- Does it create space for student reasoning, not just completion?
- Does it help teachers identify and build on students' developing ideas—not just diagnose and label them?

These questions are not barriers to innovation—they are commitments to integrity.

Building a Culture of Thoughtfulness

To protect and promote long-term mathematical development, leaders should:

- Encourage practices that pair AI tools with student discussion and metacognition
- Avoid overuse of platforms that prioritize speed, repetition, or test alignment at the expense of thinking
- Create room for teachers to share how they observe, nurture, and extend reasoning—not just how they use a product

We are not preparing students to be fast. We are preparing them to be thoughtful.

And in a world increasingly shaped by artificial intelligence, thoughtful mathematical problem solvers will be the ones best equipped to lead.

4 WHAT IS AI LITERACY?

Definition and Key Components of AI Literacy for Educators and Students

AI literacy is increasingly recognized as a foundational skill set for both educators and students in today's education landscape. As artificial intelligence continues to shape the tools and systems used in teaching and learning, understanding how to navigate, evaluate, and apply AI responsibly is essential for fostering equity, critical thinking, and instructional effectiveness in mathematics education.

The U.S. Department of Education defines AI literacy as an evolving skillset that enables individuals to understand, evaluate, and use AI-enabled tools in ways that are safe, ethical, effective, and aligned with educational goals. According to their *Empowering Education Leaders* toolkit, AI literacy includes both foundational knowledge and applied skills across three key domains:

- **Awareness:** Understanding what AI is, how it works, and how it's used in education
- **Evaluation:** Critically assessing AI tools for bias, accuracy, transparency, and alignment to learning goals
- **Action:** Applying AI in classroom or leadership contexts in ways that amplify human decision-making, maintain equity, and support student learning (U.S. Department of Education 2024, p. 41)

"Educators, especially those in mathematics, benefit from AI literacy by being able to discern between tools that automate instruction..."

Building on this framework, Digital Promise has released a comprehensive AI Literacy Framework designed to help educators and learners develop the competencies needed to thrive in an AI-enhanced world. Their definition emphasizes that AI literacy is not only about technical understanding but also about civic awareness, critical inquiry, and responsible use. The framework outlines four key pillars of AI literacy:

1. **Understanding AI:** Grasping basic AI concepts and distinguishing between types of AI (e.g., machine learning, generative AI)
2. **Evaluating AI:** Identifying how AI systems make decisions, including recognizing bias and understanding data sources
3. **Interacting with AI:** Using AI tools effectively while maintaining control over outcomes and understanding how to interpret results
4. **Creating with AI:** Engaging in designing or modifying AI systems responsibly and with a clear understanding of ethical implications (Digital Promise, 2024)

Educators, especially those in mathematics, benefit from AI literacy by being able to discern between tools that automate instruction and those that amplify mathematical thinking. For students, developing AI literacy equips them to be informed participants in a world increasingly shaped by algorithmic decision-making and to engage with AI tools thoughtfully rather than passively.

In both cases, AI literacy is not about becoming programmers or engineers—it is about fostering informed agency and the ability to make ethical, pedagogically sound choices in a digital environment.

Why Teacher AI Literacy Matters in Math Education

AI literacy takes on new meaning when contextualized within specific disciplines. In mathematics education, it plays a critical role in helping educators engage with technology in ways that preserve and enhance deep mathematical thinking, problem-solving, and equitable instructional practices.

As noted in the previous section, AI-literate educators are not only aware of how AI functions but also equipped to evaluate and apply AI tools in ways that uphold core pedagogical values. This becomes especially important in mathematics, where instruction should be designed to promote reasoning, discourse, conceptual understanding, and procedural fluency—not just task completion or rote answers.

According to *Principles to Actions: Ensuring Mathematical Success for All* by the National Council of Teachers of Mathematics (NCTM), effective mathematics teaching practices include:

- Facilitating meaningful mathematical discourse
- Supporting productive struggle in learning mathematics
- Using and connecting mathematical representations
- Posing purposeful questions
- Eliciting and using evidence of student thinking (NCTM, 2014, pp. 10–11)

When AI tools are used without a strong foundation in AI literacy, they risk undermining these practices by automating learning in ways that bypass student thinking. For example, a generative AI tool that provides full solutions to math problems may inadvertently discourage reasoning and remove opportunities for struggle—especially if used without teacher mediation.

"When AI tools are used without a strong foundation in AI literacy, they risk undermining these practices by automating learning in ways that bypass student thinking."

Conversely, when educators are AI-literate, they can select and implement tools that align with strong instructional practices. AI can be used to:

- Surface student thinking through tools that generate multiple representations or pose follow-up questions
- Support formative assessment by analyzing patterns in student responses and offering suggestions for next instructional steps
- Enhance access to mathematics through tools that provide multilingual support or adapt tasks to meet diverse learning needs

As NCSM (2019) emphasizes in its vision, math leaders must ensure that mathematics learning is equitable, rigorous, and responsive and that it "supports the development of positive mathematical identities." Teacher AI literacy supports this vision by empowering educators to scrutinize the role of technology in either reinforcing or disrupting equity and deep learning.

Ultimately, teacher AI literacy matters in math education because it enables educators to navigate the complex intersection of technology, pedagogy, and identity. It ensures that AI serves as a tool for amplifying meaningful mathematics learning, not replacing it.

Why Student AI Literacy Matters in Math Education

While teacher AI literacy is critical, students must also develop the skills to engage with AI as active, critical thinkers. AI is increasingly woven into the technologies they use daily, both in and out of school. Without intentional development of AI literacy, students risk becoming passive consumers of machine outputs rather than reflective learners and problem-solvers.

In mathematics classrooms, student AI literacy connects directly to core disciplinary practices:

- **Logic and reasoning:** Understanding how AI uses algorithms and patterns helps students connect machine reasoning with mathematical reasoning.
- **Data and bias awareness:** Students can learn to question the data sets and assumptions that shape AI outputs, building capacity for critique and evaluation.
- **Representation and modeling:** Engaging with AI as a tool for generating representations or testing models encourages students to compare, analyze, and refine their own thinking.

Developing student AI literacy also supports identity and agency. When students are taught to interrogate AI outputs—asking, "Why did the system generate this solution?" or "What assumptions underlie this model?"—they position themselves as decision-makers in their learning. This strengthens both their mathematical identity and their civic readiness to participate in a world where AI shapes daily life.

For math leaders, this means designing learning environments where AI is not only a source of efficiency but also a catalyst for critical reflection. Students must be prepared to move beyond consuming AI outputs to becoming discerning, empowered users who understand both the possibilities and the limitations of the tools before them.

Skills Teachers and Leaders Need to Evaluate and Use AI Wisely

To effectively integrate AI in ways that align with strong mathematics instruction, educators and leaders must develop a distinct set of skills. These go beyond technical proficiency—they include critical evaluation, pedagogical discernment, ethical reasoning, and a commitment to student-centered learning. As emphasized in the *AI Literacy Framework* from Digital Promise (2024), the ability to interact meaningfully with AI tools depends on the capacity to ask questions like: *What is this tool doing? How is it making decisions? Who benefits from it? Who might be left out?* (Digital Promise, 2024).

In mathematics classrooms, the wise use of AI begins with a clear instructional purpose. As NCTM's *Principles to Actions* outlines, good teaching is intentional—it centers on goals, student thinking, and deep engagement with content (NCTM, 2014, p. 12). To ensure AI tools support these outcomes, educators and leaders must be equipped with the following AI literacy skills:

1. Alignment to Effective Teaching Practices

Teachers and leaders must evaluate whether AI tools support high-quality mathematics instruction by asking:

- Does this tool encourage mathematical reasoning and discourse, or does it simply generate answers?
- Does it allow for productive struggle, or does it short-circuit thinking by over-assisting?
- Can it be used to surface student thinking and inform next steps in instruction?

AI tools should be viewed not as shortcuts but as amplifiers of effective teaching practices. Educators must resist the temptation to outsource instruction to AI and instead use it to deepen engagement with mathematical concepts.

2. Bias and Equity Analysis

AI systems are only as fair as the data and design behind them. Educators must develop the skills to:

- Identify potential biases in AI recommendations or content
- Recognize when an AI tool may disadvantage certain student populations, especially multilingual learners, students with disabilities, or those from historically marginalized communities
- Evaluate tools for accessibility and cultural responsiveness

As the U.S. Department of Education notes, part of being AI-literate is ensuring that tools do not reproduce systemic inequities (U.S. Department of Education, 2024, p. 19). This is particularly urgent in mathematics, where opportunity gaps can be exacerbated by algorithmic decision-making.

3. Interpretive and Reflective Use

Educators should treat AI outputs as starting points, not answers. Skills in this category include:

- Methods for interpreting AI-generated feedback or suggestions, especially in instructional planning
- Reflecting on how the AI's response aligns—or conflicts—with student needs or instructional goals
- Teaching students how to critically engage with AI tools, rather than accepting outputs uncritically

> As NCSM asserts in its leadership framework, math leaders must cultivate environments where teachers and students engage in mathematical sense-making. This includes interpreting technology-generated data through a pedagogical lens, rather than relying on it as the final word.

