AI Hub for Education

National Student Support Accelerator

AI Tutoring is Not a Monolith: What We Actually Know

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AI Tutoring is Not a Monolith: What We Actually Know

The Brief at a Glance

- High-impact tutoring remains defined by live human-led instruction. Current research supports leveraging AI tools to enhance tutor effectiveness and educator capacity, rather than serving as a replacement for high-impact tutoring.
- AI-led tutoring software, even software based on learning sciences, offers potential for supplemental practice but does not yet meet the established evidence base or definition of high-impact tutoring.
- The effectiveness of AI-led tutoring depends as much on integration, such as by teachers in classrooms or parents at home, as on the quality of the software itself.
- Safe implementation of direct-to-student AI tools requires careful evaluation of data privacy safeguards, student safety guardrails, and the depth of unmonitored interaction.

High-impact tutoring is a highly effective, well-researched approach for accelerating student learning. Students who receive it show learning gains of three to more than 15 months across grade levels and content areas, along with improved well-being and engagement in school. Many practitioners identify strong relationships as a key driver of effective tutoring, and research suggests that relationship-building strategies, particularly consistent tutoring with the same tutor, improve student engagement, attendance, motivation, and learning outcomes.

Practitioners are increasingly considering Artificial Intelligence (AI) as a way to expand access, lower costs, and improve personalization of tutoring. Although the published AI tutoring research base currently lags behind field implementation, an emergent body of research, supplemented by applicable research in educational technology, can guide current practice.

This brief draws on research on high-impact tutoring, emerging evidence on AI-enabled tutoring models, and interviews with AI tutoring providers, platform developers, and researchers. It defines the core elements of high-impact tutoring, then identifies and maps **a spectrum of AI tutoring models** by how much human interaction each one preserves.

The Elements of High-Impact Tutoring

High-impact tutoring is one of the best-evidenced interventions in K-12 education. A growing body of research continues to sharpen what we know about which design features drive results. Features defining high-impact tutoring include:

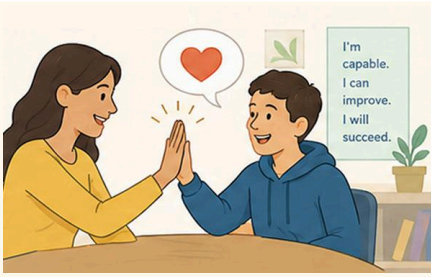
Regular tutoring sessions implemented during the school day

Small-group formats with tutor-student ratios of 1:4 or fewer

Consistent, well-trained tutors

Data-driven instruction

Vetted, structured instructional materials



Strong student-tutor relationship

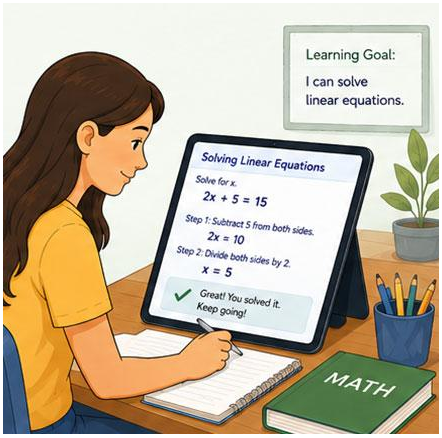
The Tutoring Quality Standards, developed by an Advisory Group of practitioners and researchers, further outline research-based effective practices.

These elements matter for AI tutoring because they explain *why* tutoring works, not just that it does work. Effective tutoring depends on frequency and consistency, instructional quality, responsiveness to individual student data, and a relationship that keeps students showing up and engaged. These features give practitioners and product developers a concrete place to start with any AI tutoring model: which of these conditions does it reproduce, which does it change, and which does it drop? Asking that question yields more useful information on effectiveness than simply asking whether AI tutoring "works."

Evaluating AI tutoring doesn't have to start from scratch.

