FOUNDATIONS

Learning Systems

The Landscape of Artificial Intelligence in K-12 Education

By Amy Chen Kulesa, Michelle Croft, Brian Robinson, Mary K. Wells, Andrew J. Rotherham, and John Bailey

SEPTEMBER 2024

Bellwether

Contents

Introduction

Key Takeaways

Overview

- What is AI?
- Growth
- Concerns
- Adoption Rates
- Evolving Education Sector Needs

Conclusion

Sources

Acknowledgments

About the Authors

About Bellwether

Introduction

Generative artificial intelligence (GenAI) advancements have prompted both excitement and concern about how AI could be used in education. From streamlining administrative tasks to personalized resources for students with learning differences to reimagining staffing models, AI offers a spectrum of possibilities. However, its integration requires careful consideration of both potential benefits and inherent risks.

This three-part series, developed through consultations with experts and practitioners, aims to take a holistic approach, analyzing the opportunities, risks, and considerations surrounding AI in education in the following ways:

Foundations

The Landscape of Artificial Intelligence in K-12 Education

An introductory guide exploring AI developments, capabilities, potential impacts, and current usage.

Considerations

Opportunities and Challenges of Artificial Intelligence-Enhanced Education

A deep dive into the broader ecosystem, including technology platforms, policy landscapes, and stakeholder experiences.

Applications

Artificial Intelligence Use Cases

An outline of how AI could potentially be used in education, detailing opportunities and risks for each use case.

Contents

Introduction

Key Takeaways

Overview

- What is AI?
- Growth
- Concerns
- Adoption Rates
- Evolving Education Sector Needs

Conclusion

Sources

Acknowledgments

About the Authors

About Bellwether

Key Takeaways

Insights From the Learning Systems Series

The education sector has an opportunity to shape its future as GenAI technology is developing. Proactive planning allows thoughtful integration of AI's potential benefits to carefully address its challenges and prepare for emerging capabilities. To help education stakeholders navigate this complex and evolving landscape, Bellwether offers the following recommendations to build strong capacity, resilient infrastructure, and thoughtful design.

Building Strong Capacity

To safely and effectively incorporate AI, the education sector must invest in the development of knowledge, skills, and diversity of leaders and contributors. **Capacity-building effort is not just beneficial — it is critical.** While these efforts require a meaningful investment of time, talent, and resources, without them, the education sector faces barriers to progress. Even though capacity-building around AI may not rise to high urgency for individual organizations, funders and policymakers can and should incentivize the system so that there is meaningful progress over time.

1. Strengthening AI literacy.	Administrators, teachers, students, and families alike need to build understanding of AI's capabilities, limitations, and implications so that communities can make informed decisions about AI and effectively choose where to (and not to) integrate AI into learning environments. AI literacy also extends into the thoughtful teaching of AI — what students should know and be able to do related to being prepared for the workforce of the 2030s.
2. Enabling the development of policies and guidelines.	Comprehensive and flexible policies and guidelines are essential to wider AI adoption but have been slow to develop, notably at the federal and state levels. As of August 2024, approximately half of states have yet to provide AI guidance. State and local education leaders would benefit from collaboration opportunities, including with industry leaders, as they develop and refine their policies.

Building Strong Capacity *(continued)*

3. Bridging educators, developers, and researchers.	Currently, there is a gap between teams building AI tools and education practitioners. Fostering strong partnerships, especially in development and design stages, can ensure AI tools are safe, effective, and relevant for education purposes, aligned with pedagogical principles, and grounded in research about how students learn. Partnerships will increase the likelihood of well-designed solutions, thereby enabling the realization of AI's transformative potential in education.
4. Expanding sectorwide capabilities.	The rapid advancement of AI in education has surfaced a significant gap between current capabilities and needed expertise. To bridge this chasm, the sector needs to expand capacity across the entire educational ecosystem, addressing needs such as data privacy, ethical implementation, procurement, and other challenges surfaced throughout this three-part series. This expansion can take multiple forms: Existing education organizations can develop AI competencies, AI experts from other sectors can be encouraged to apply their knowledge to educational contexts, and new organizations can be established to address emerging needs. Addressing these gaps in the education sector is crucial for developing comprehensive, education-specific AI solutions that incremental improvements in existing structures may not be able to achieve.
5. Diversifying voices at the table.	Degree attainment data suggest that the current AI field is not yet reflective of the diverse students and educators across the country. Diversification of voices involved in AI-related dialogues and decisions can promote more inclusive AI solutions that benefit all students. This includes conversations with and among AI developers, solution builders, and researchers as well as authentic engagement with diverse educators, students, and families who will be most impacted by decision-making processes.

Building Resilient Infrastructure

In the excitement of thinking about how AI can be used, there is the potential to overlook the importance of a robust, secure, and nimble infrastructure. **Strong data and research not only enhance the quality of AI outputs but also serve as a crucial safeguard, particularly in protecting sensitive student data.** Investing in resilient infrastructure is essential for realizing AI's benefits while mitigating its risks, ensuring that enthusiasm for innovation is matched by a commitment to security and quality.

6. Robust data infrastructure.	Implementing AI widely throughout a system or organization will require a secure, high-quality data infrastructure. This includes ensuring data quality and usability, system interoperability, robust security measures, well-planned change management processes, and reliable internet connectivity.
7. More quality datasets and new benchmarks.	To enhance the quality of AI outputs, there is an opportunity to develop more high-quality, education-specific datasets for fine-tuning AI models for tailored uses. Additionally, establishing education benchmarks for AI tools can incentivize and align the market around quality and effectiveness.
8. Continued research and learning.	Ongoing research is needed to understand what works and what does not work in AI-enhanced education. By continuously evaluating the impact of AI tools and methodologies and building from existing learning science research, developers can refine their approaches and ensure that AI enhances learning outcomes for all students.

Building Thoughtful Design

As developers create AI tools for education, it is important to prioritize purposeful design that considers the diverse needs of all students while maintaining the essential role of human interaction. **Thoughtful design goes beyond technological capabilities, focusing on clear educational objectives and research-based approaches.**

9. Purposeful, inclusive, and research-backed AI design.	As opposed to leading with the technology, AI tools must be designed with a clear purpose. From the early stages of product development, tools designed for widespread adoption should consider the needs of all students, inclusive of students with learning differences and multilingual learners. The lower barriers to entry to create AI tools also offer the opportunity to develop highly tailored tools that can focus on the unique needs of specific groups of students. Tools should also be grounded in learning sciences research to increase the likelihood they will improve student outcomes.
10. Intentional human-AI relationship.	It is important to recognize both the opportunities and limitations of AI and human cognition. While AI can be transformative, educators and students must also nurture human skills through deep learning experiences, opportunities for critical thinking, and authentic human interactions so that AI amplifies — not detracts from — meaningful learning experiences.

As stakeholders look to incorporate AI into education, they should leverage past insights for future innovation. While AI presents new opportunities in education, the valuable lessons from prior innovation attempts must not be overlooked. Innovation lies not just in the technology but notably in its change management, implementation, and long-term sustainability. This approach to AI integration in education demands significant effort and resources, but it is essential for creating an educational ecosystem that leverages AI's potential while prioritizing student needs and learning outcomes.

Contents

Introduction

Key Takeaways

Overview

- What is AI?
- Growth
- Concerns
- Adoption Rates
- Evolving Education Sector Needs

Conclusion

Sources

Acknowledgments

About the Authors

About Bellwether

Overview

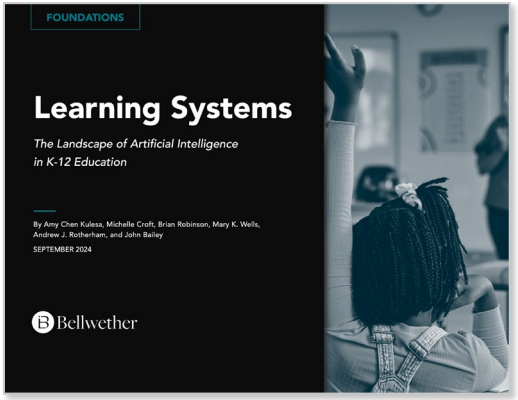
GenAI can create new content, such as text, images, videos, or code, based on patterns learned from training data and has rapidly evolved to near-human-level capabilities in numerous tasks while incorporating multimodal (e.g., audio and video) functionalities.

Given this growth in capabilities, AI is poised for rapid, global market growth, including in education. With renewed interest in ed tech investments, there is now a proliferation of new and updated tools incorporating AI features.

Despite the market growth, in the initial year following GenAI's public release, few Americans are using AI tools and fewer are using it as part of their everyday work. The education sector has seen similarly low adoption rates, though some students are using AI. The limited adoption is likely exacerbated by limited state and local guidance. **If left unattended, uneven incorporation of AI tools into the classroom leads to inequitable use of varied quality among students and educators.**

AI may meaningfully shift the skills employees need to be successful, compelling educational systems to adapt. Current trends highlight a growing disconnect between traditional education and evolving workforce demand, such that the education sector will need to adapt to ensure that students are taught the skills necessary for a changing workplace.

