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Google

AI in Education Report

From potential to practice

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Contents

Executive summary 3

Introduction
- The education landscape 6
- How AI is impacting education — global themes 9
- Philosophy for driving impact in teaching and learning 12

What we are pursuing
- For educators 17
- For students 21
- For the broader ecosystem 24

Looking ahead
- The future of education 26

Executive summary

Learning is the number one reason people use AI globally.[1]

But when students use AI for schoolwork, it is natural to wonder: Are they actually learning, or are they shortcutting — and thus shortchanging — their learning?

In last year's report, AI and the Future of Learning, we explored the educational promise of AI alongside critical challenges including accuracy, safety risks, and potential learning loss.[2] We also noted that AI offers transformative potential to personalize learning, reduce educational barriers, and foster curiosity while maintaining educators as the central architects of classroom learning.

One year later, there continue to be questions and concerns about the impact of AI on learning, including academic integrity, cognitive offloading, and training and policy gaps. These developments are unfolding against longstanding challenges in education, such as global math and reading score declines, educator shortages, and concerns over students' preparedness for future careers.

At the same time, there is also a growing body of evidence on the positive impacts of AI on teaching and learning. When intentionally designed and deployed, AI can provide personalized student support, enabling deeper conceptual understanding, targeted opportunities to practice, and lower accessibility barriers. Meanwhile, educator-facing AI tools have been shown to help educators reclaim valuable instructional — and personal — time by reducing administrative burdens, enabling new assignment and assessment methods, and targeted professional training.

Executive summary

Recognizing both the challenges and opportunities continues to shape our approach to designing research-backed AI tools specifically for education. With the goal of transforming learning responsibly, our approach is anchored on **three key areas**: keeping educators in the lead; grounding our work in learning science; and developing purpose-built products for education.



Educators in the lead

Supporting educators with training, tools, and controls



Learning science principles

Grounding AI models and products in pedagogical science



Purpose-built products

Building responsibly to meet the diverse needs of learners

This philosophy comes to life in our latest learnings from the field, our ongoing work, and what we are exploring as we think about the future of education.

In this report, we share what we are building and learning in partnership with educators, students, and the broader ecosystem, with the following key takeaways:

Educators

A key learning from our work and research is that **AI tools are most impactful when educators are in the lead.** Google Classroom has always been a teacher-oriented tool since its inception 12 years ago — and this has been a core part of our approach with AI as well. We have built an ecosystem of connected tools for educators with this in mind. Using Google Classroom and Gemini for Education, alongside other tools, educators can more efficiently tackle administrative tasks and reclaim time for direct student engagement, innovate and improve the teaching and learning experience, and uplevel their skills. In a pilot with schools in Northern Ireland, teachers used Gemini in

Executive summary

Workspace to save an average of 10 hours weekly, freeing up some of that time for student instruction.[3] We also see multiple examples of student learning outcomes increasing with AI when educators are involved.

Students

AI can enable more efficient and deeper learning, but it also entails the risk of cognitive offloading. More than 80% of adult students (18+) globally use AI for their studies, reporting clear gains in both learning and efficiency.[4] Yet in the U.S., two-thirds of middle school, high school, and college students worry that instant-answer tools degrade their critical thinking.[5] To counteract this risk of passive completion, we focus on features grounded in learning science with educators in the lead — including encouraging active learning, adapting to each learner, and deepening metacognition. In one trial, using Gemini's Guided Learning feature improved math scores by prompting learners through active, step-by-step problem-solving instead of direct solutions.[6]

Broader ecosystem

The rapid adoption of AI has outpaced institutional and ecosystem guidelines, leading to a drop in trust across education systems. In one Nordic study, for instance, 82% of educators surveyed said they use AI tools at work, but showed low trust in those same tools — rating their outputs an average of 2.4 on a scale of one to five.[7] To help rebuild this confidence, we invest in sustained collaborations with partners, targeted AI literacy training initiatives, and convenings with educators and leaders. These ecosystem experiences inform our product roadmap, enabling us to pair learnings from educators, parents, and students with our ongoing approach to rigorous research.

Introduction

The education landscape

Since the publication of last year's report on AI and the Future of Learning, global education institutions and systems continue to face notable challenges. The OECD's Program for International Student Assessment (PISA) results point to a decade-long slide in global learning outcomes. Between 2015 and 2025, average scores across OECD member countries fell by 28 points in reading and 22 points in mathematics — equal to more than a full year of lost schooling.[8]

The COVID-19 pandemic exacerbated a decline that was already underway, wiping out more than half a school year of math progress on its own.[9] Persistent equity divides make these losses even harder to overcome, with advantaged students outperforming their disadvantaged peers by an estimated four years of schooling.[10]

During this same period, spending on various forms of educational technology has climbed dramatically: Industry data shows global spending on education technology grew from $107 billion in 2021 to $187 billion in 2025.[11]