4. Ethical and Responsible Use

Educators and leaders need to understand the ethical dimensions of AI, such as:

- Student data privacy and consent
- Transparency in how tools operate
- Clearly communicating how AI is being used and what its limitations are

These skills ensure that math educators remain trusted agents of students' learning, even in AI-enhanced classrooms.

Bridging AI Literacy and Mathematics Leadership

Developing these skills is not optional—it is essential for ensuring that AI becomes a tool for inclusion, innovation, and insight, rather than a force that narrows learning to what an algorithm can score. As math leaders, we must empower educators to ask critical questions, evaluate tools through an instructional lens, and maintain human-centered decision-making even in AI-supported environments.

Spotlight: Examples of AI Use That Promote Versus Hinder Mathematical Thinking

As educators grow more AI-literate, one of the most critical skills they develop is the ability to discern between AI applications that enhance learning and those that diminish it. In mathematics education, this means recognizing when a tool supports the goals of meaningful mathematical engagement—and when it short-circuits thinking or reinforces inequities.

Drawing from *Principles to Actions* (NCTM, 2014) and the AI literacy frameworks from Digital Promise (2024) and the U.S. Department of Education (2024), the following examples illustrate the distinction between AI used as a thoughtful instructional tool versus AI used as a replacement for reasoning.

Examples That Promote Mathematical Thinking

1. AI Tools That Surface Student Thinking

- Example: An AI-powered platform analyzes open-ended student responses and highlights common misconceptions or strategies.
- Why it supports good instruction: The teacher can use these data to plan rich classroom discussions or reengage students in different representations of the problem—aligning with NCTM's teaching practices such as eliciting student thinking and connecting mathematical representations (NCTM, 2024, p. 10).

2. Generative AI Used for Teacher Planning

- Example: A teacher uses an AI assistant to generate sample prompts, create scaffolds for tasks, or differentiate exit tickets.
- Why it supports good instruction: The teacher remains the decision-maker, adapting AI-generated materials based on student needs and instructional goals—preserving teacher autonomy and professional judgment (NCSM, 2019).

3. Student Use of AI as a Reflective Tool

- Example: Students ask a generative AI tool to explain a concept in different ways, then compare those explanations to classroom instruction or peer thinking.
- Why it supports good instruction: This encourages metacognition and sense-making, especially when paired with class discussions on why some explanations are more mathematically sound than others.

Examples That Hinder Mathematical Thinking

1. AI-Driven Platforms That Provide Step-by-Step Solutions

- Example: Students input problems and receive full worked-out solutions from AI (e.g., step-by-step algebra answers without justification).
- Why it hinders learning: Students may bypass struggle, reasoning, and explanation, undermining core math practices such as supporting productive struggle and constructing viable arguments (NCTM, 2014, pp. 10–11).

2. AI Tools That Automate All Feedback and Scoring

- Example: Adaptive math software immediately corrects answers, provides hints, and advances students based on right/wrong responses.

- Why it hinders learning: Teachers lose visibility into how students are thinking, and the tool emphasizes correctness over process. Instruction becomes reactive rather than responsive.

3. AI Used Without Transparency

- Example: A district uses an AI-driven assessment tool without a clear understanding of how it scores or what data it collects.
- Why it hinders learning: Without transparency, teachers cannot interpret or trust AI-generated insights, and students may experience inequitable outcomes if biases in the algorithm go unexamined (U.S. Department of Education, 2024, p. 19).

Framing for Math Leaders

These examples are not intended to declare certain tools "good" or "bad"—rather, they highlight how intentional implementation and teacher mediation make all the difference. A tool that hinders thinking in one setting may be used reflectively in another, depending on how it is introduced, discussed, and integrated into instruction.

For math leaders, the task is to equip educators with the literacy to make these distinctions, ensuring that AI serves as an amplifier of inquiry, not a shortcut through it.

5 THE ROLE OF THE TEACHER IN AI-INTEGRATED CLASSROOMS

From Automation to Amplification: The Evolving Role of the Teacher

As AI tools become more prevalent in K–12 classrooms, the role of the teacher is not diminished—it is transformed. Teachers are no longer simply facilitators or content deliverers; in AI-integrated classrooms, they must become critical decision-makers, adaptive guides, and ethical stewards of student learning. Nowhere is this more important than in mathematics, where deep understanding, reasoning, and identity development cannot be delegated to an algorithm.

In the context of mathematics education, NCTM's *Principles to Actions* calls for instruction that fosters conceptual understanding, procedural fluency, and problem-solving through active engagement and discourse (NCTM, 2014, pp. 10–11). AI tools, if used indiscriminately, can shift focus toward efficiency and automation—offering correct answers without requiring student reasoning or guiding instruction based on right/wrong responses rather than student thinking. This kind of automation risks eroding the very foundation of meaningful mathematics learning.

However, when teachers use AI to amplify good instruction—to inform decisions, enrich discourse, and surface student ideas—they remain firmly in the center of the learning process. As NCSM emphasizes in its *Framework for Leadership in Mathematics Education*, math leaders must promote environments in which "teaching is a complex, intellectual endeavor" and "teachers are positioned as professionals who make critical instructional decisions" (NCSM, 2019).

The Teacher as an Instructional Leader in an AI Context

In AI-integrated classrooms, effective teachers must:

- **Frame the purpose of technology use**, ensuring students understand when and why a tool is used and what it should (and should not) do for them.
- **Mediate interactions with AI**, using the outputs of AI tools as opportunities for rich discussion, critique, and refinement—rather than as endpoints.
- **Design tasks and classroom experiences** where AI supports inquiry, exploration, and mathematical modeling—not passive consumption.
- **Model ethical use** of technology, helping students recognize biases, question algorithmic decisions, and reflect on the broader implications of AI.

A Spectrum of Teacher Roles

Teachers may interact with AI tools across a spectrum of engagement—from passive use to active co-design. The most impactful roles occur when teachers:

- Use AI to generate ideas or insights, but interpret and adapt those outputs based on their knowledge of students
- Position AI tools as partners in formative assessment, allowing them to identify trends or surface misconceptions, which the teacher then acts on
- Guide students to engage critically with AI-generated feedback, comparing it to their own reasoning and class expectations

The teacher's expertise in mathematics content, pedagogy, and student identity remains irreplaceable. AI may provide insights, generate tasks, or offer adaptive feedback—but only a teacher can contextualize those outputs, connect them to broader learning goals, and ensure they support the development of mathematical agency.

Risks of Overreliance: When AI Replaces Instruction Instead of Enhancing It

While AI offers promising opportunities to enhance teaching and learning, an uncritical or unchecked reliance on these tools can fundamentally undermine the principles of high-quality mathematics instruction. As AI becomes more accessible—particularly through adaptive platforms, automated feedback systems, and generative tools—the risk increases that some technologies will be used to replace teacher decision-making and student reasoning, rather than support them.

The U.S. Department of Education's AI Toolkit warns against treating AI as a "plug-and-play" solution, emphasizing the importance of human-centered learning environments and maintaining educator agency in all instructional decisions (U.S. Department of Education, 2014, p. 18). This is particularly vital in mathematics classrooms, where teaching is not just about delivering content—it is about developing students' mathematical identities, sense-making abilities, and conceptual understanding.

How Overreliance Could Show Up in Math Classrooms

1. **Delegating Instructional Authority to AI**
   - When platforms automatically assign problems, explain concepts, and adjust pathways based solely on algorithms, the teacher may become a passive observer.
   - Students miss out on opportunities for mathematical discourse, struggle, and peer collaboration—all critical components outlined in *Principles to Actions* (NCTM, 2014, pp. 10–11).
2. **Reducing Mathematics to Correctness**
   - Many AI tools focus heavily on right/wrong answers, offering hints or explanations without engaging students in the why behind their thinking.
   - This approach erodes practices such as posing purposeful questions, eliciting student thinking, and using multiple representations to explore mathematical ideas.
3. **Bypassing Differentiation and Contextual Knowledge**
   - AI systems cannot fully understand the classroom environment, student histories, or the nuanced relationships that inform instructional moves and interventions.
   - Teachers risk losing the ability to tailor learning experiences to student needs, interests, or cultural contexts, a practice emphasized by NCSM and foundational to equity.

Impact on Equity and Identity

Overrelying on AI also risks exacerbating educational inequities:

- Students from historically marginalized communities may be disproportionately placed on AI-based platforms that offer limited human interaction.
- If AI tools are not critically examined for bias or data limitations, they may reinforce stereotypes or make flawed predictions about student ability.

- Over time, students may internalize the belief that learning math is about pleasing an algorithm, rather than engaging in inquiry, debate, or creative problem-solving.