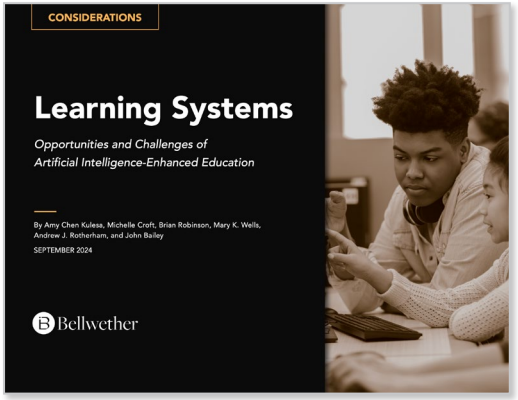
This report is part one in a series that looks holistically at AI's impact on learning systems in education.



Foundations

The Landscape of Artificial Intelligence in K-12 Education

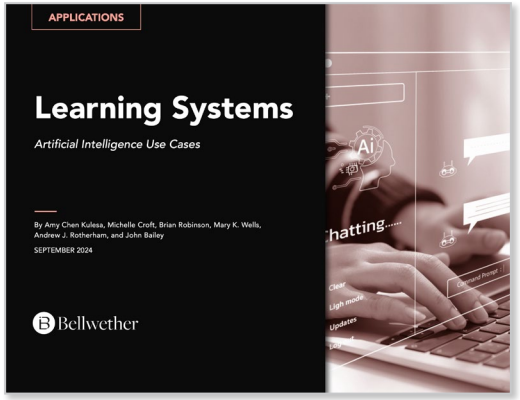
An introductory guide exploring AI developments, capabilities, potential impacts, and current usage.



Considerations

Opportunities and Challenges of Artificial Intelligence-Enhanced Education

A deep dive into the broader ecosystem, including technology platforms, policy landscapes, and stakeholder experiences.



Applications

Artificial Intelligence Use Cases

An outline of how AI could potentially be used in education, detailing opportunities and risks for each use case.

What is artificial intelligence (AI)?

AI refers to the ability of machines or computer programs to perform tasks that normally require human intelligence, such as learning, problem-solving, decision-making, and perception. Two types of AI are commonly referenced:

This report is mostly focused here.

GenAI: A system capable of generating new text, images, or other media in response to prompts, based on data that exists.

Large Language Models (LLMs): A type of AI program that is trained on large amounts of data and can perform natural language processing tasks by analyzing and understanding text.

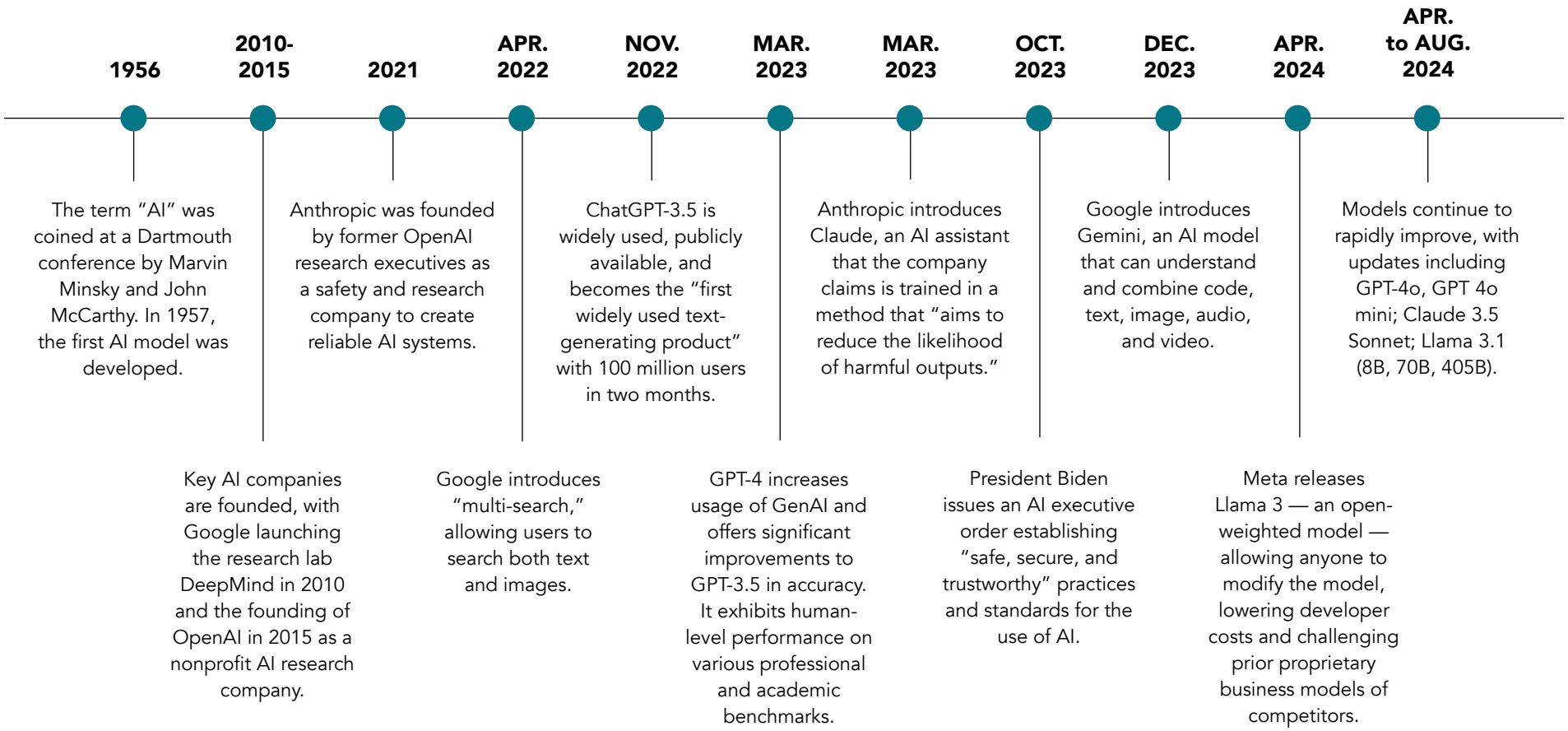
Examples include: Claude, Gemini, GPT, and Llama.

Traditional/Classical AI: A system that focuses on performing a specific task intelligently. It responds to a set of inputs and has the capability to learn from data and make decisions or predictions based on that data. This AI has been the most prevalent for more than 60 years.

***Note**: Bellwether adapted definitions from UNESCO and the Family Online Safety Institute.*

AI has evolved significantly since 1957, with recent increased investment and rapid changes led by big tech.

Timeline of AI Milestones and Its Rapid Acceleration



AI's capabilities extend beyond text production and can be applied across media modalities …

Historically, AI was less accessible to the general public due to several factors:

1. Only a small number of programmers possessed the necessary skills to develop advanced AI algorithms.

2. The lack of user-friendly platforms made it challenging for non-technical individuals to deploy AI capabilities, restricting access to a few large corporations.

3. AI tools were unreliable due to incomplete and poor datasets.

Today, the capabilities of AI are vast and much more accessible to the public.

Modalities and Nonexhaustive GenAI Applications

Audio
Text-to-voice generation
Sound creation
Audio editing

Code
Code generation
Application prototype
Dataset generation

Image
Stock image generator
Image editor

3D or Other
3D object generation
Product design and discovery

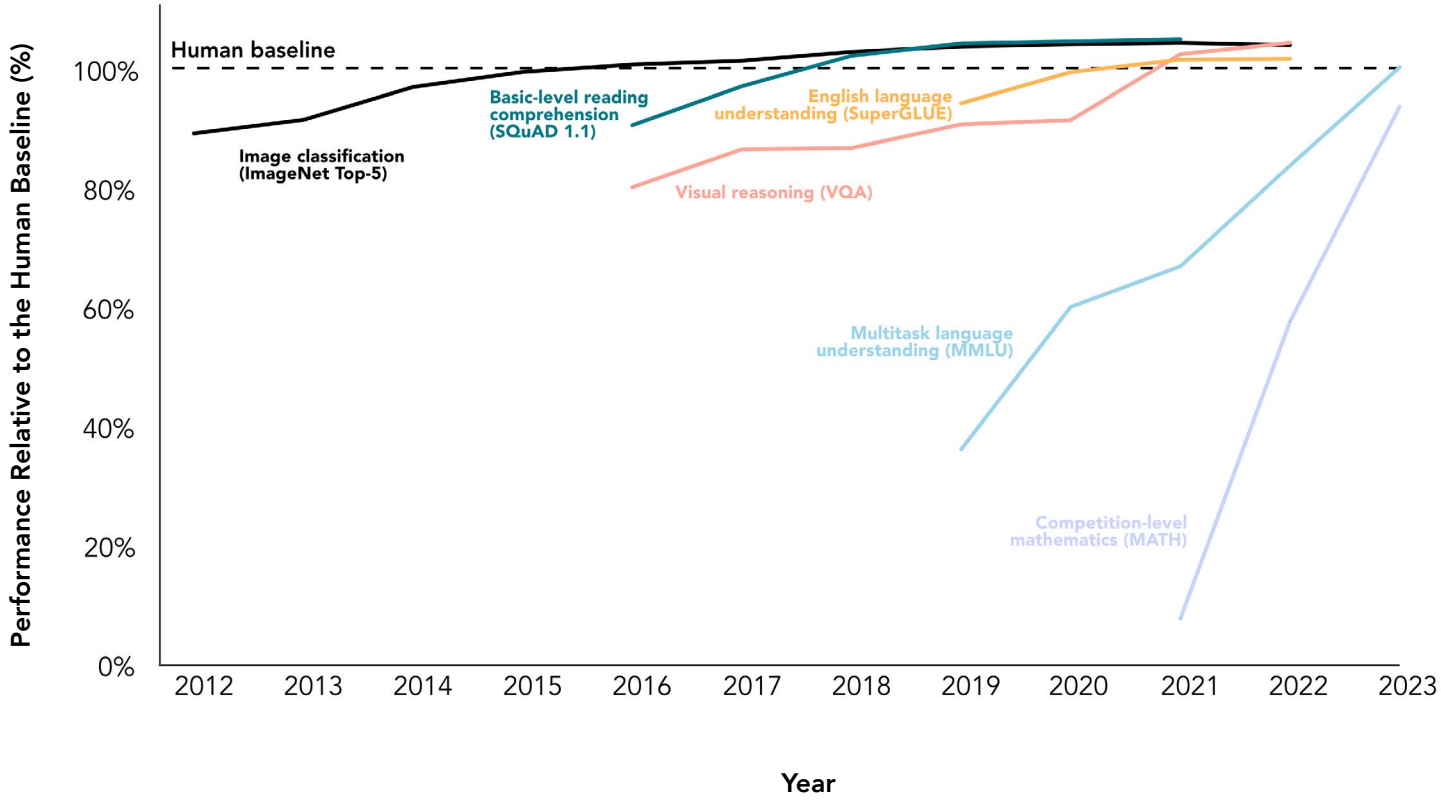
Text
Content writing
Chatbots or assistants
Analysis and synthesis
Search