These parallel trends have led some to conclude that investments in educational technology alone don't always lead to better outcomes. The latest OECD PISA 2025 benchmarks show that how and why devices are used in school makes the difference: More screen time for leisure at school is associated with lower scores in science, while moderate screen use for deliberate learning correlates with stronger results.[12]

The same pattern holds for AI: Students who use AI chatbots weekly to help them learn — and are taught how to judge the quality of AI-generated information — tend to outperform peers who receive no such guidance.[13]

In Singapore, which leads the world in PISA reading scores and ranks second in math and science, 66% of students use AI chatbots weekly to support their learning (compared to the OECD average of 46%).[14] Crucially, the Ministry of Education in Singapore has integrated AI literacy into school curricula, training students to think critically about AI outputs and identify false or misleading information.[15]

The education landscape

We see a similar pattern in Japan, which ranks fifth for in-school device use and second for out-of-school use among 24 OECD countries.[16] According to the National Assessment of Academic Ability from Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT), students who regularly use classroom devices score higher across Japanese, Mathematics, and English — and lower-income students who are skilled with these devices score higher on average than wealthier peers who cannot use them effectively.[17]

> "The PISA results show how students use devices matters more than whether or not they have them. The same tool can lead to opposite results: AI can enable cognitive offloading among students who use it to replace thinking, but when supported by an educator and used in purposeful ways, AI can improve learning outcomes."
>
> **Jean-Claude Brizard**
> PRESIDENT AND CEO OF DIGITAL PROMISE

As noted in last year's paper, we are optimistic about using AI to support personalized learning, remove barriers, and assist busy educators. To make sure we get this right, we are investing in research to understand how AI can help augment teaching and learning, and where more improvement or deeper insights are needed.

Our research has demonstrated that purpose-built AI learning tools can contribute to learning gains. For example, a recent randomized controlled trial (RCT) demonstrated that Gemini's Guided Learning drove significant improvement on independently conducted endline math assessments (equivalent to between one and two years of typical learning progress), with 90% of students' interactions with Guided Learning focused on actively working through concepts.[18]

The education landscape

AI can also have a positive impact on educators, freeing up more of their time from administrative tasks to focus on engaging with students. For example, a pilot in Northern Ireland found that teachers using Gemini in Workspace saved up to 10 hours per week on routine administrative tasks, enabling more student-facing interactions as well as a more sustainable experience for educators.[19]

Research has also shown areas where the introduction of AI alone does not clearly lead to better outcomes. In an early pilot with the ASU Study Hall program, and more recently Coursera, optional "tutor-on-the-side" implementation of AI failed to yield meaningful performance gains despite being grounded in course materials.[20] This was primarily due to low student adoption (30% on Coursera; 39.3% in Study Hall). Khan Academy reached a similar conclusion from the first version of its AI tutor, Khanmigo. Students who engaged received the support it was designed to give, but an add-on tool depends on students recognizing when they need help and asking for it. Khan Academy has since built Khanmigo directly into its practice experience, where it offers help if a student gets a question wrong, lowering the help-seeking barrier.[21]

In contrast, we found that integrating conversational AI tutoring as an educator-prescribed component within Coursera courses nearly doubled adoption. Further investing in this teacher-led approach in Sierra Leone — where teachers determined how and when students should interact with AI — resulted in statistically significant learning gains.[22] We are building these learnings into our products, such as Guided Learning in Google Classroom, which will enable teachers to use grounded, learning-focused AI with their students and view insights on their progress.

Technology alone is never a substitute for effective teaching; the effectiveness of AI for learning must be driven by putting educators in the lead, improving AI literacy, and grounding tools in learning science.

How AI is impacting education — global themes

As with other major technology shifts, AI brings both new challenges and opportunities for educators, students, leaders, and families. Below are a few global themes that help shape our approach to transforming learning and teaching responsibly.

1. Cognitive offloading vs. deeper learning

Students often struggle to start an essay or project from scratch, synthesize fragmented research, or break down and solve a complex problem. While AI can help, it also introduces the risk of cognitive offloading when not used responsibly.

True learning requires productive friction — the hard effort of drafting, revising, and reasoning. If AI does the thinking, students miss out on foundational cognitive development. Nearly 40% of U.S. middle and high school students are concerned they generate fewer of their own ideas when using AI,[23] while 66% of university students worry AI makes learning too shallow.[24] These concerns, among others, contribute to Gen-Z anxiety and resentment around AI tools.[25]

In one study published in PNAS, high school math students with access to AI scored 17% lower on unassisted exams than peers who worked without AI.[26] Yet the same research also points to how these risks can be mitigated: For example, adding teacher-designed guardrails eliminated the 17% learning drop — demonstrating that instructional safeguards can help keep learning intact.[27]