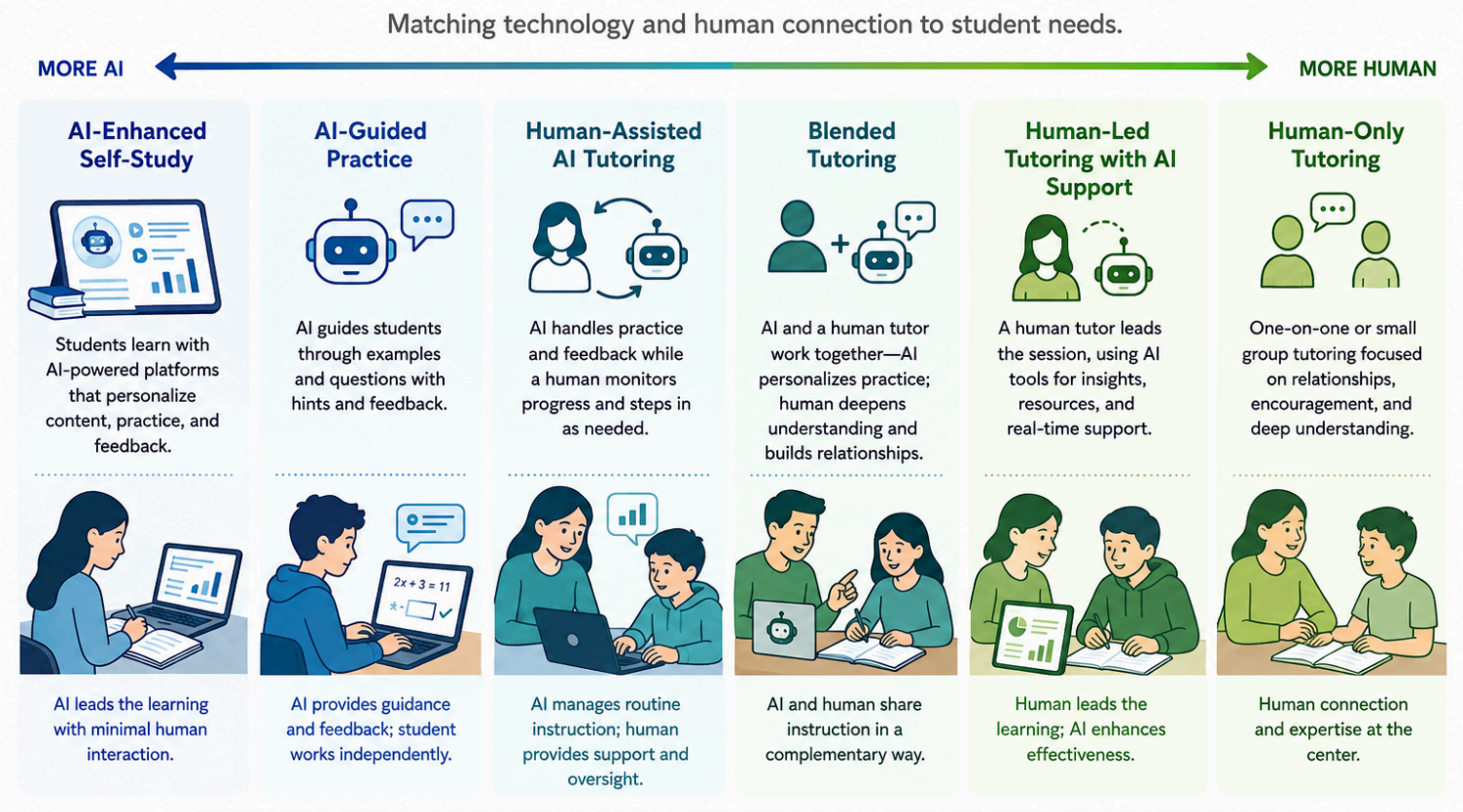
Artificial Intelligence Tools in Education

AI tools in education range from general-purpose platforms to tools built specifically for teaching and learning. They also differ in who they're designed for: some engage students directly, while others work behind the scenes to support the adults delivering instruction. Both distinctions shape how a tool integrates into high-impact tutoring:

General-purpose AI Tools	Student-focused AI Tools	Educator-focused AI Tools
		
Answer questions, generate content, and save time. These tools depend on the user, e.g. students or educators, to initiate each interaction, and often function as homework helpers or answer engines.	Built around learning goals, high-quality instructional materials, and pedagogical support. They encourage productive struggle, provide step-by-step guidance, and keep students aligned with a standard curriculum.	Support the teacher or tutor rather than the student. These tools can provide in-the-moment pedagogical suggestions during a session, differentiate materials for individual students, match students with similar needs into small groups, flag struggling students or tutors so a coach can step in, and support professional development.

This brief primarily focuses on student-focused and educator-focused AI tools, those built with explicit instructional intent. General-purpose tools can also be adapted for education settings, through prompt engineering and custom guardrails.

Tutoring Models Across the AI-Human Spectrum



AI tutoring models vary by their level of human involvement, what we call relational intensity. Relational intensity is the depth and consistency of the human connection between a student and a tutor within a given tutoring model, ranging from human-led models with close, sustained relationships to AI-led models with minimal or no human interaction. As direct human relationships decrease, the evidence base becomes thinner, leaving unresolved questions about student safety, developmental impact, and long-term efficacy.