Video
Video creation
Video editing
Voice translation and adjustments
Face swaps and adjustments

AI use cases will have differing implications across functions and industries. Predictions suggest that AI can increase workforce productivity in supply chains, operations, marketing, and sales.

… And AI capabilities are approaching, sometimes exceeding, human performance.

Select AI Index Technical Performance Benchmarks Versus Human Performance, 2012-2023

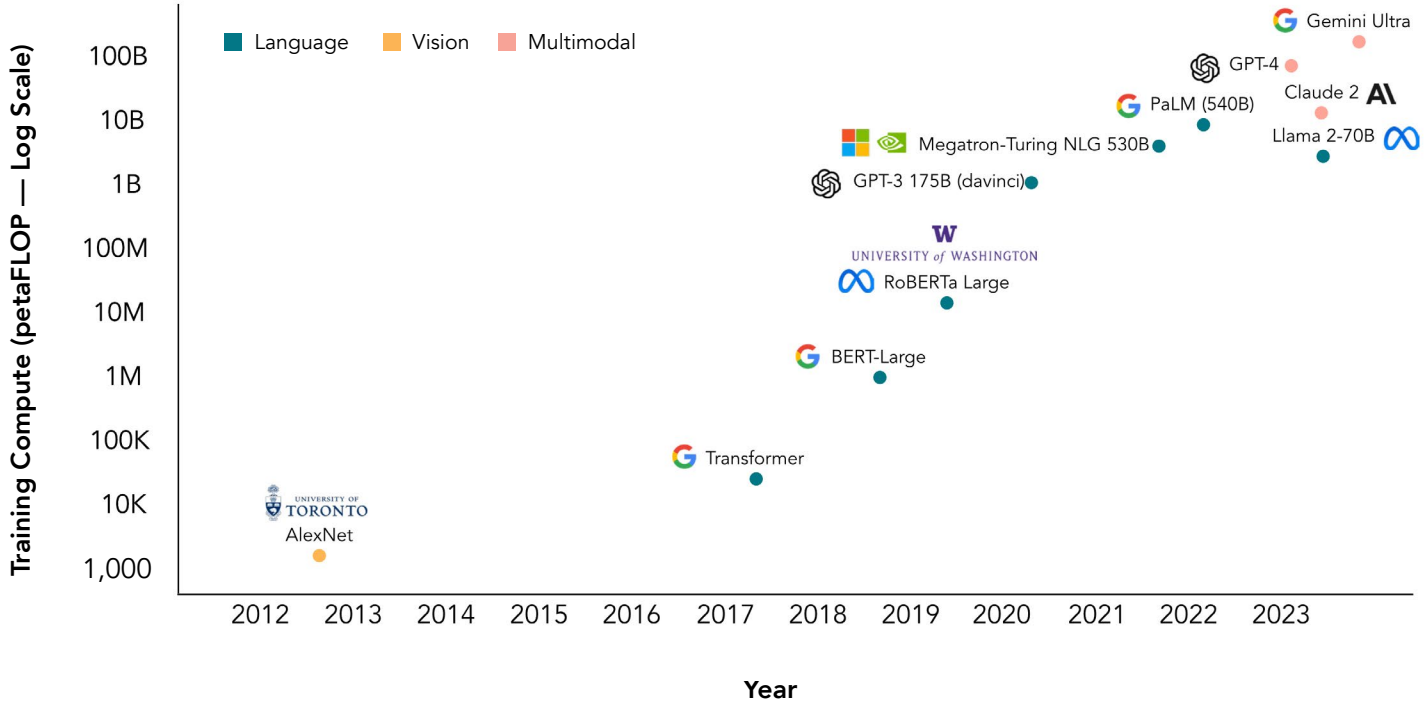


Roles with a high degree of human connection — such as early childhood and K-12 classroom teachers — are likely less at risk and/or slower to be impacted by AI relative to other industries such as health care, STEM, and business.

Source: *Re-created figure from Stanford University Human-Centered Artificial Intelligence, The AI Index Report, Figure 2.1.16.*

Training advanced models requires significant resources, limiting development to a few well-funded companies.

Training Compute of Notable Machine Learning Models by Domain, 2012-2023



In 2023, leading foundation models like OpenAI's GPT-4 and Google's Gemini Ultra incurred estimated training costs of $78 million and $191 million, respectively.

Environmental Impact of AI

Early training of chatbots (e.g., GPT-3) required significant energy and natural resources, leading "to the production of 500 metric tons of greenhouse gas emissions — equivalent to about 1 million miles driven by a conventional gasoline-powered vehicle."

Source: *Re-created figure from Stanford University Human-Centered Artificial Intelligence, The AI Index Report, Figure 1.3.7.*

To mitigate cost challenges, major technology companies are creating parallel Small Language Models (SLMs).

In contrast to LLMs, SLMs are smaller and more compact versions of AI models that aim to provide similar capabilities to their larger counterparts but with reduced size, lower latency, and decreased computational requirements.

LLMs

- Generalist, more powerful functionality.
- Trained from vast amounts of data.
- Costly to train and run.
- Greater inherent risks.

Examples include: GPT-4o, Claude 3.5 Sonnet, Gemini, and Llama 3.1 405B.

SLMs

- Specialized, more narrow functionality.
- Trained from a specific set of information.
- Cheaper, can run on local devices.
- Greater ability to limit misuse and errors.

Examples include: GPT-4o mini, Claude 3 Haiku, Gemma, and Llama 3.1 8B.

Of the LLM models and platforms, there is a range of openness, resulting in trade-offs for the broader ecosystem.

Range of Model Openness

Closed Model

- Full control over the technology and consistency of quality.
- Greater security with restricted access.
- Clear pathway for monetization.
- Higher barrier to entry for developers and small organizations.

Partially Open Model

- Balances control, transparency, and security considerations.
- Potential for monetization through premium features, services, or partnerships.
- Complex licensing and management of open versus closed components.

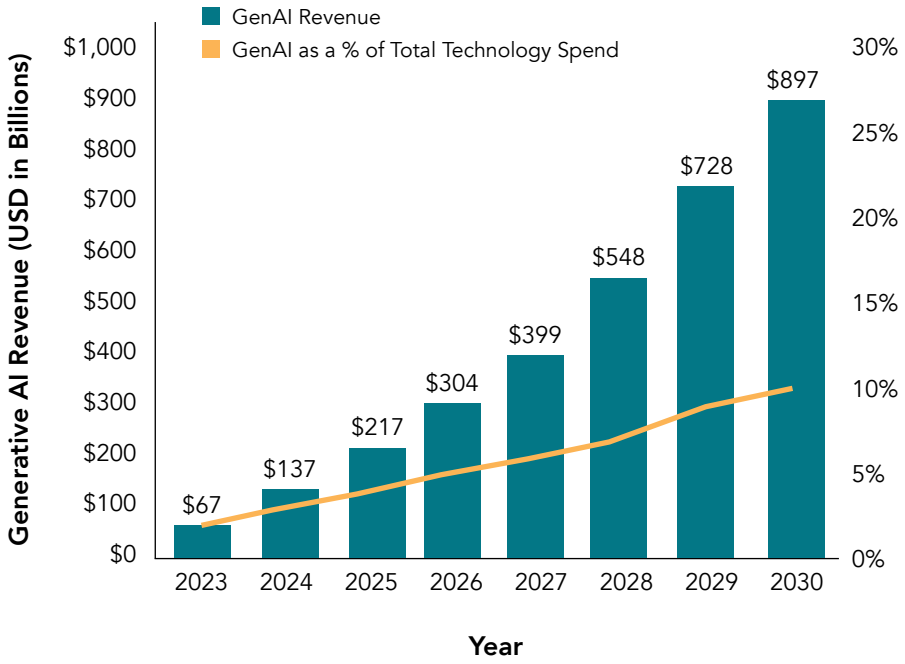
Fully Open Model

- Greater transparency, encouraging widespread use and collaboration.
- Increased risk of misuse.
- May be difficult to monetize initially, often requiring significant investments to launch.
- May have longer-term competitive advantages for other aspects of business.
- Limited control over the direction and usage of the technology, which may lead to ethical and legal challenges.