Beyond mitigating risks, intentionally designed AI tools can enable deeper, more personalized learning. Sixty-six percent of U.S. middle and high school students say AI helps them better understand school work rather than just complete it faster.[28] In higher education, more than 80% of university students report positive learning outcomes from using AI tools, with 61% spending less time on repetitive tasks to focus on higher-order thinking.[29]

These self-reported findings are supported by academic evidence. One study found that while unguided use of AI led to passive offloading, structured prompting reversed that decline and lifted critical reasoning scores by nearly eight points over learners working on their own.[30] AI can also enable students to ask questions and explore concepts independently at their own pace. This individualized approach shows measurable benefits: in one trial, students who used an interactive “Learn Your Way” AI feature scored higher on later tests than those using standard digital readers.[31]

How AI is impacting education — global themes

2. Academic integrity and new forms of assessment

The adoption of AI tools heightens concerns over academic integrity and "frictionless completion," necessitating a re-evaluation of how to assess understanding and ensure students are learning. In a recent survey of higher education faculty and staff, assessment design topped the list of ways faculty are adjusting their teaching approach due to AI.[32] And it's not just educators who are concerned — 60% of students worry classmates might misuse AI to gain unfair advantages.[33]

Even as AI complicates traditional testing, it opens up new possibilities for evaluating the learning process — moving from high-stakes summative exams toward continuous, interactive methods that assess understanding and generate real-time insights. To support this, Google.org is funding a joint field study with the International Society for Transforming Education (ISTE) to explore the potential of using AI in assessment to protect academic integrity and save teachers time.

3. Institutional policies and training

The rapid rise of generative AI has outpaced accompanying policies and training for educators and institutions. Although 85% of educators report using generative AI tools,[34] a U.S. Gallup survey shows only 18% of teachers report receiving any type of formal guidance from school administrators on how AI tools should be used.[35] In higher education, only 6% of faculty strongly agree their institutions provide sufficient training resources on using AI.[36]

Leaders around the globe are starting to fill this gap. For example, across the U.S., 40 states and Puerto Rico have established official AI guidance frameworks, with several states passing laws that require school districts to adopt transparent policies.[37] To support this work, our Global Policy team created a program to gather education leaders to co-develop actionable, product-agnostic, 12-month implementation roadmaps for AI in education, bridging high-level regulation and daily classroom practice. The program is available globally.

To help tackle the training shortage, efforts like the Google AI Educator Series are rolling out free, bite-sized courses that help teachers in the U.S., India, U.K., Philippines, South Korea, and elsewhere build everyday classroom skills.

How AI is impacting education — global themes

4. Future readiness

As AI reshapes the skills required for future workforces — nearly 40% of core job skills are projected to shift by 2030 according to the World Economic Forum[38] — educators are grappling with how to prepare students for the rapidly shifting labor market.

For example, 70% of U.S. managers consider an AI-trained workforce essential, yet only 14% of workers report receiving training on the job.[39]

With this in mind, many people are seeking reskilling opportunities to keep pace, including turning to verified credentials to close the preparation gap. Programs like the Google AI Professional Certificate aim to address this gap by focusing on tasks such as data analysis, research, and project planning. Worldwide, more than 1 million people have completed Google Career Certificates, with over 70% reporting a positive career outcome such as a new job, promotion, or raise within six months.[40]

5. Equity and access

The latest PISA results point to wide achievement gaps based on socioeconomic status. With the rapid advancement of AI tools and their adoption, there is a risk of exacerbating these divides — that is, that students from more advantaged backgrounds will access and use these tools more easily and fluently, deepening entrenched disparities.

In our Sierra Leone study, for example, we saw that while all students improved on average, those who started further ahead in their math attainment benefited more from Guided Learning.[41] In light of this, we are actively working to ensure our tools benefit students across performance levels.

At the same time, intentionally designed AI tools can help narrow equity divides by opening new learning pathways for students with diverse abilities and backgrounds.

For example, in a study we conducted across Italian schools, educators dedicated 38% of their Gemini activity to supporting students with Special Educational Needs (SEN), with 42% of teachers documenting direct grade improvements among those students.[42] Instead of singling students out with visibly modified work, teachers converted grade-level texts into accessible audio and visual formats. Plus, offline and low-bandwidth tools help ensure that students in areas with limited internet connectivity can still access high-quality study support.

Philosophy for driving impact in teaching and learning

Understanding the above themes helps motivate and inform our approach to building education-specific AI tools. It is worth noting the distinction between general-purpose AI tools and those that are specific for educational contexts or environments; experts like Rebecca Winthrop from the Brookings Institution and Andreas Schleicher of the OECD refer to this distinction as "wide versus narrow" applications of AI in education.