The tables below use a visual framework to map tutoring models that incorporate AI by relational intensity and the strength of the evidence base:

Green – high-intensity human instruction with strong research support

Yellow – emerging AI-assisted models dependent on implementation quality

Red – fully automated AI models with significant evidence gaps

Human-Led Tutoring Models With High Relational Intensity

Human-led tutoring models build upon a research-based program design in which a human tutor holds the relationship with the student. The tutor delivers the session, responds to the student in real time, and is the person the student shows up for. AI, where present, works behind the scenes, supporting preparation, data analysis, and tutor efficiency.

Tutoring Model	Description	Evidence Base and Effectiveness
In-Person Tutoring or Remote Tutoring	A live tutor is directly responsible for all instruction and student interaction (in-person or via online platform). No AI is used during student-tutor sessions, though providers may use standard software or dashboards for operations.	Robust evidence base; highly effective. **Note:** The evidence for in-person tutoring is stronger, but virtual tutoring has also demonstrated meaningful positive effects in high-quality studies.
Human Tutoring With AI Support	A live human tutor is responsible for interaction with the student. AI assists the tutor behind-the-scenes through synchronous or asynchronous support.	Emergent research base; potentially as effective as, or more effective than, in-person and remote tutoring.

AI-Led Tutoring With Decreasing Relational Intensity

Adopting AI-led solutions without clear integration plans risks undermining several elements of effective high-impact tutoring. Given strong evidence that dosage is a key driver of student outcomes in human-led tutoring, similar requirements, such as a 90-minute weekly dosage threshold, apply to AI-led tutoring. Meeting dosage requirements presents a documented challenge for learning software. For example, in a study of 181,000 students using a supplemental math platform, only 5% reached the recommended 30 minutes per week, and 41% never logged on. Teacher, school, and district factors explained 57% of the variance in usage, indicating classroom integration determines whether students reach recommended dosage.

AI tutoring with human support places AI in the lead, while a human oversees the process and intervenes as needed. Two recent studies suggest this model is workable in design but unproven in effect. A pair of randomized controlled trials (RCTs) across two school districts found that adding human check-ins and motivation raised elementary students' engagement with an AI platform, but usage still

fell short of the dosage associated with learning gains, and reading achievement did not improve. An exploratory randomized controlled trial in United Kingdom classrooms points to a different strength of the model: with a human supervising, AI-led sessions preserved structured learning goals and curriculum alignment.

Together, these findings point to what human oversight can and cannot do in AI-led tutoring models: it improves engagement and keeps instruction aligned, but it does not by itself get students to the dosage that produces gains. Whether AI-led tutoring can benefit students is not yet clear, given unresolved barriers to engagement and dosage.

Tutoring Model	Description	Evidence Base and Effectiveness
AI Tutoring with Human Support	The student engages directly with AI, while a human tutor oversees, guides, and intervenes when prompted.	Emergent evidence; early research indicates implementation determines effectiveness on student outcomes.

At the low end of relational intensity sits AI-only tutoring. This model represents standalone AI tools operating without direct human oversight. Results from the two-district randomized controlled trials demonstrated that when left to work independently, 40% to 47% of students never used the AI platform at all. Even students who logged on used it only for four to five weeks total across a multi-month intervention, averaging two to five minutes per week, far below the dosage associated with reading gains.

Tutoring Model	Description	Evidence Base and Effectiveness
AI-Only Tutoring	The student works directly with AI for all aspects of the tutoring experience without direct human oversight.	Emergent evidence; unknown effectiveness.

Open questions remain about how AI affects student emotional needs and long-term cognitive development, beyond questions of dosage. Recent survey data shows a rapid rise in youth using AI tools to build emotional bonds. This use raises questions about how AI companions affect developing minds and how to protect prosocial development both inside and outside of school.

Cognitive risks also exist. AI can ease a student's immediate learning burden, but long-term educational effects are mixed once the tool is removed. Interviews with AI tutoring developers revealed efforts to build education-focused AI tools that prioritize student agency and access while supporting human connection.

Intentional AI Integration in High-impact Tutoring

The following section explores how each element of the high-impact tutoring design principles translates into AI implementation decisions. Under each element of high-impact tutoring, AI tutoring use cases are curated from interviews and experimental research with the primary goal of enhancing human-led instruction and augmenting educators' capacity.