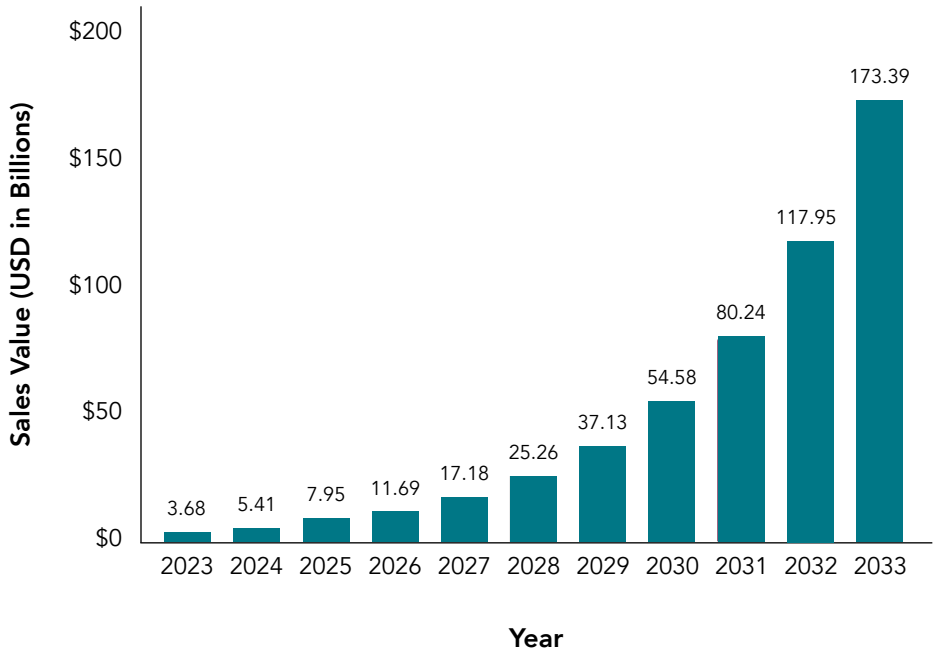
It is not yet clear which LLM will become the dominant market player(s), as there has been fast-paced competition to create the leading model.

Globally, the GenAI market is poised for rapid growth in the coming years, including in education …

Expected Growth of GenAI Revenue, 2023-2030



Expected Annual Growth of Global AI Education Market, 2023-2033



Bloomberg Intelligence predicts that the GenAI market will experience explosive growth; **projections reach a market size of $1.3 trillion by 2032** (42% compound annual growth rate [CAGR]) from just $40 billion in 2022. Consumer-facing generative AI programs like Google's Bard and OpenAI's ChatGPT are contributing to this growth.

Estimated projections of the current size of the AI Education market range. A widely reported estimate is that the market was worth **$3.68 billion *globally*** in 2023 and "can be expected to grow to $173.39 billion by 2033, a CAGR of 47%." This projected growth underscores the need to understand efficacy and safety of AI tools.

Sources: *Berkman, R. (2023). AI in the classroom 2023-2024: Promises and perils. Simba Information, Education Group, 8; Berkman, R. (2023). AI in the classroom 2023-2024: Promises and perils. Simba Information, Education Group, 4.*

… Which has cascading effects on the education sector with expected growth to the market and proliferation of tools.

Market size and investment are rapidly growing.

Hundreds (or more) education tools have been created.

Many products are free or low cost (for now).

AI in education market size:

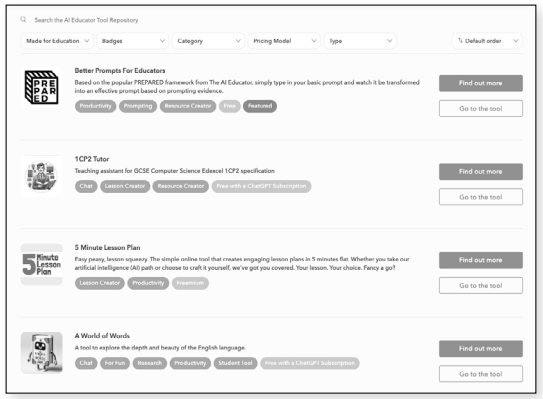
- 2023: $3.7 billion
- 2033: $173.4 billion (47% CAGR)

"Although private investment in education has dropped steeply since 2021, the recent slew of AI-focused startups and renewed interest among investors is a portend of possible turnaround."

—Robert Berkman, Simba Information

Grassroots efforts have begun to aggregate lists of tools:

- AI Educator Tools
- Edtech Insiders



Copilot

Eduaide.Ai

MAGIC SCHOOL

Current AI tools and applications span many aspects of schooling.

More From Bellwether
For information about each use case, see Applications: Artificial Intelligence Use Cases in the Learning Systems series.

However, the way the underlying AI models are constructed contributes to concerns about their use.

Building Models

- **Data Bias**: AI models can inherit biases from training data; AI models trained in data inherit existing bias across racial, cultural, gender, language, political, and even pedagogical differences.
- **Over/Under-Fitting**: AI models may be too specialized or too generalized to address new, unknown situations.
- **Reproducibility Issues**: Hard to replicate AI model results.
- **Environmental Impact**: High energy costs are needed for training models.

Bad Actors

- **Misinformation (Intentional and Unintentional)**: AI models can be used to generate convincing but fake content, including images, audio, and video "deepfakes."
- **Spam/Bots**: Bad actors can use AI tools to develop a greater volume of malicious content or code that may also be higher quality.

Nature of Output

- **Opacity**: Most AI models are "black boxes" and provide no insight into how outputs are generated; even model developers do not fully understand why models act the way they do.
- **Accuracy**: AI models can provide inaccurate or misleading output, which are sometimes called "hallucinations." The chance for errors increases when there is limited high-quality data on a topic.

Ownership of Work

- **Cheating**: AI models can facilitate academic dishonesty.
- **Copyright and Intellectual Property (IP) Violations**: There is undefined legal ground for when an AI model trained on copyrighted material or IP may violate laws or lead to confusion.
- **Worker Value-Add**: As more work is supported — or done — by AI tools, it may change how companies compensate or employ workers.

Bias — A Significant Concern in Education That Is Difficult to Address

Efforts to offset existing biases are building in a set of new counter-biases and it is difficult to predict how they will play out, given the opacity and complexity of AI models.

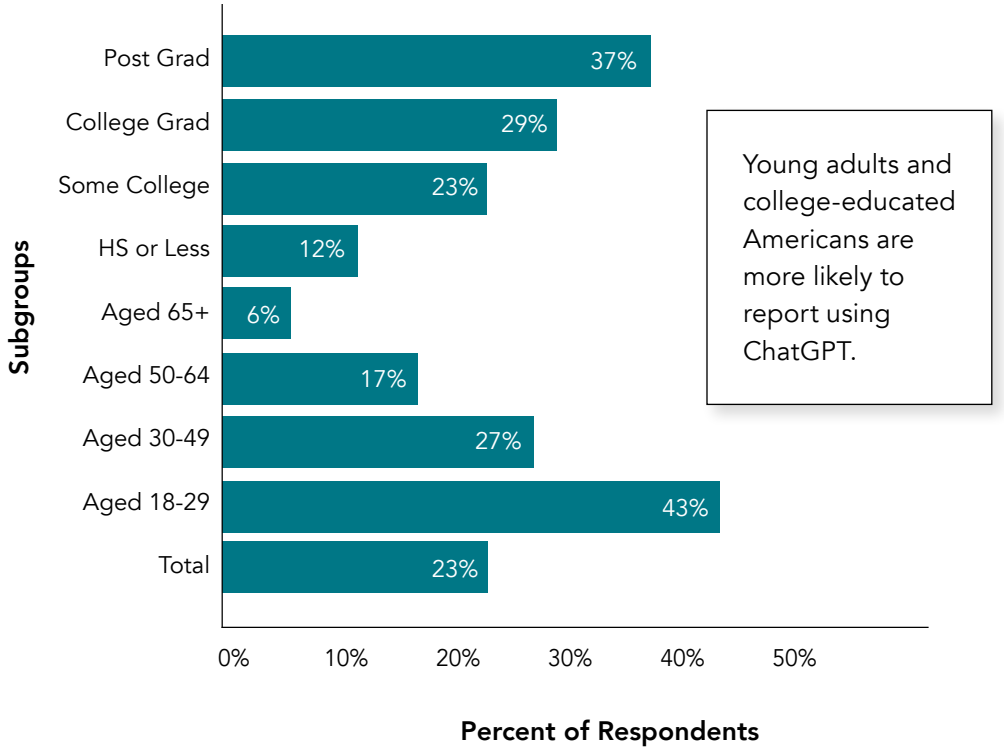
However, bias has long been present in education, with or without AI.