With our "narrow," purpose-built tools for education, our goal is to impact teaching and learning in a positive, meaningful way while mitigating the risks and challenges described above. **Three core elements** guide our approach:



Educators in the lead

Supporting educators with training, tools, and controls



Learning science principles

Grounding AI models and products in pedagogical science



Purpose-built products

Building responsibly to meet the diverse needs of learners

Philosophy for driving impact in teaching and learning

Educators in the lead

We believe educators are the essential architects of the learning environment, and technology should amplify (never replace) their professional judgment and the human connection between educator and student. Our education tools are thus designed to assist educators in leading the learning experience. To make this happen, we aim to build and refine our teaching and learning tools through deep collaboration with experts — experienced educators, learning scientists, school and university leaders, as well as youth, mental health, and parenting experts.

For example, with Class Tools on Chromebooks, educators can manage digital boundaries in real time. Features like Focus Mode guide student attention toward designated resources like Gemini Notebook, minimizing off-task browsing while keeping educators in control of the learning environment.

> "The real opportunity for AI is to empower educators to create richer, more meaningful learning experiences that wouldn't otherwise be possible."
>
> **Richard Culatta**
> CEO OF THE INTERNATIONAL SOCIETY FOR TRANSFORMING EDUCATION (ISTE)

Learning science principles

While technology continues to evolve, the human mind has not, and the fundamentals of learning remain important. Google's ecosystem of learning tools reflects our deep commitment to the science of learning. The tools we build for teachers and students are designed in partnership with pedagogical experts — including our dedicated team of learning scientists as well as educators, school leaders, and other experts. This approach ensures that research-based learning science principles are the bedrock of how we build. Learning science encompasses many foundational concepts; our work focuses on building tools that apply factors that are most closely linked to positive learning outcomes, including:

Philosophy for driving impact in teaching and learning

- **Encourage active learning:** Prompting thoughtful engagement with material.
- **Manage cognitive load:** Structuring information clearly to direct cognitive demand toward core learning goals.
- **Deepen metacognition:** Helping students understand how, when, and why they learn, and encouraging self-reflection to plan, monitor and adapt their strategies.
- **Stimulate curiosity and motivation:** Inspiring interest, relevance, and persistence.
- **Adapt to the learner:** Adjusting scaffolding and task difficulty while personalizing learning pathways to meet individual needs and goals, including multiple means of engagement, representation, action, and expression (Universal Design for Learning).
- **Develop durable skills:** The above principles work in service of helping learners develop skills for the future, like critical thinking, creativity, communication, and collaboration.

To help ensure our AI learning tools embody each of these learning science principles, we built LearnLM. Introduced in 2024, LearnLM was the world's first domain-specific family of models built for learning. The pedagogical capabilities of LearnLM were validated by learning science experts in multiple blind experiments. Today, LearnLM is infused across our family of Gemini models so that our AI teaching and learning tools are grounded in learning science principles from the start.

To learn more about the origin of these principles, how they are infused into our large language models, and evaluated in our product features, check out our deeper dive in our pedagogical framework review.[43]

IMPACT STUDY

To evaluate how our learning-science-infused Gemini models translate to meaningful learning gains for students, we partnered with Eedi to run an exploratory RCT.[44] In a subsequent 10-week randomized control trial with nearly 1,200 students in the UK, Google and Eedi evaluated how an AI tutor combining Eedi's diagnostic engine with Gemini capabilities compared to support from expert human tutors and standard static support.[45] Students using AI tutoring achieved clear learning gains on in-platform tasks, and an advantage on intermediate quizzes, matching the performance of peers supported by human tutors. Furthermore, supervising human tutors approved 95% of drafts written by the AI tutor and only six of more than 114,000 drafts (under 0.01%) had a math error or tone issue, none of which reached a student. We also heard positive feedback from tutors, such as: "[AI] shifted my role from explaining content to supervising the learning process. It allowed more time for personalized support and deeper discussions than I could have done on my own with the same number of students."

Philosophy for driving impact in teaching and learning

Purpose-built products

Our education tools are purpose-built to meet the diverse needs of students and educators across the globe. This drives how we approach managing data, building safety guardrails, and enabling the ability to adapt the product experience for diverse contexts.

- **Data privacy:** Schools own their data, not Google — our core Workspace for Education services do not sell student data, use it for advertising, or use it to train our generative AI models.
- **Safety guardrails:** Beyond data protections, we proactively build guardrails to help keep our generative AI tools supervised and secure. For example, in the Gemini App, we introduced protections designed to avoid language that simulates intimacy or acts like a human companion, and to help prevent young audiences from forming unhealthy personal attachments.
- **Contextualization and adaptation:** Meaningful educational technology can't rely on a one-size-fits-all model, which is why our tools aim to support teaching and learning across diverse contexts, adapting to the unique needs of educators and learners. From students with mobility challenges adopting Chromebook's built-in Face Control camera navigation to educators grounding their lesson plans in local curriculum and standards, our approach centers accessibility and adaptability. These efforts extend into language adaptation as well. Grounded in Google's 25 years of linguistic research, our technology actively reduces language barriers to learning, reflected by the fact that 17% of education-related Gemini conversations globally take place in a non-primary language for the user's country,[46] with students and educators leveraging the tool to engage with academic materials, translation, and study resources across global languages.