Regular Tutoring Sessions with School-Day Implementation

> *If teachers are not bought into using [AI] in their classroom practice or setting homework, then there is no impact of [AI], because dosage is absolutely key.*
>
> -Tutoring provider using AI to support human tutors

Tutoring embedded in the school day, with appropriate dosage (three or more sessions weekly, 90 minutes total, for at least 10 weeks), produces effects roughly twice as large as out-of-school programs, particularly within a Multi-Tiered System of Support (MTSS) model. This difference likely reflects the removal of barriers such as transportation, scheduling conflicts, and opt-in requirements.

AI-led tutoring inherits the dosage evidence base only when it is scheduled, supervised, and protected within the school day on the same terms as human-led tutoring. AI removes the staffing constraint that caps how many students a school can tutor by serving any number of students at once, but it reintroduces an opt-in requirement that a live, school-day tutoring model eliminates. Even with dedicated classroom time set aside for tutoring, an AI tutor on a device relies on the student to decide to engage and self-monitor. Interviews highlight AI tools designed to streamline master scheduling and attendance tracking, helping schools protect time for human-led tutoring.

Leveraging AI to Support Dosage and Scheduling Efficacy

- AI can streamline master scheduling and effective allocation of students and educators, significantly reducing schedule-building time while preserving core instructional time and intervention blocks.
- AI can analyze attendance data to identify students below dosage standards and pinpoint root causes.
- AI can identify integration points for tutoring within the district's existing Multi-Tiered System of Support (MTSS) or Response to Intervention (RTI) Systems.

Small-Group Formats

> *[Tutors] are the critical lever... AI will enhance scalability and efficiency, but humans are still at the heart of it.*
>
> -NSSA Badged Tutoring Provider

High-impact tutoring operates with tutor-student ratios at or below 1:4 to support individualized instruction, foster stronger relationships, and maximize student achievement. Experimental evidence on online tutoring demonstrates 1:1 instruction yields the strongest gains in student cognitive outcomes and academic achievement. An AI model delivering 1:1 instruction inherits the ratio evidence only if it also delivers what the ratio produces: consistent engagement, personalized instruction, ability to diagnose misconception, and responsiveness to student cues.

This ratio evidence cuts both ways. In human-led tutoring models, small-group formats remain viable and cost-effective alternatives to 1:1, particularly in secondary mathematics, where peer collaboration adds value and effects on student performance stay strong. AI's ability to give every student an individual session is not automatically an upgrade if it removes the peer interaction those positive impacts are attributed to.

Supporting Small Group Formats with AI

- AI can facilitate station rotations within small-group tutoring, allowing human tutors to deliver targeted one-on-one instruction while the remaining students engage in high-quality individual practice.
- AI can expand opportunities for student practice, reinforcement, and progress tracking outside of regularly scheduled tutoring sessions.
- AI can automate administrative tasks, including session notes, usage metrics, and engagement tracking, so tutors maximize direct instructional time.
- AI can evaluate performance data to regroup students by current skill needs while keeping each student with the same tutor.

Consistent, Well-Trained Tutors

Consistent pairings in 1:1 and small-group formats deepen student-tutor relationships, which is often a precursor to learning. High-impact tutoring increased student attendance in D.C. schools, with students 7% less likely to be absent on days when they had a scheduled tutoring session. Tutoring programs that prioritize consistent tutor-student pairings with the intent of developing a positive relationship-based experience may produce improved attendance, motivation, and learning outcomes. AI can be used as a tutor support tool by providing well-timed and responsive recommendations to tutors during virtual tutoring sessions. Research shows that students whose instructors used the system were four percentage points more likely to master lesson topics, a benefit that increased to nine percentage points for the students of lower-rated tutors.

Supporting Tutor Efficacy With AI

- AI can provide real-time feedback and suggestions on key interaction metrics, including tutor talk time, instructional moves, participation equity, and behavior management.
- AI can scaffold student practice through adaptive hints, guiding questions, and step-by-step reasoning support under the direct oversight of a human tutor.
- AI can support novice tutors by generating real-time session scripts and instructional scaffolds to boost pedagogical confidence and consistency.
- AI can enhance tutor training and professional development through realistic practice simulations that allow tutors to hone their instructional techniques before leading live sessions.

Data-Driven Instruction

> *Our hope is actually to free up the human beings in the loop to spend more time on the human connection side of things.*
> -AI-led instructional tool developer

The use of data to improve organizational outcomes, guide instruction, and measure student progress is well-researched in education. Effective tutoring programs use data to increase their program effectiveness and adjust the program to be responsive to student needs and outcomes. Analyzing student-level progress data and system-level organizational metrics can drive continuous improvement in programs. AI has the opportunity to alleviate human constraints around data capture and synthesis, provided educators and program leaders act on the resulting insights and data privacy is protected.