"The use of AI in decision-making can reduce human subjectivity, but it can also do the exact opposite when AI systems are powered by biased datasets and algorithms, producing discriminatory outcomes at scale and posing immense risks to businesses and societies."

—UNESCO

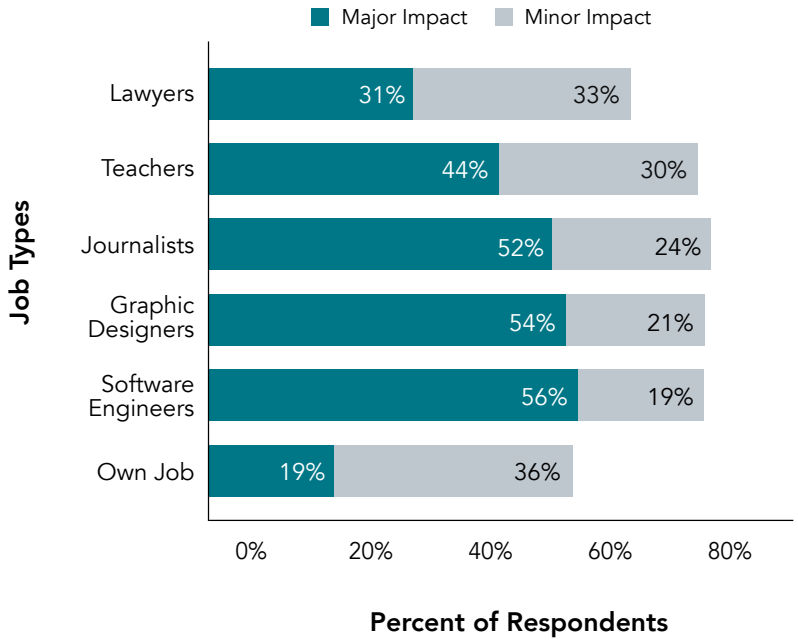
Despite market forecasts, most Americans are slow to adopt AI tools such as ChatGPT.

Percent of U.S. Adults Who Have Heard of and Use ChatGPT



Among U.S. adults, 66% say they have heard about ChatGPT. Of those who have heard of ChatGPT, **just 23% say they have ever used it, but usage varies** widely by age and educational attainment.

Percent of Americans Who Say Chatbots Like ChatGPT Will Have a Major or Minor Impact on the Following Jobs Over the Next 20 Years



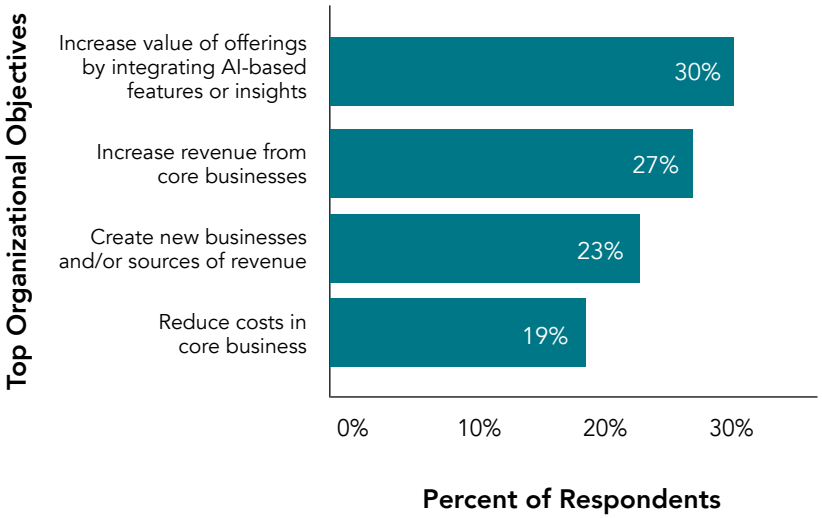
About half or more of those who have heard of ChatGPT say chatbots will have a major impact on some jobs, but **Americans are less likely to think chatbots will impact their own job**.

Sources: *McClain, C. (2024, March 26). Americans' use of ChatGPT is ticking up, but few trust its election information. Pew Research Center.*
Park, E. and Gelles-Watnick, R. (2023, August 28). Most Americans haven't used ChatGPT; few think it will have a major impact on their job. Pew Research Center.

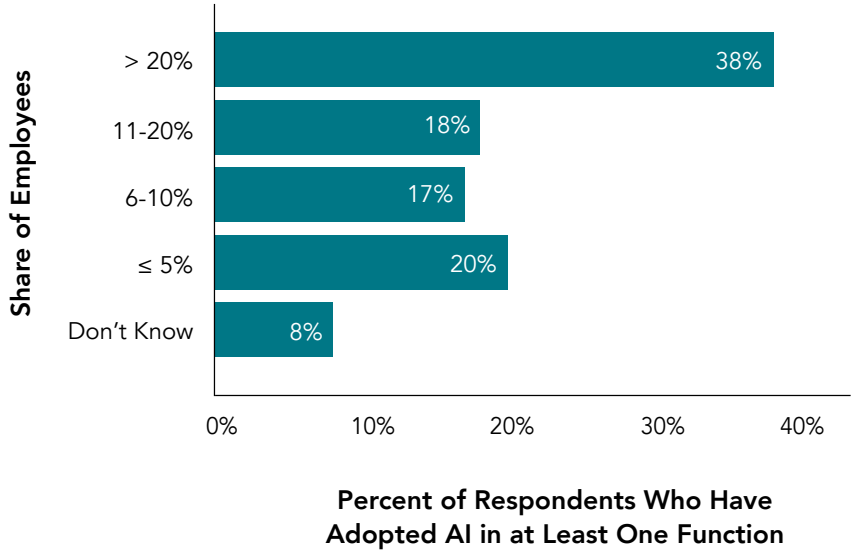
AI is expected to significantly impact the way companies do business and the skills employees will need.

Only 20% of working U.S. adults who use ChatGPT say they use it to complete tasks at work; meanwhile, most companies expect AI to meaningfully change their organization in the next three years.

Top Objective for Organizations' Planned GenAI Activities



Share of Employees Expected to Be Reskilled



Companies anticipate AI will increase value and revenue of businesses ...

... To achieve that, most expect meaningful changes to the skills employees need to be successful.

 Source: *Chui, M., Yee, L., Hall, B., Singla, A., and Sukharvesky, A. (2023, August 1). The state of AI in 2023: Generative AI's breakout year. McKinsey & Company.*

To meet the evolving workforce needs, both educators and students see the need for school systems to adapt.

To enable educators to prepare students for the job market of the future, the K-12 public education system may need to shift how it supports students and teachers. Students are aware of AI and changing workforce trends and believe AI should change schooling in the future. Teachers are aware of AI, and some are using it and believe AI is important for preparing their students for the future.

Students	**75%** of K-12 students say they are somewhat or very familiar with ChatGPT, with 49% using it at least once a week or more.	**53%** of teens use AI to get information, and 51% use it to brainstorm ideas.	**73%** of teens in the U.S. expect GenAI to be a part of everyday life in the future, and 71% believe that GenAI will be used in their everyday professional work in the future.
Teachers	**79%** of teachers say they are somewhat or very familiar with ChatGPT, with 46% using it at least once a week or more.	**51%** of teachers using AI products and tools report using them to support students with learning differences.	**65%** of teachers believe they need to teach their students to use and develop AI so they will be in a better position for the future and to compete globally.

However, variations in survey topics, framing, and timing complicate a full understanding of AI usage and perception.*

		Walton Family Foundation *July 2023*	**Pew** *November 2023*	**RAND** *April 2024*	**Walton Family Foundation** *June 2024*
Usage	Students	**42%** of students say they use ChatGPT for schoolwork.	**19%** of students who have heard of ChatGPT say they have used it for schoolwork.		**72%** of students say they use ChatGPT for schoolwork.
	Teachers	**63%** of teachers say they have used ChatGPT for their job.		**33%** of teachers reported using AI tools and products in their teaching at least once.	**73%** of teachers say they have used ChatGPT for their job.
Perception	Students	**30%** of students think ChatGPT has had no impact at all on their learning.	**69%** of students believe it is acceptable to use ChatGPT to research new topics.		**21%** of K-12 students think AI chatbots have had no impact at all on their learning.
	Teachers	**84%** of teachers who have used ChatGPT say it positively impacted their classrooms.		**73%** of teachers who use AI expect to use AI products and tools more in the next school year than they currently do.	**48%** of teachers say AI chatbots positively impacted their classrooms.

 ***Disclosure**: See Page 40.*

Some districts began embracing AI heading into the 2023-24 school year (SY), though many stances remain unclear.

Early adopter districts illustrate a range of ways that AI can be incorporated into education. Examples include:

Creating New AI Courses and Standards

- **Baltimore County Public Schools** (Maryland) planned to launch an AI program at three high schools in SY23-24 focusing on on-the-job learning.
- **Several Florida school districts, including Tampa**, planned to launch AI and data science programs in SY23-24, in partnership with the University of Florida, as part of a broader initiative by the university to integrate AI into the state's K-12 curriculum.