RESEARCH AND MEASUREMENT APPROACH

As we build our education tools with the above principles in mind, we also conduct research with education communities around the world to understand how our tools affect teaching and learning, using the learnings to iterate and improve. This is why we have a dedicated team of research scientists running a global portfolio of studies from observational pilots to randomized control trials — the gold standard of efficacy research — to understand how the use of AI impacts learning outcomes.

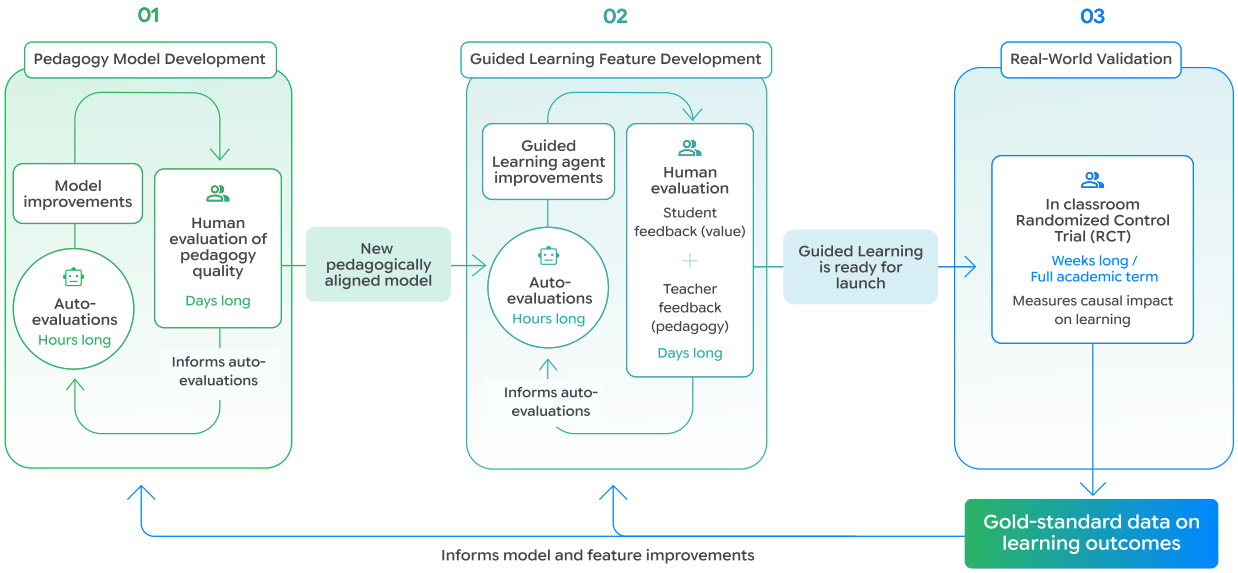
Philosophy for driving impact in teaching and learning

RESEARCH AND MEASUREMENT APPROACH (continued)

For example, before we launch key education features, we aim to utilize both automatic and human-led evaluations, as well as feedback from students, educators, researchers, and pedagogical experts. As these features mature, we aim to progress from exploratory classroom pilots to deeper causal studies, which can include randomized controlled trials. We use a structured framework to match the right study design to the questions — whether we are measuring causal impact on student outcomes or studying how our tools can be most effectively integrated into classrooms. We also use a range of sources to assess our tools, from quantitative data like product metrics and surveys to qualitative insights like educator and student interviews and classroom observations.

Guided Learning reflects this multi-stage approach. First, teachers and learning scientists helped adjust the underlying Gemini models to follow sound educational principles. Next, teams updated the agentic system that balances instructional guidance with student agency. Finally, researchers evaluated Guided Learning in real-world classrooms through randomized controlled trials. Starting in Sierra Leone, teams partnered with local educators to co-develop implementation protocols and teacher training and instructional design materials that complement daily lessons.[47] The trial confirmed the tool's effectiveness while highlighting opportunities to support students across varying skill levels and ground content in local curricula. These learnings informed the recent integration of Guided Learning into Google Classroom, giving teachers more control and insights around students' learning experiences.

Evaluation-driven approach to building Guided Learning



What we are pursuing in our education products

For educators

Efficiency, effectiveness, and innovation with educators in the lead

We strive to help educators become more effective and efficient in their current teaching practices with our tools, while also enabling them to innovate to drive more learning impact — all while reinforcing their role as the essential architects of their classrooms.

With this in mind, we design our educational tools to work as a cohesive ecosystem that streamlines daily workflows and keeps educators at the center of the learning environment.

Here are a few examples of how these tools work in practice:

1. Google Classroom and Workspace/Gemini for Education

Educators can use **Gemini for Education** to turn teaching standards into full lesson sequences and activities in minutes.