As Digital Promise notes in its AI Literacy Framework, educators must be prepared to challenge the authority of AI tools when necessary, ensuring that students are empowered to question and interpret technology—not simply absorb it (Digital Promise, 2024).

Opportunities for Teachers to Deepen Instruction Using AI and Technology

When used intentionally and critically, AI and digital tools can enhance—not replace—mathematics instruction. These technologies offer powerful opportunities for teachers to deepen student engagement, uncover mathematical thinking, and inform instructional decisions. The key lies in how teachers frame and integrate AI within their pedagogical goals, maintaining their central role in facilitating learning and positioning AI as a support for deep, meaningful math experiences.

According to NCTM's *Principles to Actions*, effective math instruction depends on practices that include posing purposeful questions, eliciting evidence of student thinking, supporting productive struggle, and facilitating meaningful discourse (NCTM, 2024, pp. 10–11). AI tools can play a role in these practices when used to amplify what teachers already do well—especially in supporting formative assessment, enhancing representations, and scaffolding inquiry.

How AI Can Support Deep Mathematics Instruction

1. Surfacing and Analyzing Student Thinking

- AI tools can quickly sort and identify common errors or strategies in student responses, helping teachers tailor whole-class discussions around these themes.
- For example, a tool that analyzes written justifications or visual work (e.g., graph sketches, number lines) can help teachers identify productive misunderstandings and design responsive follow-ups.

2. Enriching Representational Fluency

- Some AI-powered tools can generate multiple representations of the same concept (e.g., tables, graphs, equations) on demand.
- Teachers can use these features to support connections across representations, a core practice in helping students build conceptual understanding (NCTM, 2024, p. 10).

3. Supporting Multilingual Learners and Accessibility

- AI-driven translation, speech-to-text, or text simplification tools can help make mathematics more accessible without diluting mathematical rigor.
- Teachers remain responsible for ensuring mathematical precision and meaning, but AI can support communication and inclusion in ways that were previously difficult to scale.

4. Planning With Adaptive Insights

- AI can help teachers quickly analyze class-wide performance trends or identify which students are struggling with specific standards or concepts.
- These insights, when paired with teacher judgment, can support targeted small-group instruction, purposeful grouping, or just-in-time interventions.

5. Generating Rich Instructional Materials

- Teachers can use AI to generate variation in task design, such as creating parallel problems, alternate contexts, or scaffolding prompts.

- When reviewed and revised by the teacher, these resources can support differentiation and increased cognitive demand, aligning with best practices from NCSM and NCTM.

Ensuring AI Use Supports Critical Thinking

The goal is not for AI to take over instructional decision-making but to serve as a thinking partner for both teachers and students. As NCSM (2019) emphasizes, math leaders must support the professional growth of teachers so they can use tools like AI to design equitable, student-centered learning experiences.

Teachers should always remain in control of:

- What questions are asked in the classroom
- What counts as evidence of understanding
- How students are positioned as capable mathematical thinkers

When AI is used to enhance—not bypass—these instructional goals, it becomes a force multiplier for effective teaching.

Case Examples: Contrasting Two Uses of Technology—Substitution Versus Enhancement

To support educators in making informed decisions about how they use AI and educational technology, it is helpful to examine concrete case examples that distinguish between substitution—when technology simply replaces instructional work—and enhancement, where technology is used to amplify mathematical thinking, discourse, and student agency.

This distinction is especially critical in math classrooms, where the quality of instructional interaction, not just the tool itself, determines the learning outcome. As *Principles to Actions* reminds us, the goal is not efficiency or coverage, but instruction that promotes reasoning, conceptual understanding, and student ownership of ideas (NCTM, 2014, p. 10).

Case Example 1: AI-Based Practice Platform

Scenario A: Substitution
A teacher assigns a group of students to spend 30 minutes each day using an AI-powered math program that auto-generates problems, grades responses, and provides hints or explanations. The teacher uses the platform's summary dashboard to mark participation and progress.

- **Impact:** Students complete many problems but have limited opportunities for discussion, explanation, or visual reasoning. The teacher is largely removed from the instructional process, relying on the AI tool to assess and intervene.
- **Instructional Alignment:** Low. This approach bypasses essential teaching practices such as eliciting student thinking and facilitating mathematical discourse (NCTM, 2014, pp. 10–11).

Scenario B: Enhancement
The same platform is used selectively as a warm-up, where students complete a few AI-generated problems. The teacher then uses the data to launch a discussion around common misconceptions identified by the platform. Students reflect on their reasoning in pairs and compare different solution strategies.

- **Impact:** The teacher uses AI insights to inform instruction and promote student reflection and collaborative reasoning.
- **Instructional Alignment:** High. AI is supporting—not replacing—the teacher's role, and students are positioned as active participants in learning.

Case Example 2: Generative AI for Task Design

Scenario A: Substitution
A teacher uses a generative AI tool to create a math worksheet with 20 procedural problems on multiplying fractions. The worksheet is printed and handed out without review or modification.

- **Impact:** Students engage in rote practice, with little variation in cognitive demand. The task does not promote exploration or deeper understanding.
- **Instructional Alignment:** Low. The use of AI is limited to convenience, not instructional quality.

Scenario B: Enhancement
A teacher uses generative AI to brainstorm real-world contexts for multiplying fractions. After reviewing the suggestions, the teacher modifies two of them to better match the interests of the class (e.g., scaling a recipe for a school event). Students solve the problems and then write their own fraction contexts using the same structure.

- **Impact:** Students see mathematics as relevant and contextualized, and the task promotes conceptual understanding through problem creation.
- **Instructional Alignment:** High. The teacher uses AI to increase access and relevance, while remaining the driver of instructional quality.

Case Example 3: Student Use of Generative AI for Learning Support

Scenario A: Substitution
A student struggling with a homework assignment copies the entire problem into a generative AI tool and receives a step-by-step solution. They copy the answer into their work without reflecting on the reasoning.

- **Impact:** The student completes the assignment quickly but gains little conceptual understanding.
- **Instructional Alignment:** Low. The tool is used as a shortcut, bypassing productive struggle and reasoning.

Scenario B: Enhancement
A student uses a generative AI tool to check their reasoning after attempting a problem independently. The AI provides an explanation that the student compares with their own strategy. In class, the student shares where their method differed and discusses which approach they find more efficient or clear.

- **Impact:** The student remains the primary problem-solver while using AI as a support for reflection and sense-making.
- **Instructional Alignment:** High. The AI serves as a catalyst for metacognition and discourse, reinforcing the student’s role as a mathematical thinker.

What Makes the Difference?

Across these examples, the technology itself doesn’t determine the outcome—the instructional design and the role of the teacher or student do. In enhancement scenarios:

- AI supports student thinking, not just task completion.
- Teachers remain active designers and interpreters of instruction.
- Students use AI as a scaffold for reflection and sense-making, rather than as a shortcut to bypass struggle.

- Learning experiences are connected to mathematical reasoning, discourse, and identity.

These case studies help reinforce the message of NCSM and NCTM: Effective teaching is irreplaceable, but technology—when used wisely—can amplify and extend high-quality practices.

6 A SPECTRUM OF TECHNOLOGY INTEGRATION

Visualizing the Role of Technology in Mathematics Instruction

As math leaders consider whether and how to adopt AI and educational technologies, the goal is not to label tools as “good” or “bad,” but to understand how each tool positions the teacher, the student, and the learning process. To support this reflection, we offer a spectrum-based framework that describes the roles different technologies play in the classroom—from automation to amplification.

This model invites educators and decision-makers to ask:

- What kind of learning does this technology promote?
- What is the teacher’s role when this tool is in use?
- How does the student engage with mathematics through this tool?

The spectrum is not a rating scale—it’s a thinking tool. It encourages nuanced evaluation, helping leaders match the right tools to the right instructional purposes.

A SPECTRUM OF TECHNOLOGY INTEGRATION

A way of organizing and understanding how educational technology shapes teaching, learning, and mathematical thinking

AUTOMATION
May limit reasoning & discourse

GUIDED USE
Supports planning & responsiveness

AMPLIFICATION
Promotes reasoning, agency, identity

AUTOMATION

TECH ROLE: Delivers instruction, grades automatically, adjusts difficulty without teacher input

EXAMPLES: AI tutors, adaptive practice, auto-feedback tools

TEACHER ROLE: Minimal; monitors or reviews reports

STUDENT ROLE: Procedural; follows system pathways

USE WHEN: Paired with teacher insight for practice or intervention

GUIDED USE

TECH ROLE: Offers suggestions, prompts, or data to inform teacher decisions

EXAMPLES: Dashboards, AI lesson planners, formative tools

TEACHER ROLE: Interprets output, leads instruction

STUDENT ROLE: Active responder; reflects on input

USE WHEN: Tech guides but teach drives learning

AMPLIFICATION

TECH ROLE: Enables exploration, multiple representations, and student-driven analysis

EXAMPLES: Collaborative platforms, dynamic math tools, generative AI for modeling

TEACHER ROLE: Designs tasks, facilitates inquiry

STUDENT ROLE: Thinker, creator, problem-solver

USE WHEN: Deep learning, discourse, and rigor are the goal

This spectrum is a reflective tool, not a rating system. A tool’s placement depends on instructional use and context, not just its design.