Informing Instruction and Systems with AI Insights

- AI can scale real-time analysis across operational data and logistics, such as attendance, scheduling, and dosage, as well as student performance metrics.
- AI can analyze multi-source data to rapidly identify students in need of additional academic support.
- AI can synthesize performance data to generate real-time insights on skill mastery, progress monitoring, and specific student misconceptions.
- AI can summarize performance trends and generate actionable, data-informed recommendations for subsequent sessions.

Instructional Materials

Effective tutoring sessions use high-quality instructional materials that align with grade-level classroom instruction and focus on skills and concepts most critical to accessing the upcoming content. Effective tutoring programs prioritize consistency between tutoring content coverage and assessment, integrate with existing data systems, and align with district and state standards and curricula. Interviews surfaced a need for AI-generated materials to be structured within existing curricula and vetted by humans before they are used with students.

Supporting High-Quality Instructional Materials with AI

- AI can support curriculum alignment by confirming tutoring lessons strictly correspond with district and state standards, pacing guides, and High-Quality Instructional Materials (HQIM).
- AI can personalize learning by generating targeted student practice materials, while maintaining quality control through required human review before implementation.
- AI can audit structured curricula to identify opportunities for culturally relevant examples, inclusive content, and language accessibility features for diverse and multilingual learners.

Strong Student-Tutor Relationships

> *You're not necessarily replicating that experience [of tutoring with humans]. I think it's a mistake to try and—you know, an AI is not human. You should focus on the strengths of it [AI].*
>
> -Human-led tutoring provider developing AI-led delivery

Research on youth mentoring, student-educator matching, and attendance suggests a strong student-tutor relationship as an essential contributor to engagement and improved outcomes in high-impact tutoring. To date, AI does not replicate human relationships. Most AI tutoring developers interviewed describe the goal as applying specific AI strengths rather than replacing human relationships.

Enabling Strong Student-Tutor Relationships With AI Assistance

- AI can support student motivation and social connection by delivering personalized, adaptive learning paths while human tutors provide essential social-emotional support, troubleshooting, and redirection.
- AI can facilitate real-time, multilingual communication and translation between educators and families.
- AI can track student interests, hobbies, and personal goals across sessions to support meaningful, personalized interactions.
- AI can analyze session transcripts to provide targeted feedback to tutors and teachers on safety, cultural responsiveness, and growth-mindset messaging.

- AI implementation can incorporate staged human-review and decision points before, during, and after sessions, supporting safety, relational quality, and instructional alignment.

Essential Guardrail: Student Data Privacy

Effective AI implementation relies on strict student data privacy safeguards. Secure deployment requires enterprise-grade AI platforms with formal data protection agreements alongside comprehensive tutor training on personally identifiable information (PII) protection. Existing NSSA data privacy guidance outlines the platform requirements and training components district and state leaders verify before deployment.

Next Steps:

Four actions can help a district or state adopt AI in tutoring responsibly as the possibilities and research rapidly expand:

- Distinguish direct-to-student software from tutor-facing applications to mitigate implementation risks.
- Prioritize applications expanding human-led instruction and operational capacity, such as generating curriculum-aligned practice materials and streamlining lesson preparation.
- Establish strict student data privacy safeguards, verifying formal enterprise-grade agreements and tutor training on personally identifiable information (PII) protection prior to deployment.
- Monitor emerging evidence continuously through dedicated repositories like the Stanford SCALE AI Hub Research Repository to adapt strategies as the field evolves.

Conclusion

AI offers a pathway to extend the reach of high-impact tutoring by expanding access, lowering costs, and improving personalization. Technology alone cannot replace the foundational student-tutor relationship driving learning gains. When integrated with specific pedagogical structures, AI can expand the capacity of human-based tutoring by improving tutor effectiveness and minimizing the operational complexity of high-impact tutoring. AI also supports personalized instruction, increasing opportunities for student practice, streamlining operations, and reducing cost. The research at this time supports using AI tools to enhance tutor effectiveness and educator capacity within high-impact tutoring.

> *“I don't think it's a thing to be rushed. AI is exploding everywhere, but I think this is one where being thoughtful and taking our time to do it the right way is going to be the right answer.*
>
> -Badged Tutoring Provider

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Participation in an interview or review does not imply endorsement of this brief's findings, nor does inclusion here imply NSSA endorsement of any product or organization.

Badged Tutoring Providers refers to Tutoring Providers that have earned the Tutoring Program Design Badge by submitting evidence that their program design adheres to high-impact tutoring standards.