- In a two-year study we conducted across 31 schools in Northern Italy, over 600 educators used Gemini to design active, student-centered lessons, which was evaluated through an analysis of over 1,200 paired lessons to track instructional shifts.[48] Planning with Gemini reduced average preparation time by 37%. This shift allowed teachers to focus on creative lesson design rather than routine material production. Teachers who built custom AI tools reported the deepest creative ownership. Ultimately, this transformed classroom delivery, reducing whole-class lecture time by 66% in favor of active, cooperative learning.

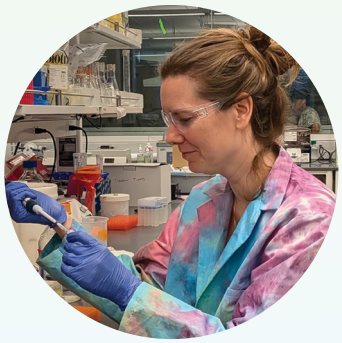
2. Gemini Notebook (formerly NotebookLM)

Educators frequently use **Gemini Notebook** to prepare classes using trusted content, align curriculum across courses and semesters, and organize materials for teaching and research.

- Professors at Florida State University, for example, tell us they value Gemini Notebook because it is grounded in their syllabus and source materials.

Across universities, nearly eight in 10 faculty and leaders we surveyed reported that using Gemini and Gemini Notebook moderately or significantly improved student outcomes.

For educators



Rebecca Glineburg, Ph.D.

A biology professor in California using Gemini Notebook to make science more accessible

The challenge

Rebecca's molecular genetics classes rely on dense, technical reading assignments and lectures that are difficult to digest without a prior science background. She noticed that students with past science experience consistently scored higher on weekly quizzes than their peers.

How she responded

To help all students build foundational comprehension before tackling dense technical terminology, Rebecca used Gemini Notebook to create audio overviews of each lecture. She shared these recordings alongside her slide presentations as an accessible pre-lecture primer to activate prior knowledge, and encouraged students to generate self-test practice quizzes in Gemini Notebook to reinforce key concepts.

Rebecca noticed higher weekly quiz scores for students and stronger course proficiency among students without a science background who paired using the Gemini Notebook audio overviews with active review, helping narrow the performance divide with more experienced peers.

What happened next

Rebecca is expanding how her students use Gemini Notebook for active retrieval practice, noting that its grounded review questions are more accurate and curriculum-aligned than those generated by ungrounded chatbots.

For educators

3. Guided Learning in Google Classroom:

Teachers using **Google Classroom** can assign students to work in **Guided Learning mode.** Grounded in the teacher-uploaded class materials, Guided Learning is an interactive study partner that guides students step by step using probing questions rather than quick answers. Teacher-led controls enable students to interact with Guided Learning in Focus Mode, which keeps them on-task, and guides the conversation back to the teacher-specified learning objectives even if the student tries to steer it off-topic. Teachers also get class and individual-level insights, including access to full chat transcripts.

- In a recent four-week research pilot across three U.K. secondary schools, educators integrated Guided Learning into lessons across four different subjects, grounding the tool in their own class materials. We heard feedback from teachers and students alike that they valued the tool's ability to absorb initial questions and free up teacher capacity during independent work.

AREAS OF EXPLORATION

Areas of continued exploration focus on educator pressures outlined earlier in this report, from heavy workloads to concerns over students taking cognitive shortcuts: we continue to explore how AI can enable learning experiences that educators trust and students learn from. Areas of exploration include interactive assignments, diagnostic assessments, and co-teaching tools to better help educators reclaim time for human-to-human mentorship.

- **Example:** We recently released a research experiment enabling educators to create custom, interactive, and guided educational simulations. These teacher-vetted learning interactives are created dynamically using generative user interfaces structured to support active conceptual exploration. Following positive teacher feedback, we released a sample library of over 30 learning interactives across STEM subjects like physics, chemistry, biology, and math for middle and high school.[49] This experiment is currently entering school pilots to explore classroom implementation and student impact.

For educators



Stephanie Williams

An elementary school music teacher in Benton, Arkansas, using AI to 'vibe code' accessible learning experiences

The challenge

In Stephanie's music classes, traditional musical instruments often present physical barriers for students with mobility challenges. Stephanie struggled with a lack of customizable tools tailored to her students' needs: "I always try to find ways to make music inclusive with the resources at my disposal... [musical tools I build with Gemini] allow some of my students who don't have the option to be independent to find their voice through a musical platform."

How she responded

Stephanie learned how to 'vibe code.' She used Gemini as a rapid prototyping partner to build custom, camera-activated assistive music software.

Using Gemini, Stephanie built an interactive web application that uses the Chromebook camera to translate physical gestures into musical notes in real time. She created distinct modules mapped to natural movements, such as swaying, blinking, opening one's mouth, arm flapping, and clapping.