The Spectrum: From Automation to Amplification

End 1: Automation (Technology as Instructor or Corrector)

At this end of the spectrum, technology performs tasks on behalf of the teacher or student. These tools often:

- Provide instruction, explanations, or demonstrations
- Grade and give feedback automatically
- Adapt difficulty levels based on performance
- Offer interventions without human oversight

Examples: Adaptive learning platforms, AI tutors, automated assessment tools

Teacher Role: Minimal; often monitoring progress or interpreting platform reports
Student Role: Passive recipient; success depends on interacting with the tool's algorithm
Instructional Risk: Can undermine reasoning, discourse, and productive struggle if not paired with teacher facilitation
Instructional Opportunity: May help provide additional practice, flag misconceptions, or support targeted intervention—*if* paired with teacher interpretation

Middle: Guided Use (Technology as Partner or Recommender)

In this central zone, technology and teachers share responsibility for the learning process. These tools typically:

- Provide suggestions or prompts to support instruction
- Highlight trends or student needs for teacher action
- Offer feedback that requires teacher mediation or follow-up

Examples: Co-planning tools, diagnostic dashboards, AI-informed formative assessment platforms

Teacher Role: Interprets and acts on technology's input; facilitates learning
Student Role: Engages actively, often responding to or reflecting on AI input
Instructional Balance: Enhances decision-making without replacing it
Instructional Opportunity: Can streamline planning, target instruction, and support responsive teaching

End 2: Amplification (Technology as Catalyst for Thinking)

Here, technology serves as a tool for exploration, reflection, and representation. These tools empower students and teachers to deepen understanding and engage with mathematics in new ways.

Examples: Dynamic geometry software, simulation tools, generative AI used for generating contexts or multiple representations, collaborative tools for peer critique

Teacher Role: Designs tasks, guides exploration, prompts reasoning
Student Role: Active agent; engages in inquiry, critique, and sense-making
Instructional Alignment: High—supports NCTM's and NCSM's vision for discourse-rich, reasoning-centered instruction
Instructional Opportunity: Fosters mathematical identity, agency, and rigor; students develop transferable problem-solving and analytical skills

Using the Spectrum as a Reflective Tool

This framework is not meant to rank tools, but to help educators and leaders:

- Make contextual decisions about when and how to use a given tool
- Design professional learning conversations about tech integration
- Evaluate whether tech usage aligns with mathematics teaching practices from *Principles to Actions* (NCTM, 2014)
- Ensure that equity, access, and student thinking remain central

You might ask:

- When I use this tool, who is doing the thinking?
- Does this tool enhance or replace discourse, struggle, or exploration?
- What decisions am I making, and what decisions is the technology making?

7 DEVELOPING LOCAL POLICIES AND PRACTICES

Questions for District and School Leaders

As educational technology and AI tools become more embedded in instructional ecosystems, math leaders and administrators must engage in proactive policy and implementation planning. Without clear guidance, the adoption of these tools can be uneven, inequitable, and misaligned with core instructional goals.

Strong local policies don't start with technical requirements—they begin with instructional values, particularly in mathematics. As NCSM and NCTM emphasize, effective math education must promote:

- Student reasoning and sense-making
- Equity and access
- Positive mathematical identities
- Teacher professionalism and decision-making

To guide district and school teams in crafting thoughtful policies and practices, we offer a series of reflective questions in five focus areas:

1. Instructional Alignment

- What role does this tool play in supporting reasoning, discourse, and conceptual understanding in math classrooms?
- How does the tool align with the *Principles to Actions* (NCTM, 2014) teaching practices and our district's instructional vision for math?
- Are we clear about the **instructional purpose** of each AI or tech tool we use?

2. Equity and Student Access

- Who has access to this tool—and who doesn't?
- Are students using this tool in ways that promote **agency and identity**, or are they in passive, automated learning loops?
- Does the tool offer multilingual, disability, or culturally relevant supports?
- Are students in different schools, tracks, or demographics **experiencing different levels of teacher interaction** based on the tech used?

3. Teacher Roles and Professional Judgment

- How are teachers supported in understanding and shaping how these tools are used?
- Does the tool constrain or support teacher autonomy and professional knowledge?
- Are teachers positioned as **critical users and interpreters** of AI or merely implementers of vendor-driven decisions?
- Are policies built with **teacher voice** and feedback in mind?

4. Transparency, Ethics, and Data Privacy

- Do we understand how each tool collects and uses student data?
- Can teachers, students, and families make sense of how decisions are being made by AI systems?
- Do we have clear policies on **data ownership, consent, and algorithmic accountability**?
- Are students being taught to engage with AI ethically and critically?

5. Evaluation and Feedback Loops

- How do we evaluate the impact of a tool on student learning, engagement, and instructional quality?
- Do we have feedback structures in place to revisit technology use regularly (e.g., walkthroughs, focus groups, surveys)?
- Who makes decisions about continuation, expansion, or replacement—and how is that process communicated?

Why These Questions Matter

These aren't just operational considerations. They reflect **core values**: that educational technology and AI should be **in service of learning—not in control of it**. Policies built around these questions help ensure that AI adoption in mathematics supports **equity, agency, and excellence** and that teachers remain at the heart of instructional design.

Considerations for Procurement and Implementation

The process of selecting and implementing educational technology and AI tools is often led by operational or IT teams—but without instructional leadership at the table, there is a real risk that adopted tools may misalign with teaching practices, equity commitments, or subject-specific goals, particularly in mathematics.

Procurement decisions must move beyond functionality and cost to include pedagogical fit, teacher agency, student identity, and long-term instructional impact. AI tools in particular require greater scrutiny, as their decision-making processes are often opaque and their potential for misuse is high without proper guidance.

Below are key considerations for math leaders and district teams when making procurement and implementation decisions:

1. Involve Instructional Stakeholders Early

- Are math educators, coaches, and content leaders included in tool evaluation panels or pilot selection processes?
- Do procurement teams understand the instructional needs and non-negotiables for high-quality mathematics learning (e.g., support for reasoning, discourse, representation)?
- Is there alignment between technology departments and instructional departments on the goals for the tool?

"Technology decisions must be instructional decisions first."
—U.S. Department of Education, *AI Integration Toolkit* (2024)

2. Examine Claims Through a Critical Lens

- Does the vendor clearly explain how the tool works, particularly for any **AI-driven decisions or adaptivity**?
- Are there **independent reviews or research-backed evidence** for the tool's effectiveness—especially in math instruction?
- Are terms like "personalized," "data-driven," or "learning acceleration" defined clearly, with examples?

Tip: Use the **rubric from Section 8** as part of your vendor vetting process to align their claims with actual instructional implications.

3. Evaluate the Tool's Flexibility for Classroom Use

- Can teachers modify content, customize feedback, or turn off automated features that conflict with instructional goals?
- Does the tool allow for **open-ended responses**, **multiple representations**, or **conceptual exploration**?
- How does the tool provide **just-in-time supports or scaffolding**, especially in mixed-ability math classrooms?

4. Plan for Professional Learning and Ongoing Support

- Does the purchase include **ongoing training—not just onboarding**—for both teachers and instructional leaders?
- Will professional development focus on **instructional integration**, not just technical features?
- Is there a plan for **coaching, modeling, or PLC support** to help educators use the tool in alignment with *Principles to Actions (NCTM, 2014)*?

5. Align Contracts With Transparency and Ethics

- Are **data use agreements** aligned with your district's privacy standards?
- Can you ensure **algorithmic transparency**—knowing how and why decisions (e.g., scoring, placement, feedback) are made?
- Does the vendor commit to **continuous improvement** and responsiveness to educator feedback?

6. Pilot Before Full Rollout

- Are pilot classrooms diverse in grade level, teacher experience, and student demographics?
- Is there a plan to observe instruction, collect feedback, and assess student experience during the pilot?
- Will pilot results shape broader implementation or determine whether to move forward?

"When implemented thoughtfully, educational technology can become a vehicle for deeper learning and equity in mathematic."

Procurement and implementation are not just logistical processes—they are equity and instruction decisions. When math leaders shape these processes, they ensure that tools are chosen because they empower students and teachers, not because they promise efficiency or novelty.

When implemented thoughtfully, educational technology can become a vehicle for deeper learning and equity in mathematics. When implemented without intentionality, it can widen gaps and erode instructional quality. This section aims to ensure the former.

Collaborating With Stakeholders

The successful adoption of educational technology—especially AI—requires broad collaboration among stakeholders, who each bring unique perspectives, responsibilities, and concerns. Math leaders must serve as connectors, ensuring that the voices of teachers, students, families, IT teams, and instructional leaders all inform the development of policies, tool selection, and classroom practices.