Improving Communications and Operational Efficiency

- **The School District of Philadelphia** (Pennsylvania) launched a chatbot in 2023 to answer families' questions and track the status of concerns until they are resolved.
- **Los Angeles Unified School District** announced "Ed," a chatbot intended to provide families real-time access to student data, including grades, test results, and attendance. The project was paused due to vendor challenges.

Supporting Learning and Emotional Well-Being

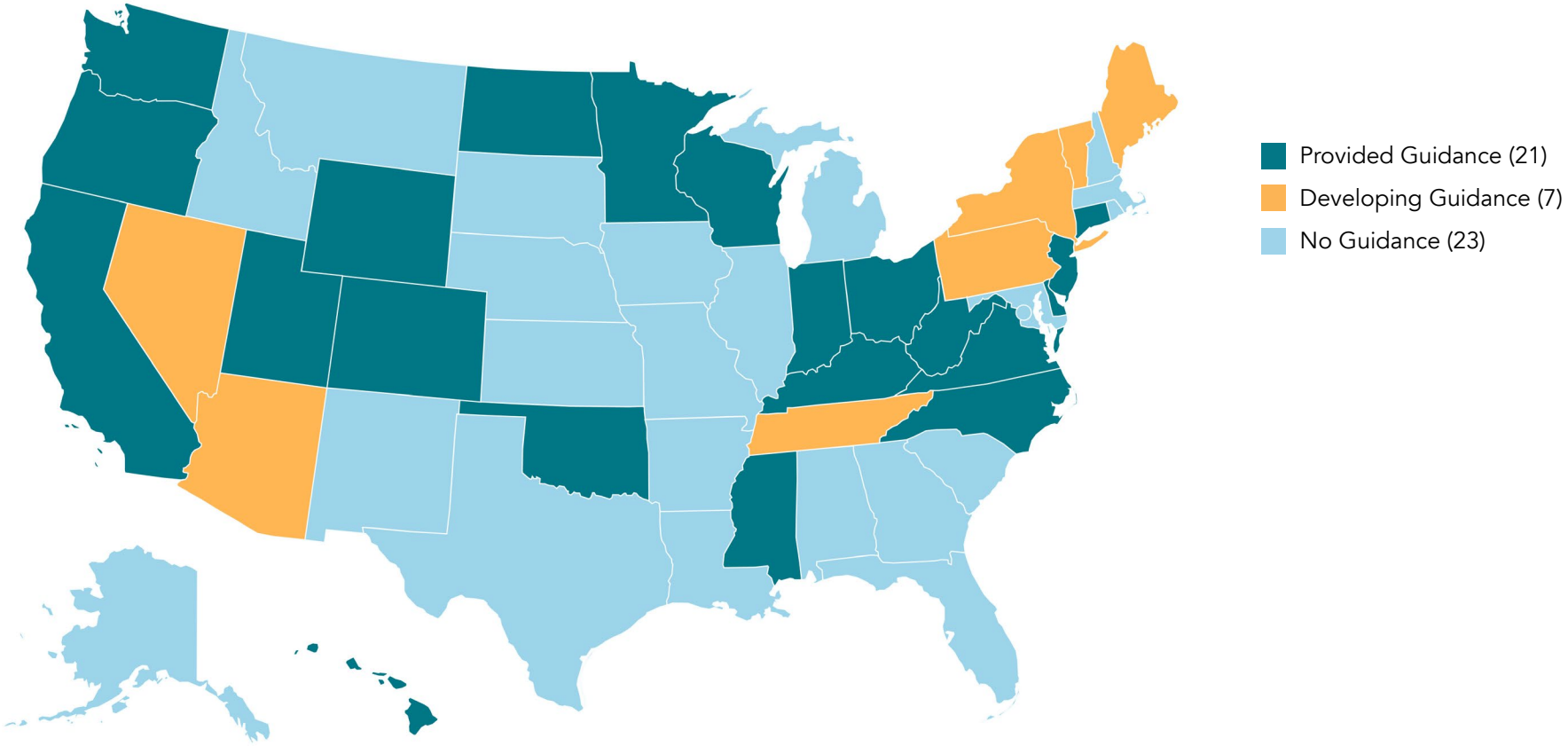
- **Mesa Public Schools** (Arizona) and **Austin Independent School District** (Texas) piloted an AI-enabled "early warning" system that monitors student academic performance and sends alerts if kids are in danger of failing a course.
- **Newark Public Schools** (New Jersey) piloted Khan Academy's AI-powered tutorbot, Khanmigo, to provide students personalized support across core subjects.

Supporting Teacher Development

- **Spokane Public Schools** (Washington), **St. Vrain Valley School District** (Colorado), and **Keller Independent School District** (Texas) piloted AI Coach by Edthena, a platform for instructional coaching.
- **Prince George's County Public Schools** (Maryland) trained teachers on how to incorporate AI into their lessons as part of a three-year agreement with aiEDU, beginning in summer 2023.

Approximately half of states have issued AI guidance.

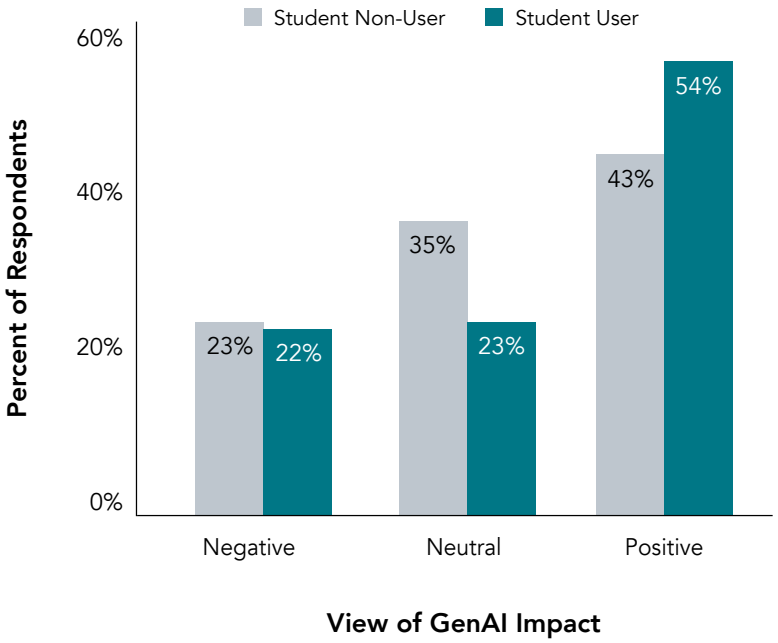
The Center on Reinventing Public Education (CRPE) and TeachAI are regularly tracking whether state departments of education are issuing guidance on the use of GenAI.



***Note**: Map is current as of August 2024. Arizona's Department of Education has not provided AI guidance at this time; however, the Arizona Institute for Education and the Economy and Northern Arizona University issued guidance for K-12 schools in the state. **Source**: CPRE (2023 and 2024); TeachAI AI Policy Tracker (2024).*

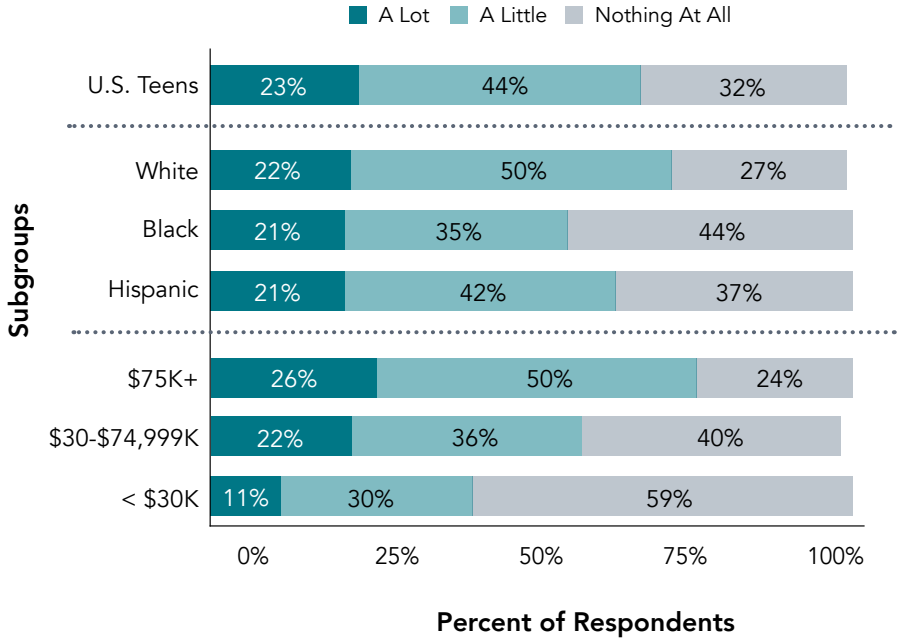
Regardless of state/district actions, students have and will continue to use AI; however, gaps exist by race and income.

Beliefs About GenAI Tools' Impact on Student Learning



K-12 and higher education students are using AI and generally have a positive view of its use for student learning.