What happened next

Today, Stephanie's assistive tools are used across classrooms in her district, making music accessible to more students. Stephanie also shares her methods at conferences and professional development sessions, empowering educators to create custom learning tools with Gemini.

Stephanie customized the software to support goals outside of music. She mapped gesture triggers to support occupational and physical therapy exercises, and tuned modules to a shared pentatonic scale so students could collaborate easily.

For students

Enabling more personal, active, and multimodal learning

We aim to empower students with more personal, active learning experiences at key moments in their academic journeys — including understanding a new concept, practicing and studying to reinforce learning, and creating something new like a creative project or an essay.

Here are a few examples of how we are pursuing this today:

1. Guided Learning in Gemini

This **student-centered mode, available in Gemini App**, uses pedagogically grounded dialogue-based questioning to encourage active engagement and productive struggle supported by step-by-step scaffolding. Early testing in Sierra Leone demonstrated a 0.26 standard deviation (SD) improvement in learning outcomes on independent math assessments in a teacher-directed environment.[50]

- In a recent RCT, Japanese undergraduate students who used Guided Learning in a 4.5-hour independent study session showed significantly improved learning outcomes compared to control students with full internet access and PDFs, achieving a +0.14 standard deviation improvement from pretest to post-test assessment.[51]

2. Read Along (Foundational Literacy):

Read Along in Classroom is a free tool within **Google Workspace for Education.** It helps elementary learners build oral reading fluency by providing 1:1 reading support with real-time feedback. Educators can easily differentiate instruction by importing their own content, using Gemini to generate customized stories, or converting curriculum PDFs into interactive reading books. The tool also shares reading progress metrics to help teachers track growth. Available in more than 16 languages, Read Along in Classroom supports learners globally and ensures school-to-home continuity by making assignments available on personal mobile devices.

- In a RCT in India, students using Read Along saw 114% higher reading fluency gains in Hindi, 44% in English, and 120% in Marathi compared to the control group — with over 40% of students improving by at least one reading level.[52]

3. Education capabilities offered across surfaces:

Personalized test prep: Across products including Gemini Notebook and Gemini App and features like Study Notebooks, students can turn textbooks and other study materials into

For students

adaptive practice tools such as personalized flashcards, quizzes, and full-length practice exams for tests like the SAT and the JEE.

- Students who trigger immersive study elements in Gemini (like flashcards or quizzes) display higher conversational engagement, asking ~40% more follow-up questions compared to students who use the chat interface alone.[53]

Multimodal learning experiences: Our tools support comprehension by pairing complementary verbal and visual representations, such as integrating text, audio narration, and structured diagrams.

- These concepts are embedded across Google products such as **Gemini App**, **Gemini Notebook** (which features audio overviews, video overviews, and mind maps), and **Search**, with generative interactive visuals. In Gemini Notebook, for example, we are introducing interactive learning overviews, which weave together summaries and studio outputs like quizzes, flashcards, and mind maps.
- An early example was "Learn Your Way," a Labs experiment that transformed static textbook content into a multimodal learning experience including immersive text, slides, audio lessons, and visual mind maps. Research showed students who used the tool scored 11 percentage points higher on both immediate and delayed retention tests compared to students who used standard digital readers.[54]

AREAS OF EXPLORATION

Areas of continued exploration to preserve and enhance active learning: Our teams are conducting ongoing research on how AI can enable active inquiry, identify and remediate misconceptions by providing adaptive scaffolding and calibrated challenges, and cultivate durable skills (e.g., critical thinking, collaboration, metacognitive reflection) — while maintaining the productive friction required for learning.

- **Example:** A recent research experiment called Vantage — developed in partnership with pedagogy experts and researchers from New York University — uses generative AI to create simulated environments for students to assess and practice essential skills like critical thinking and creativity. Google and the Network for Teaching Entrepreneurship (NFTE) conducted a joint RCT evaluating the impact of practicing entrepreneurship skills within Vantage. The study evaluated Vantage within NFTE entrepreneurship summer camps for students across the U.S. At the end of the camp, students submitted a business plan as their final project. Students who practiced in Vantage scored 7 percentage points higher on their business plans than peers completing identical tasks without the tool.[55]

For students



Megan*

A nursing student in the U.S. using Gemini App to simplify complicated physiological processes

The challenge

Nursing coursework involves exceptionally complex, dense subjects like pathophysiology and pharmacology. Megan found herself struggling to understand and apply these concepts in large lecture halls: “I can’t learn alone in a classroom with 50 plus other students who learn differently from me. My professor would never just take time to focus on how I learn or what I need to learn.” Relying solely on static PowerPoint slides and textbook pages made it difficult to verify whether she truly understood the biological mechanisms behind diseases.

How she responded

She input her dense lecture slides into the Gemini App and, using the voice feature, asked the model to simplify complicated physiological processes without losing detail: “Gemini is the best, period...it gives really thoughtful responses. I’ll ask it to explain something in a simpler, descriptive way, and I really take my time to learn because I’m not being rushed and I have something that’s actually willing to teach me wherever I’m lacking knowledge.”