Strong collaboration ensures that decisions are contextual, inclusive, and responsive, rather than top-down or vendor-driven. It also strengthens the capacity of everyone in the system to understand the purpose of a tool and use it meaningfully.

"Strong collaboration ensures that decisions are contextual, inclusive, and responsive, rather than top-down or vendor-driven."

Teachers and Instructional Coaches

- Engage teachers as co-designers and testers during tool evaluation and pilot phases.
- Create opportunities for feedback on instructional alignment, student engagement, and professional learning needs.
- Support teachers in developing AI literacy so they can ask critical questions and adapt tools thoughtfully.
- Provide collaborative structures (e.g., PLCs, grade-level meetings) where teachers can share insights and develop shared practices.

"Teacher voice is essential in shaping AI use that supports—not undermines—professional judgment." —Digital Promise (2024)

Students and Families

- Ask students about their experiences with the tool:
  - *Does it help you think more deeply about math?*
  - *Do you understand how it gives you feedback or answers?*
  - *Do you feel like you're learning, or just doing tasks?*
- Provide students with agency and transparency: Explain what the tool does, how it works, and what to question.
- Engage families in learning conversations:
  - Share how technology is used to support reasoning and learning.
  - Address data privacy, AI decision-making, and equity concerns in family-friendly language.

District Technology and Data Teams

- Align around shared goals: Instructional priorities must guide data infrastructure, platform management, and procurement timelines.
- Collaboratively review AI and technology tools using shared frameworks (like the rubric in Section 8).
- Establish routines for data audits, ethical reviews, and transparency checks that include instructional leadership.

Building and District Administrators

- Ensure school leaders understand how to observe and support effective AI-integrated math instruction (e.g., what to look for beyond tool usage).

- Involve administrators in professional learning so they can model informed tech use and protect teacher autonomy.
- Facilitate district-wide conversations about equity in access and use of instructional technology.

External Partners (Vendors, Universities, Nonprofits)

- Push vendors to be transparent, responsive, and collaborative:
    - *How is the tool designed to support reasoning in math?*
    - *What research informs this tool's design?*
    - *Can we co-develop use cases aligned to our instructional vision?*
- Invite researchers or external partners to co-develop evaluation plans, ensuring continuous learning and refinement.

Technology adoption is not just a technical or administrative decision—it's a social and pedagogical process. Collaboration ensures that tools are not only implemented but also understood, trusted, and improved through dialogue.

In mathematics education, where identity and equity are deeply intertwined with instructional design, shared leadership is critical. Every stakeholder group must see itself as part of a system working toward meaningful, equitable math learning—and math leaders play a key role in orchestrating that system.

Creating a Professional Learning Pathway for AI Literacy

The Challenge: A Common Misstep

At a recent district meeting, a middle school math teacher asked:

"So are we supposed to be teaching AI now? Or using it? Or both?"

The district had just rolled out several AI-powered math tools, but the professional learning focused entirely on how to click through the platform—not on how to integrate it meaningfully into math instruction. Teachers walked away knowing which buttons to press, but not how to navigate the instructional, ethical, or equity implications of these tools.

This scenario is increasingly common: Schools invest in AI-enhanced technology but provide limited support for how teachers and leaders can critically evaluate and apply these tools in their practice.

The solution? Build a professional learning pathway that treats AI literacy as a pedagogical skill set, not a tech feature.

What an Effective AI Literacy Pathway Looks Like

Rather than a one-time training, AI literacy development should be scaffolded, subject-specific, and grounded in real classroom practice. A successful pathway might include:

1. Foundational Workshops: What Is AI Literacy?

Introduce educators to key ideas:

- What is AI? What isn't it?
- How does AI show up in tools we already use?
- What does it mean to be AI-literate in a math classroom?

Pair this with hands-on analysis of tools using the Guidance Rubric (see Section 8). Let teachers practice placing familiar tools on the spectrum and reflect on implications for instruction.

2. Collaborative Case Study Sessions

Host team-based walkthroughs of classroom scenarios:

- A student uses an AI tool to generate a solution—what do we do?
- A platform flags a misconception—how do we respond?
- An adaptive system advances a student automatically—what is the teacher's role?

Encourage teams to **discuss, debate, and document** decisions using prompts like:

- *What thinking is happening here?*
- *What's the instructional opportunity we might miss if we rely on the tool alone?*

3. Content-Specific Coaching and Modeling

Offer coaching cycles or video lesson study that models:

- Using AI tools to **generate multiple representations** or prompts for discourse
- Strategies for **pairing tech with student reflection or revision**
- Ways to **reclaim teacher agency** when a tool suggests a path that doesn't align with classroom observations

Focus on **connecting tools back to the 8 Effective Teaching Practices** in *Principles to Actions* (NCTM, 2014) and the **Instructional Empowerment Domain** in the NCSM Leadership Framework (NCSM, 2019).

4. Ongoing Reflection and Sharing

Establish routines like:

- "Tool of the Month" discussions in PLCs
- Collaborative use of the rubric to guide new tool adoption
- Peer showcases where teachers demonstrate how they've adapted AI use to center student reasoning

A Shift in Culture, Not Just Capacity

Ultimately, building AI literacy isn't just about keeping up with emerging tools—it's about cultivating a culture of critical inquiry and instructional leadership.

In schools where teachers are empowered to ask hard questions about technology, experiment with purpose, and adjust based on student learning, AI becomes a tool for transformation, not replacement.

The professional learning pathway is how we get there.

At the same time, math leaders should recognize the real pressures districts and schools face: limited time, constrained budgets, and strong vendor promises. The temptation to adopt quickly without a thorough process is understandable—but cutting corners can carry significant consequences. Tools chosen without attention to instructional alignment, equity, and teacher voice can unintentionally widen gaps, undermine trust, and diminish the very practices leaders seek to strengthen. Even when resources are tight, slowing down to ask critical questions and involve multiple stakeholders is not a luxury—it is an essential safeguard to ensure that AI adoption enhances, rather than erodes, meaningful mathematics learning.

8 THE GUIDANCE RUBRIC

Helping Math Leaders Make Informed Decisions About Technology and AI

The rapid growth of educational technology—particularly AI—has left many school and district leaders searching for guidance on what tools to adopt, how to evaluate them, and how to ensure their alignment with instructional goals and equity priorities. This rubric is designed to meet that need.

It is not a rating scale or checklist. Rather, it is a reflective decision-making tool, aligned to the spectrum of technology integration described in the previous section. It invites leaders and educators to analyze how a tool functions, who it centers, and how it aligns with strong mathematics instruction.

Step 1: Preassessment—Understanding Your Context and Needs

Before using the rubric, math leaders should begin with a **preassessment of local context**. No two schools or districts face the same challenges, and tool selection must reflect the realities of instructional capacity, staffing, and student needs.

Key preassessment questions include:

- **Instructional Capacity**
    - How many teachers are available to support mathematics instruction?
    - Are teachers responsible for multiple grade levels or subjects?
- **Instructional Priorities**
    - Are our immediate needs centered on efficiency and coverage or on deepening reasoning and discourse?
    - Do we need tools to supplement instruction (e.g., in rural schools with fewer math specialists) or tools to enrich and extend existing strong instruction?
- **Equity and Access**
    - Which students are most at risk of limited access to high-quality math teaching?
    - Do technology gaps exist across schools, programs, or demographics?
- **Professional Learning and Teacher Autonomy**
    - How prepared are teachers to evaluate and adapt AI tools?
    - Do they have structures (PLCs, coaching, collaboration) to critically engage with technology use?

This preassessment step allows leaders to **clarify their “must-haves” versus “nice-to-haves”** before scoring tools against the rubric. For example, a rural district with one teacher covering multiple grade levels may prioritize tools that provide automated support and structured feedback, while an urban district with strong coaching systems may focus on tools that amplify student reasoning and discourse.

The goal is not to lower expectations for instructional quality but to ensure that technology adoption decisions are rooted in the realities of context.

Preassessment Tool: Clarifying Context Before Using the Guidance Rubric

Before applying the rubric, use this preassessment to reflect on your local context and instructional needs. Your answers will help identify **non-negotiables**, **priorities**, and **trade-offs** when selecting or implementing technology and AI tools.

Focus Area	Guiding Questions	Notes/Local Context
Instructional Capacity	How many teachers are available for mathematics instruction? Do teachers cover multiple grade levels or subjects?	
Instructional Priorities	Are our immediate needs focused on efficiency/coverage or on deepening reasoning and discourse? Are we seeking tools to **supplement** limited teacher capacity or to **enrich** existing instruction?	
Equity & Access	Who currently has access to high-quality math instruction—and who does not? Are there technology or connectivity gaps across schools, grade levels, or student demographics?	
Student Needs & Identities	Which students might be most impacted (positively or negatively) by the adoption of a new tool? Does our student population have multilingual, disability, or cultural/representation needs that must be prioritized?	
Teacher Autonomy & Professional Learning	How prepared are teachers to critically evaluate and adapt AI tools? Do we have structures (PLCs, coaching, peer learning) to support reflective and intentional tool use?	
Community & Stakeholder Voice	How are families, students, and community members engaged in conversations about technology adoption? Have teachers had a chance to give input before decisions are made?	