U.S. Teen Awareness of ChatGPT, 2023



Top Percent of Teens Who Have Used AI	• Male: 64% • Private School: 62% • Liberal: 60% • Aged 13: 55%
Bottom Percent of Teens Who Have Used AI	• Midwest: 46% • Rural: 46% • Black: 44% • Female: 35%

Half of teens have used AI in their free time or at school compared to less than one-third of adults.

Sources: *Nejame, L., Bharadwaj, R., Shaw, C., and Fox, K. (2023, April 25). Generative AI in higher education: From fear to experimentation, embracing AI's potential. Tyton Partners; Sidoti, O. and Gottfried, J. (2023, November 16). About 1 in 5 U.S. teens who've heard of ChatGPT have used it for schoolwork. Pew Research Center. EdChoice and Morning Consult. (2023, September 2023). Teens and their schooling perspectives: A national polling report.*

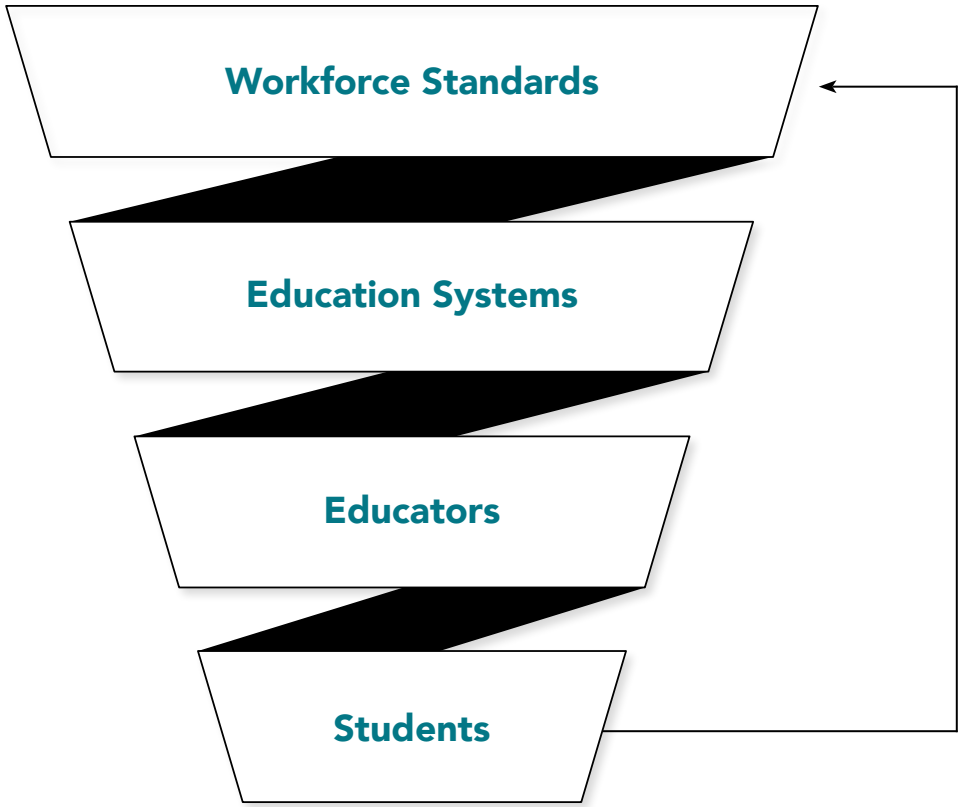
Changing workforce standards driven by AI are expected to have downstream and cyclical effects on education.

AI is changing what **skill sets, knowledge, and capabilities** will be needed in the future workforce.

Federal, state, and local education systems will need to **reconsider structures**, relational dynamics, and models for teaching and learning.

What is taught and how educators teach their students will need to adapt to evolving technology, employer needs, and new education standards.

As systems begin to shift, it will change **what and how students learn** to be ready for future careers.



Contents

Introduction

Key Takeaways

Overview

- What is AI?
- Growth
- Concerns
- Adoption Rates
- Evolving Education Sector Needs

Conclusion

Sources

Acknowledgments

About the Authors

About Bellwether

Conclusion

Given the pace of technological advancement, there is an opportunity for leaders across the education sector to proactively plan for an AI-integrated future. This foresight must extend beyond current AI tools, anticipating and preparing for emerging capabilities that may impact education in the coming years.

While the integration of AI in education presents certain risks, leaders should also consider the significant risks of failing to adopt a proactive approach, including exacerbating existing inequities. If AI becomes a key skill in the workforce, schools must be preparing students for future careers.

This is a unique point in time with the opportunity to shape the education system thoughtfully, mitigating potential pitfalls while harnessing AI's potential. **It is important to view AI neither as a passing fad nor a panacea, but as a potentially powerful tool that can support steady, long-term improvements toward a more equitable and efficient education system.**

Navigating the complex landscape of AI in education requires a holistic approach that addresses both its vast potential and inherent challenges. Stakeholders must carefully consider a wide array of factors spanning educational practices, technological applications, policy frameworks, and systemic changes. Capacity-building and change management will be significant challenges to overcome. ✦

For a deeper exploration of these aspects, refer to part two of the Learning Systems series — Considerations: Opportunities and Challenges of Artificial Intelligence-Enhanced Education.

Contents

Introduction

Key Takeaways

Overview

- What is AI?
- Growth
- Concerns
- Adoption Rates
- Evolving Education Sector Needs

Conclusion

Sources

Acknowledgments

About the Authors

About Bellwether

Sources

PAGE 13

- "Artificial Intelligence Coined at Dartmouth," Dartmouth, https://home.dartmouth.edu/about/artificial-intelligence-ai-coined-dartmouth.
- Will Henshall, "4 Charts That Show Why AI Progress Is Unlikely to Slow Down," *Time*, August 2, 2023, https://time.com/6300942/ai-progress-charts/.
- "Introducing OpenAI," OpenAI, December 11, 2015, https://openai.com/index/introducing-openai/.
- "Our Mission: Build AI Responsibly to Benefit Humanity," Google DeepMind, https://deepmind.google/about/.
- William Guo and Alice Ao, *Anthropic*, Contrary Research, August 2, 2024, https://research.contrary.com/company/anthropic.
- "What's the Future of Generative AI? An Early View in 15 Charts," *McKinsey Explainers*, McKinsey & Company, August 25, 2023, https://www.mckinsey.com/featured-insights/mckinsey-explainers/whats-the-future-of-generative-ai-an-early-view-in-15-charts.
- Belinda Zeng, "Go Beyond the Search Box: Introducing Multisearch," *The Keyword* (blog), Google, April 7, 2022, https://blog.google/products/search/multisearch/.
- "Fact Sheet: President Biden Issues Executive Order on Safe, Secure, and Trustworthy Artificial Intelligence," The White House, October 30, 2023, https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/30/fact-sheet-president-biden-issues-executive-order-on-safe-secure-and-trustworthy-artificial-intelligence/.
- Sundar Pichai and Demis Hassabis, "Introducing Gemini: Our Largest and Most Capable AI Model," *The Keyword* (blog), Google, December 6, 2023, https://blog.google/technology/ai/google-gemini-ai/#sundar-note.
- "Introducing Meta Llama 3: The Most Capable Openly Available LLM to Date," *AI at Meta* (blog), Meta, April 18, 2024, https://ai.meta.com/blog/meta-llama-3/.

PAGE 14

- H. James Wilson and Paul R. Daugherty, "What Changes When AI Is So Accessible That Everyone Can Use It?," *Harvard Business Review*, January 30, 2018, https://hbr.org/2018/01/what-changes-when-ai-is-so-accessible-that-everyone-can-use-it.
- Bhaskar Chakravorti, "Why AI Failed to Live Up to Its Potential During the Pandemic," *Harvard Business Review*, March 17, 2022, https://hbr.org/2022/03/why-ai-failed-to-live-up-to-its-potential-during-the-pandemic.
- McKinsey & Company, "Future of Generative AI."

PAGE 15

- Nestor Maslej et al., *The AI Index 2024 Annual Report*, Stanford University Institute for Human-Centered AI, April 2024, 81, https://aiindex.stanford.edu/wp-content/uploads/2024/05/HAI_AI-Index-Report-2024.pdf.
- Eric Hazan et al., *A New Future of Work: The Race to Deploy AI and Raise Skills in Europe and Beyond*, McKinsey, May 21, 2024, https://www.mckinsey.com/mgi/our-research/a-new-future-of-work-the-race-to-deploy-ai-and-raise-skills-in-europe-and-beyond.

PAGE 16

- Maslej et al., *AI Index 2024*, 51.
- Maslej et al., *AI Index 2024*, 5.
- Joseph B. Keller, Manann Donoghoe, and Andre M. Perry, "The US Must Balance Climate Justice Challenges in the Era of Artificial Intelligence," *Brookings Institution*, January 29, 2024, https://www.brookings.edu/articles/the-us-must-balance-climate-justice-challenges-in-the-era-of-artificial-intelligence/.

PAGE 17

- OpenAI, https://openai.com/api/.
- Jeanine Banks and Tris Warkentin, "Gemma: Introducing New State-of-the-Art Open Models," *The Keyword* (blog), Google, February 21, 2024, https://blog.google/technology/developers/gemma-open-models/.
- "Meet Claude," Anthropic, https://www.anthropic.com/claude.