When reviewing exam practice questions, Megan shared the scenario and explained her chosen answer and rationale to Gemini App before receiving the solution: “I like to give the reason why I chose that answer before it even gives me an explanation — so it can see my thought process and correct me on where I’m lacking.”

What happened next

Today, Gemini App has transformed Megan’s time management and study habits around her demanding work schedule. By using AI as an interactive assistant rather than a shortcut engine, she has gained the confidence to navigate and reason through complex clinical scenarios on her own terms: “I use AI as a tool, an assistant — not for it to do my work, but to help me better understand things and gain more knowledge.”

* Name changed

For the broader ecosystem

Supporting local education communities and global partners

As schools and organizations navigate the changing landscape of AI adoption, we want to listen to, co-create with, and support our partners on the ground. By collaborating closely with education systems, ministries, and non-profit organizations, we help build regional capacity and expand access to high-quality learning.

Here are a few examples of how we are doing this today:

1. Sustained collaborations and catalytic funding

Scaling meaningful educational change requires working hand in hand with regional school districts, global developmental agencies, and leading teacher coalitions to ground technology in diverse classroom realities. Through Google.org, we also provide strategic funding and grants to advance research and evidence, scale open-source curricula, and reduce barriers to digital access.

Collaborative partnerships: We work directly with school systems to observe and support the responsible integration of technology in real-world classrooms.

- For example, in our **Miami-Dade Public Schools Pilot**, we observed first-hand the power of a gradual and responsible roll-out of age-appropriate generative AI tools for 100,000 high school students. This effort was powered by a district-led training of principals, parents, and the 18,000 educators who support them in the third-largest school district in the U.S.

Catalytic funding: A three-year, $150 million commitment from Google.org is fueling grants to support AI education and digital well-being globally.

- One grant example is **Google.org and Google for Education's partnership with UNICEF**, which will support education innovation for millions of students across Brazil, India, Kenya, and Pakistan by providing training, tools, and expertise for government-led digital learning transformation. The partnership will leverage our portfolio of education interventions for personalized instruction to support teachers and equip children and young people with the foundational learning and essential skills they need for the 21st century.

Note: UNICEF does not endorse any company, brand, organization, product or service.

For the broader ecosystem

2. Training and support

To ensure technology serves as an equalizer, we build and deliver free, flexible learning programs that equip educators and students with foundational AI literacy and practical skills.

- For example, this year we launched the **Google AI Educator Series**, a professional learning initiative created with ISTE (International Society for Transforming Education). The program provides free, comprehensive training to millions of educators across the U.S., India, U.K., Philippines, South Korea, and elsewhere. Built by educators for educators, the curriculum is designed to fit easily into busy school days through bite-sized, standards-aligned micro-sessions. These short lessons help educators build a foundational understanding of AI's capabilities, along with its pedagogical and administrative applications.
- Another example is **Experience AI.** Co-created by Google DeepMind and the Raspberry Pi Foundation, this free, UNESCO award-winning program equips students with foundational AI knowledge. Backed by a $10 million Google.org grant, it has trained 63,000 teachers and reached 5.9 million students globally. Its new unit, "Using LLMs strategically for learning," shows students how to use AI as an active study partner while protecting their own independent thinking. Additionally, **AI Quests** — a game-based experience developed with Google Research and Stanford Accelerator for Learning — brings AI literacy concepts to life through hands-on simulations of real-world challenges.

3. Convenings

We engage in forums that bring together practitioners, learners, policymakers, researchers, and administrators — from hosting leadership events like the AI for Learning Forum to participating in hundreds of industry events each year, from Bett and ISTELive to policy events like the Education World Forum, ASU+GSV Summit, and SXSW EDU. These discussions offer space to share learnings, ideas, and challenge areas. Working directly with the education community helps build clarity around the benefits and risks of AI, and how we can support meaningful learning outcomes together.

Looking ahead

The future of education

As the OECD recently noted: “The future of education must focus on human flourishing for all, with technology as one way of helping to achieve that goal.”

Navigating this inflection point requires rigorous empirical evidence about what drives learning, alongside the imagination to redesign school and university systems for the world students will actually inherit. Moving forward is not about choosing between digital or analog instruction; it requires an intentional blend that pairs thoughtfully deployed learning tools with rich social relationships and collaboration.

The questions AI poses for learning are too vast for any single company or institution to resolve. We have learning scientists and former educators across our teams, and yet we are not in the classroom every day. The most enduring breakthroughs will come from the educators, researchers, students, and leaders who engage in these topics every day.

Building the future of learning is a shared effort. Whether you have questions, different viewpoints, or practical experiences to share, your voice is an important part of this work. Please add your thoughts here. We are eager to listen, learn, and keep this conversation going together.

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