How to Use This Tool

1. **Discuss in teams:** Encourage leaders, teachers, and coaches to complete this preassessment together to surface different perspectives.
2. **Identify patterns:** Circle areas of strength and highlight areas of need.
3. **Carry insights forward:** Use the responses to frame your expectations when applying the **Guidance Rubric** in the next section.
   Remember: The purpose of the preassessment is not to lower expectations for instructional quality but to ensure that decisions about technology and AI are made with local realities in mind.

Purpose of the Rubric

- To support thoughtful adoption of educational technologies, particularly AI-powered tools
- To ensure tools enhance rather than replace teaching and learning
- To protect equity, agency, and instructional quality in mathematics education
- To provide a shared language for conversations between math leaders, teachers, and other stakeholders

Structure of the Rubric

Each tool or platform should be evaluated across several dimensions. For each dimension, you will identify where the tool most often falls on a spectrum of integration, using guiding questions and evidence from practice.

Each dimension is anchored on a continuum:

- Automates instruction
- Guided use with teacher decision-making
- Amplifies learning and mathematical thinking

Note: A tool may fall in different places depending on how it is used. The rubric is designed to surface those nuances.

Rubric Dimensions for Evaluation

1. Teacher Role & Autonomy

- **Guiding Question:** To what extent does the tool support or constrain teacher professional judgment and instructional design?

Automation (Low)	Guided Use	Amplification (High)
Teacher role is limited to monitoring or assigning tool-generated content	Tool provides suggestions or data to support instructional planning	Teacher actively interprets AI output, designs instruction, and facilitates learning using the tool

2. Student Thinking & Engagement

- **Guiding Question:** How does the tool position students as mathematical thinkers?

Automation (Low)	Guided Use	Amplification (High)
Tool provides answers, hints, or steps with little cognitive demand	Tool prompts student responses but requires teacher to engage student thinking	Tool supports reasoning, exploration, and productive struggle; students generate ideas or critique output

3. Equity & Access

- **Guiding Question:** How does the tool support equitable access, identity development, and culturally responsive teaching?

Automation (Low)	Guided Use	Amplification (High)
May reinforce inequities through opaque algorithms or lack of adaptation to student context	Some support for multilingual learners or accommodations; requires teacher mediation	Supports identity, language, and cultural relevance; promotes inclusive representations and discourse

4. Transparency & Interpretability

- **Guiding Question:** Can educators understand how the tool works and use its outputs meaningfully?

Automation (Low)	Guided Use	Amplification (High)
Black-box algorithms; limited teacher insight into tool decisions	Clear feedback or dashboards provided; teacher interprets data	Teacher and students can interrogate, critique, or modify tool outputs; supports AI literacy and ethical use

5. Alignment With Mathematics Teaching Practices

- **Guiding Question:** Does the tool support practices outlined in *Principles to Actions* (NCTM, 2014) and NCSM's leadership framework?

Automation (Low)	Guided Use	Amplification (High)
Focus on procedural fluency only; little opportunity for discourse or reasoning	Supports some practices (e.g., posing questions or checking understanding)	Encourages rich tasks, discourse, multiple representations, and reasoning; tightly aligned with effective practices

Using the Rubric in Practice

You might apply the rubric to:

- Evaluate a potential new platform for district-wide adoption
- Reflect on how a currently used tool is being implemented across classrooms
- Guide professional learning around intentional technology use
- Facilitate cross-department conversations about AI, curriculum, and instruction

Sample Use Case: After attending a vendor demonstration of a new AI-powered math tool, a district team uses the rubric to evaluate where it falls across the five dimensions. They realize that while the tool is strong in providing real-time student data, it lacks transparency and currently limits opportunities for student reasoning. This insight shapes their questions back to the vendor and their rollout plan.

What This Rubric Is—and Isn't

✅ A tool for reflection, alignment, and planning

❌ A judgment of the inherent quality of a product

✅ Designed to be adaptable and context-specific

❌ Meant to be used without professional dialogue

Educational Technology Guidance Rubric for Mathematics Instruction

Use this rubric as a reflective decision-making tool to evaluate how an educational technology or AI tool aligns with high-quality mathematics instruction. For each dimension, use the guiding question and spectrum to determine how the tool functions in your context. Fill in the table with observations, examples, or evidence from your experience with the tool. This is not a rating system but a conversation starter to support instructional alignment and equity.

How to Use This Rubric

- Identify the educational technology or AI tool you are evaluating.
- For each dimension, consider the guiding question provided.
- Reflect on your experience or observation of the tool in use.
- Review the descriptions for each level of the spectrum.
- As a team, record notes in the blank space describing how the tool functions in practice. Include examples of when it leans toward automation, guided use, or amplification.
- Remember: The same tool may show up differently depending on use. Capture that nuance.
- After discussion, record your **final placement** or decision in the box at the bottom of the page, referencing the needs identified in your preassessment.

Dimension 1. Teacher Role & Autonomy

Guiding Question: To what extent does the tool support or constrain teacher professional judgment and instructional design?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Teacher actively interprets AI output, designs instruction, and facilitates learning using the tool.	
Guided Use	Tool provides suggestions or data to support instructional planning.	
Automation (Low)	Teacher role is limited to monitoring or assigning tool-generated content.	

Final Placement/Verdict

Where does this tool most often fall on the spectrum for *our* context?
☐ Automation ☐ Guided Use ☐ Amplification
Notes on placement and alignment with preassessment needs:

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Dimension 2. Student Thinking & Engagement

Guiding Question: How does the tool position students as mathematical thinkers?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Tool supports reasoning, exploration, and productive struggle; students generate ideas or critique output	
Guided Use	Tool prompts student responses but requires teacher to engage student thinking	
Automation (Low)	Tool provides answers, hints, or steps with little cognitive demand	

Final Placement/Verdict

Where does this tool most often fall on the spectrum for *our* context?
☐ Automation ☐ Guided Use ☐ Amplification
Notes on placement and alignment with preassessment needs:

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Dimension 3. Equity & Access

Guiding Question: How does the tool support equitable access, identity development, and culturally responsive teaching?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Supports identity, language, and cultural relevance; promotes inclusive representations and discourse	
Guided Use	Some support for multilingual learners or accommodations; requires teacher mediation	
Automation (Low)	May reinforce inequities through opaque algorithms or lack of adaptation to student context	

Final Placement/Verdict

Where does this tool most often fall on the spectrum for *our* context?
☐ Automation ☐ Guided Use ☐ Amplification
Notes on placement and alignment with preassessment needs:

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Dimension 4. Transparency & Interpretability

Guiding Question: Can educators understand how the tool works and use its outputs meaningfully?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Teacher and students can interrogate, critique, or modify tool outputs; supports AI literacy and ethical use	
Guided Use	Clear feedback or dashboards provided; teacher interprets data	
Automation (Low)	Black-box algorithms; limited teacher insight into tool decisions	

Final Placement/Verdict

Where does this tool most often fall on the spectrum for *our* context?
☐ Automation ☐ Guided Use ☐ Amplification
Notes on placement and alignment with preassessment needs:

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Dimension 5. Alignment With Mathematics Teaching Practices

Guiding Question: Does the tool support practices outlined in *Principles to Actions* (NCTM, 2014) and NCSM's leadership framework?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Encourages rich tasks, discourse, multiple representations, and reasoning; tightly aligned with effective practices	
Guided Use	Supports some practices (e.g., posing questions or checking understanding)	
Automation (Low)	Focus on procedural fluency only; little opportunity for discourse or reasoning	

Final Placement/Verdict

Where does this tool most often fall on the spectrum for *our* context?
☐ Automation ☐ Guided Use ☐ Amplification
Notes on placement and alignment with preassessment needs:

____

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Discussion Protocol: Using the Educational Technology Guidance Rubric

This discussion protocol is designed to support school and district teams in collaboratively evaluating educational technology and AI tools using the Educational Technology Guidance Rubric. It encourages reflection, shared decision-making, and alignment with high-quality mathematics instruction as outlined by NCTM and NCSM.

Purpose

The purpose of this protocol is to:

- Promote shared understanding of how a tool functions in your instructional context
- Identify where a tool aligns with or diverges from effective math teaching practices
- Surface questions, concerns, or needs for support around implementation
- Guide thoughtful decisions about adoption, professional learning, or classroom use

Before the Meeting

1. Choose an educational technology or AI tool to review.
2. Ask participants to interact with or observe the tool in use if possible.
3. Print or share copies of the Educational Technology Guidance Rubric.
4. Identify a facilitator and a note taker for the meeting.

Discussion Steps

Step 1: Introduce the Tool and Context (5–10 minutes)

- Briefly describe the tool being evaluated and the context of its use (e.g., grade level, content area, instructional goals).
- Clarify that this is a reflection tool, not a rating system.

Step 2: Individual Reflection (10–15 minutes)

- Each participant completes the rubric independently.
- Focus on your observations, examples, and perceived impact of the tool in each dimension.

Step 3: Small-Group or Whole-Group Discussion (20–30 minutes)

- Compare responses and discuss where the tool seems to fall on the spectrum in each dimension.
- Use these guiding questions:
  - Where do we agree? Where do we diverge?
  - What examples can we share from our experience?
  - How is student thinking supported or limited by this tool?
  - What role does the teacher play when this tool is in use?
  - How does this tool support—or hinder—our equity and instructional goals?

Step 4: Synthesize and Act (10–15 minutes)

- Identify two to three key takeaways from the conversation.
- Decide on next steps (e.g., trial use, additional PD, vendor questions, or choosing alternative tools).
- Document findings and revisit in future tech planning meetings.

Tips for Facilitators

- Encourage all voices and perspectives to be heard.
  - Avoid framing tools as "good" or "bad"—focus on instructional fit.
  - Keep the focus on students, equity, and teacher agency.
  - Consider returning to the rubric periodically as the tool is implemented or updated.

Sample Rubric Entries

Disclaimer: The following sample entries are based on a **fictional resource** created for illustration purposes only. They are not endorsements of any existing product.

Sample Rubric Entry: ***"AutoMath Coach"—Adaptive AI Math Practice Platform***

(A fictional tool that assigns problems, adapts levels, and provides automated feedback.)

Dimension 1: Teacher Role & Autonomy

Guiding Question: To what extent does the tool support or constrain teacher professional judgment and instructional design?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Teacher actively interprets AI output, designs instruction, and facilitates learning using the tool.	Some teachers export the misconception data to spark class discussions, adapting assignments into rich tasks that promote student dialogue.
Guided Use	Tool provides suggestions or data to support instructional planning.	Dashboards highlight specific misconceptions; teachers can choose to address these during instruction or reteaching.
Automation (Low)	Teacher role is limited to monitoring or assigning tool-generated content.	Teachers often assign AutoMath Coach's default lessons and track student progress through the dashboard without customizing.

Final Placement/Decision: *Guided Use, with opportunities for Amplification if teachers receive professional learning on integrating dashboard data into discourse.*

Dimension 2: Student Thinking & Engagement

Guiding Question: How does the tool position students as mathematical thinkers?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Tool supports reasoning, exploration, and productive struggle; students generate ideas or critique output.	In structured lessons, students compare multiple AI-generated strategies and debate their effectiveness in pairs or small groups.
Guided Use	Tool prompts student responses but requires teacher to engage student thinking.	Students enter numerical responses; teachers can later use these as discussion starters. Without teacher mediation, engagement remains surface-level.
Automation (Low)	Tool provides answers, hints, or steps with little cognitive demand.	Students can repeatedly request hints that walk them through full solutions, bypassing reasoning.

Final Placement/Decision: *Mostly Guided Use, with potential for Amplification in teacher-designed activities.*

Dimension 3: Equity & Access

Guiding Question: To what extent does the tool support equitable participation, cultural relevance, and access for all learners?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Tool affirms diverse identities, offers multiple modes of access, and fosters belonging.	In pilot settings, teachers paired the tool with student-created word problems to increase cultural relevance. Students felt more ownership when their contexts were used.
Guided Use	Tool includes some supports for access and representation.	AutoMath Coach offers text-to-speech features and limited Spanish language support, though contexts remain generic.
Automation (Low)	Tool assumes narrow definitions of success (fast, procedural, monolingual).	Feedback rewards speed and accuracy, with little accommodation for multilingual learners or alternative approaches.

Final Placement/Decision: *Guided Use. Equity supports exist but are limited; cultural representation depends on teacher mediation.*

Dimension 4: Transparency & Interpretability

Guiding Question: To what extent can teachers, students, and families understand and question the tool's processes and outputs?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Tool makes its processes clear and interpretable; teachers and students can question and learn from the reasoning.	Teachers who requested extra documentation could see how mastery thresholds were determined, though this is not built into the platform.
Guided Use	Tool explains some decisions or outputs but leaves others opaque.	Teachers see limited rationale behind skill progression, though reports do flag "mastery thresholds" with examples.
Automation (Low)	Tool functions as a "black box," offering outputs without explanation.	AutoMath Coach places students on "learning paths" without disclosing the algorithm or criteria for placement.

Final Placement/Decision: *Primarily Automation, edging into Guided Use. Transparency is limited, requiring teacher workarounds.*

Dimension 5: Alignment With Mathematics Teaching Practices

Guiding Question: To what extent does the tool align with effective mathematics teaching practices (e.g., from *Principles to Actions*)?

Spectrum Level	Description	Notes/Evidence From Practice
Amplification (High)	Tool directly supports reasoning, sense-making, multiple representations, and discourse.	With teacher-designed integration, students critique AI explanations and generate multiple strategies for a problem.
Guided Use	Tool partially supports practices.	Teachers can supplement practice problems with class discussions or exploratory activities to build conceptual understanding.
Automation (Low)	Tool prioritizes efficiency, coverage, or rote practice at the expense of conceptual learning.	Tasks are primarily procedural, focusing on repetition and automaticity.

Final Placement/Decision: *Low-to-Mid Guided Use. Without intentional teacher adaptation, the tool risks undermining conceptual learning.*

Summary Recommendation: AutoMath Coach

Context Considered: An affluent school with strong instructional capacity (multiple math teachers per grade, robust PLCs, and access to professional learning). The leadership team is seeking tools that **amplify** reasoning, discourse, and student identity—not just automate or guide.

Rubric Findings:

- **Teacher Role & Autonomy:** Primarily Guided Use. Teachers can adapt dashboard data into discourse, but this requires intentional effort and training.
- **Student Thinking & Engagement:** Mostly Guided Use, with some Amplification possible in teacher-designed lessons.
- **Equity & Access:** Guided Use. Basic supports exist, but representation and cultural relevance are limited unless supplemented by teachers.
- **Transparency & Interpretability:** Primarily Automation, edging into Guided Use. Decision-making processes remain opaque.
- **Alignment With Math Teaching Practices:** Low-to-Mid Guided Use. The tool leans procedural unless heavily mediated by teachers.

Overall Judgment:
For a school explicitly looking for **amplification**, AutoMath Coach falls short. While there are *pathways toward amplification*, they rely heavily on teacher expertise and adaptation. This may not be the best fit for a context that already has strong instructional capacity and wants tools that inherently drive deeper reasoning and discourse.

Recommendation: *Not recommended as a core adoption* for this affluent school. If considered at all, it should be piloted only as a **supplemental practice tool**, paired with strong professional learning, and not as a central driver of math instruction.

9 RESOURCES AND FURTHER READING

Annotated List of Trusted Organizations, Tools, Courses, and Frameworks

Frameworks and Toolkits

- **U.S. Department of Education—*AI Integration Toolkit***
  https://tech.ed.gov
  A comprehensive federal guide for educational leaders on adopting AI in safe, ethical, and equitable ways. Includes guiding principles, reflection questions, and real-world examples. Ideal for district-level planning and policy work.
- **Digital Promise—*AI Literacy Framework***
  https://digitalpromise.org/2024/06/18/ai-literacy-a-framework-to-understand-evaluate-and-use-emerging-technology
  Outlines four core dimensions of AI literacy—Understanding, Evaluating, Interacting, and Creating. This framework is especially useful for shaping professional learning and helping teachers contextualize AI in the classroom.
- **NCTM—*Principles to Actions: Ensuring Mathematical Success for All***
  https://www.nctm.org
  Foundational guidance on effective math instruction. Each of the eight teaching practices offers a benchmark to evaluate how well technology aligns with quality mathematics learning. Crucial for instructional alignment.
- **NCSM—*Framework for Leadership in Mathematics Education***
  https://www.mathedleadership.org
  Emphasizes equity-driven leadership and instructional empowerment. Provides the vision and structure math leaders can use to shape AI and tech adoption in ways that promote identity, agency, and access.

Courses and Self-Guided Learning

- **Common Sense Education—*AI Literacy Basics for Educators***
  https://www.commonsense.org/education
  A short, free professional learning course designed to introduce K–12 educators to AI literacy. Focuses on foundational concepts, responsible use, and classroom implications. A good entry point for PLCs or workshops.
- **Grow With Google—*AI for Educators* (Coming Soon)**
  https://grow.google
  Google's initiative to support educators in responsibly using AI for teaching and learning. While still in early rollout, this program shows promise as a scalable introduction to AI tools.
- **Day of AI—Curriculum and Activities for Classrooms**
  https://dayofai.org
  A collaborative effort led by MIT and i2 Learning. Offers a full day of AI lessons

(including in mathematics) for teachers and students, with free downloadable resources and PD tools.

Tools and Platforms (for Review, Not Endorsement)

⚠️ *Use your rubric from Section 8 to evaluate any tool in your local context. These tools are listed because they are widely used and can serve as conversation starters—not because they are endorsed by this book.*

- **MagicSchool AI**
  https://www.magicschool.ai
  A teacher-facing AI assistant used by many districts to plan lessons, modify tasks, and generate teaching materials. Known for its wide adoption and educator-friendly interface.
- **Desmos**
  https://www.desmos.com
  While not traditionally considered an AI tool, Desmos remains one of the best digital math platforms for **amplifying student reasoning** through visual modeling, exploration, and discourse.
- **EdSurge Product Index**
  https://www.edsurge.com/product-reviews
  A searchable database of edtech tools with educator reviews and use cases. Can be helpful for leaders vetting new products before adoption.

Policy and Ethics Resources

- **ISTE—*AI in Education: Guidance for Schools***
  https://www.iste.org
  A working group of educators, technologists, and researchers developing standards and ethics frameworks for AI in schools. Includes implementation guides and position statements.
- **AI + Education From the Stanford HAI Initiative**
  https://hai.stanford.edu
  A research-based hub for exploring how AI affects learning, teaching, and assessment. Offers both K–12 and higher ed applications.

Links to Policy Documents, Rubrics, and Literacy Frameworks

These documents offer foundational guidance for districts and school leaders creating responsible, equitable, and instructionally aligned approaches to AI and educational technology adoption. Each one connects directly to the practices and recommendations throughout this guide.

Federal and National Policy Documents

- **U.S. Department of Education—Empowering Education Leaders: AI Integration Toolkit**
  https://tech.ed.gov/ai
  A comprehensive guide outlining how school and district leaders can safely, ethically,

and equitably integrate AI. Includes guiding principles, sample policies, and actionable strategies.

- **U.S. Department of Education—National Educational Technology Plan (2024)**
  https://tech.ed.gov/netp
  This broader policy framework emphasizes digital equity, human-centered technology use, and supports for AI literacy across the education ecosystem.

AI Literacy and Evaluation Frameworks

- **Digital Promise—AI Literacy: A Framework to Understand, Evaluate, and Use Emerging Technology**
  https://digitalpromise.org/2024/06/18/ai-literacy-a-framework-to-understand-evaluate-and-use-emerging-technology
  Defines the four key dimensions of AI literacy and provides practical application examples for K–12 classrooms.
- **Common Sense Education—AI Literacy Basics for Educators**
  https://www.commonsense.org/education
  A starter guide and PD course focused on helping educators understand what AI is, how it works, and how to use it responsibly with students.
- **Stanford HAI—AI + Education Policy Initiative**
  https://hai.stanford.edu
  Research-based insights and evolving policy recommendations on how AI impacts learning, teaching, assessment, and student privacy.

Rubrics and Reflection Tools

- **Educational Technology Guidance Rubric**
  (Included in Section 8 of this guidebook)
  A customizable spectrum-based rubric designed for evaluating how AI and edtech tools align with math instruction, teacher agency, and student reasoning.
- **ISTE—AI in Education: Guidance for Schools**
  https://www.iste.org
  Offers implementation guidance and reflection tools for school systems adopting AI tools, including ethics-focused evaluation criteria.
- **EdSurge Product Index**
  https://www.edsurge.com/product-reviews
  An educator-sourced database of edtech tools with practical notes on use cases, features, and impact—useful for vetting tools before district-level adoption.

Mathematics-Specific Instructional Frameworks

- **NCTM—Principles to Actions: Ensuring Mathematical Success for All**
  https://www.nctm.org
  Describes eight essential teaching practices for high-quality math instruction. Use this as a reference when evaluating whether a tech tool supports deep learning.
- **NCSM—Framework for Leadership in Mathematics Education**
  https://www.mathedleadership.org
  Offers a leadership-focused model for advancing equity, professional empowerment, and instructional alignment in mathematics classrooms.

10 FINAL REFLECTIONS AND LOOKING AHEAD

What We've Learned About AI and Math Education

Over the course of this guidebook, one core message has emerged again and again:

AI is not the future of education—it's already part of the present. The question isn't whether we'll use it, but how we'll use it to deepen learning and protect equity.

In mathematics education, where student identity, sense-making, and critical reasoning are central, AI tools offer both significant opportunity and real risk. Through careful exploration of the AI literacy framework, instructional practices, decision-making rubrics, and real-world case examples, we've learned that:

"AI is not the future of education—it's already part of the present. The question isn't whether we'll use it, but how we'll use it to deepen learning and protect equity."

1. Technology Alone Does Not Improve Instruction

The value of any tool depends on how it's used. Automation without intentionality can erode student thinking and teacher agency. Amplification only happens when teachers stay at the center of instructional design, using AI as a support—not a replacement.

2. Strong Instructional Vision Is the Best Safeguard

When school systems are clear about what good math teaching looks like—anchored in NCTM's *Principles to Actions* (2014) and NCSM's leadership framework—they can filter out tools that distract or diminish learning and embrace those that support reasoning, discourse, and conceptual understanding.

3. Equity and Identity Must Be Non-Negotiable

AI systems are trained on data, not values. If left unchecked, they can reproduce and even amplify inequities. Math leaders must actively design policies and practices that center student voice, access, and cultural relevance—especially for students historically marginalized in math spaces.

4. AI Literacy Is a Shared Responsibility

Teachers, students, leaders, and families all need opportunities to understand, question, and shape how AI is used in their schools. Building AI literacy is not a one-time training—it's an ongoing conversation about ethics, impact, and instructional purpose.

5. We Can—and Must—Lead the Work

Math educators are uniquely positioned to lead this conversation. We know how to examine patterns, question assumptions, and engage in thoughtful problem-solving. By applying those same habits to AI, we can ensure that math classrooms remain places of joyful inquiry and rigorous learning, not algorithmic compliance.

This section is not an ending, but a pivot point—a place from which math leaders can move forward with clarity, tools, and a vision for how to lead this work in their own schools, districts, and communities.

Appendix: Glossary of Key Terms

The following glossary defines key terms related to AI, educational technology, and mathematics instruction as used throughout this guidebook.

AI Literacy

The knowledge, skills, and dispositions needed to understand, evaluate, and responsibly use AI tools in education. This includes critical thinking about how AI wo\ks, its ethical implications, and its impact on teaching and learning.

Algorithm

A set of rules or instructions that a computer follows to solve a problem or make a decision. In AI, algorithms often analyze data to predict outcomes or generate responses.

Amplification (in technology use)

A concept describing when technology supports and enhances human learning, rather than replacing it. In math classrooms, amplification means that tools promote reasoning, discourse, and conceptual understanding.

Automation

The use of technology to perform tasks without human intervention. In education, automation can include grading, assigning tasks, or providing feedback—sometimes at the expense of teacher and student decision-making.

Bias (in AI systems)

Systematic errors in decision-making caused by flawed or incomplete data. Bias can result in unfair or inequitable outcomes for certain groups of students.

Cognitive Demand

The mental effort required to complete a task. High-quality math instruction encourages tasks that involve reasoning, problem-solving, and conceptual understanding—not just procedures.

Data Privacy

The protection of student and teacher information collected by digital tools. Policies must ensure that data are handled securely and ethically, with transparency about what is collected and how it is used.

Equity (in education)

The principle that all students—regardless of race, language, ability, or background—deserve access to high-quality instruction, tools, and opportunities. Equity is central to the responsible use of educational technology.

Feedback Loop (in AI tools)

A process by which an AI system receives input, makes a decision, and adjusts based on the result. In learning systems, this often refers to how a tool adapts tasks or feedback based on student answers.

Formative Assessment

An approach to checking student understanding during learning. AI tools can support formative assessment by identifying patterns in responses—but teachers must interpret the data to guide instruction meaningfully.

Generative AI

A type of artificial intelligence that creates new content—such as text, images, or questions—based on patterns it has learned. Tools like ChatGPT are examples. In math, it can be used to generate tasks, explanations, or representations.

Instructional Alignment

The degree to which a tool or practice supports a teacher's learning goals, curriculum standards, and best practices in math instruction. A tech tool must align with what we know about how students learn math—not just deliver content.

Mathematical Identity

How students see themselves as mathematical thinkers. Tools and instruction should affirm students' strengths, voices, and ways of knowing—not reduce them to scores or speed.

Tool Spectrum (Automation → Amplification)

A framework introduced in this guidebook that describes how technologies differ based on how they position the teacher and the learner. Tools range from doing the work for students (automation) to deepening student thinking (amplification).

Transparency (in AI tools)

The degree to which users can understand how a tool works—how it makes decisions, why it gives certain feedback, and what data it uses. Transparency builds trust and supports critical use.

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