- "Meet Llama 3.1," Meta, https://llama.meta.com/.

PAGE 18

- Maxime Labonne (@maximelabonne), "Due to popular demand, I've updated this figure to include DeepSeek-V2 and Mistral Large 2. It's also more zoomed for readability," X.com, July 25, 2024, 3:11 a.m., https://x.com/maximelabonne/status/1816416043511808259.
- "Gemini: Supercharge Your Creativity and Productivity," Google, https://gemini.google.com/.
- OpenAI, https://openai.com/api/.
- Anthropic, "Meet Claude."
- Meta, "Meet Llama 3.1."
- Hugging Face, https://huggingface.co/.

PAGE 19

- "Generative AI to Become a $1.3 Trillion Market by 2032, Research Finds," *Bloomberg*, June 1, 2023, https://www.bloomberg.com/company/press/generative-ai-to-become-a-1-3-trillion-market-by-2032-research-finds/.
- Robert Berkman, *AI in the Classroom 2023-2024: Promises and Perils*, Simba Information, 2023, 6, https://www.marketresearch.com/Simba-Information-Reports-v3481/AI-Classroom-Promises-Perils-35112114/.
- Ibid., 8.

PAGE 20

- Ibid., 4.
- AI Educator Tools, https://aieducator.tools/.
- "The AI Tools in Education Database," Edtech Insiders, https://aitoolsdirectory.notion.site/The-AI-Tools-in-Education-Database-759da4b9aca649a7add36fd7b2833c0b.
- "Simple, Transparent Pricing," MagicSchool AI, https://www.magicschool.ai/partner.
- "Pricing," Copilot, https://educationcopilot.com/pricing/.
- "Simple & Transparent Pricing, for Every Teacher," Eduaide.Ai, https://www.eduaide.ai/#pricing.

PAGE 22

- Clare Duffy, "Google's Greenhouse Gas Emissions Are Soaring Thanks to AI," *CNN*, July 3, 2024, https://edition.cnn.com/2024/07/03/tech/google-ai-greenhouse-gas-emissions-environmental-impact/index.html.
- Liz Reid, "AI Overviews: About Last Week," *The Keyword* (blog), Google, May 30, 2024, https://blog.google/products/search/ai-overviews-update-may-2024/.
- Berkman, *AI in the Classroom*, 13.
- Rose Khattar, "Will AI Benefit or Harm Workers?," *Center for American Progress*, August 24, 2023, https://www.americanprogress.org/article/will-ai-benefit-or-harm-workers/.
- Erik Brynjolfsson, Danielle Li, and Lindsey R. Raymond, "Generative AI at Work," NBER Working Paper Series 31161, National Bureau of Economic Research, revised November 2023, https://www.nber.org/system/files/working_papers/w31161/w31161.pdf.
- Miguel A. Cardona, Roberto J. Rodríguez, and Kristina Ishmael, *Artificial Intelligence and the Future of Teaching and Learning: Insights and Recommendations*, U.S. Department of Education, May 2023, 8, https://tech.ed.gov/files/2023/05/ai-future-of-teaching-and-learning-report.pdf.
- Selin Akgun and Christine Greenhow, "Artificial Intelligence in Education: Addressing Ethical Challenges in K-12 Settings," *AI Ethics* 2, no. 3 (2022): 431–440, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8455229/.
- Uwe Peters, "Algorithmic Political Bias in Artificial Intelligence Systems," *Philosophy & Technology* 35, no. 2 (2022): 25, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8967082/.
- Robert F. Murphy, "Artificial Intelligence Applications to Support K-12 Teachers and Teaching," *Perspective*, RAND Corporation, January 2019, 11–12, https://www.rand.org/pubs/perspectives/PE315.html.
- Berkman, *AI in the Classroom*, 83.
- Ibid., 29.
- Vikas Hassija et al., "Interpreting Black-Box Models: A Review on Explainable Artificial Intelligence," *Cognitive Computation* 16 (January 2024): 45–74, https://doi.org/10.1007/s12559-023-10179-8.

- Will Douglas Heaven, "AI Is Wrestling With a Replication Crisis," *MIT Technology Review*, November 12, 2020, https://www.technologyreview.com/2020/11/12/1011944/artificial-intelligence-replication-crisis-science-big-tech-google-deepmind-facebook-openai/.

- Amazon Web Services, *Developer Guide: Amazon Machine Learning*, 2024, https://docs.aws.amazon.com/pdfs/machine-learning/latest/dg/machinelearning-dg.pdf.

- U.S. Department of Homeland Security, *Increasing Threat of Deepfake Identities*, https://www.dhs.gov/sites/default/files/publications/increasing_threats_of_deepfake_identities_0.pdf.

- Reece Rogers, "Google Search Ranks AI Spam Above Original Reporting in News Results," *Wired*, July 2, 2024, https://www.wired.com/story/google-search-ai-spam-original-reporting-news-results/.

- UNESCO, *Building Partnerships to Mitigate Bias in AI*, https://www.unesco.org/en/articles/building-partnerships-mitigate-bias-ai.

PAGE 23

- Colleen McClain, "Americans' Use of ChatGPT Is Ticking Up, but Few Trust Its Election Information," Pew Research Center, March 26, 2024, https://www.pewresearch.org/short-reads/2024/03/26/americans-use-of-chatgpt-is-ticking-up-but-few-trust-its-election-information/.

- Eugenie Park and Risa Gelles-Watnick, "Most Americans Haven't Used ChatGPT; Few Think It Will Have a Major Impact on Their Job," Pew Research Center, August 28, 2023, https://www.pewresearch.org/short-reads/2023/08/28/most-americans-havent-used-chatgpt-few-think-it-will-have-a-major-impact-on-their-job/.

PAGE 24

- McClain, "Americans' Use of ChatGPT."

- Michael Chui et al., *The State of AI in 2023: Generative AI's Breakout Year,* McKinsey & Company, August 1, 2023, https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2023-generative-ais-breakout-year.

PAGE 25

- "The Value of AI in Today's Classroom," Walton Family Foundation, June 11, 2024, https://www.waltonfamilyfoundation.org/learning/the-value-of-ai-in-todays-classrooms.

- Family Online Safety Institute, *Generative AI: Emerging Habits, Hopes, and Fears*, 2023, 35, https://cdn.prod.website-files.com/5f4dd3623430990e705ccbba/654e85135ac3a85e4e3ce83b_FOSI_GenAI%20Emerging%20Habits%2C%20Hopes%20and%20Fears_Full%20Report_Nov%202023.pdf.

- Amy Green, Beck Tench, and Emily Weinstein, *Teen and Young Adult Perspectives on Generative AI: Patterns of Use, Excitements, and Concerns*, Common Sense Media, June 3, 2024, 7, https://www.commonsensemedia.org/research/teen-and-young-adult-perspectives-on-generative-ai-patterns-of-use-excitements-and-concerns.

- Melissa Kay Diliberti et al., *Using Artificial Intelligence Tools in K-12 Classrooms*, RAND Corporation, April 17, 2024, https://www.rand.org/pubs/research_reports/RRA956-21.html.

PAGE 26

- Walton Family Foundation, "Value of AI."

- "Teachers and Parents Report Positive Impact of ChatGPT on Teaching and Learning," Walton Family Foundation, July 18, 2023, https://www.waltonfamilyfoundation.org/learning/teachers-parents-report-positive-impact-of-chatgpt-on-teaching-and-learning.

- Olivia Sidoti and Jeffrey Gottfried, "About 1 in 5 U.S. Teens Who've Heard of ChatGPT Have Used It for Schoolwork," Pew Research Center, November 16, 2023, https://www.pewresearch.org/short-reads/2023/11/16/about-1-in-5-us-teens-whove-heard-of-chatgpt-have-used-it-for-schoolwork/.

- Diliberti et al., *Using Artificial Intelligence Tools*.

PAGE 27

- Bree Dusseault and Justin Lee, "Study: How Districts Are Responding to AI & What It Means for the New School Year," *The 74*, September 10, 2023, https://www.the74million.org/article/study-how-districts-are-responding-to-ai-what-it-means-for-the-new-school-year/.

PAGE 28

- Bree Dusseault and Justin Lee, *AI Is Already Disrupting Education, but Only 13 States Are Offering Guidance for Schools*, Center for Reinventing Public Education, October 2023, https://crpe.org/ai-disrupt-ed-13-states/.

- Bree Dusseault, *New State AI Policies Released: Signs Point to Inconsistency and Fragmentation*, Center for Reinventing Public Education, March 2024, https://crpe.org/new-state-ai-policies-released-inconsistency-and-fragmentation/.

- "[Shared] AI Policy Tracker," TeachAI, https://docs.google.com/spreadsheets/d/1J9CSLfbUoMRrGh0bPWoyPKMcGe41rRbllernzQXAffY/edit?gid=0#gid=0.

PAGE 29

- Louis Nejame et al., *Generative AI in Higher Education: From Fear to Experimentation, Embracing AI's Potential*, Tyton Partners, April 25, 2023, https://tytonpartners.com/generative-ai-in-higher-education-from-fear-to-experimentation-embracing-ais-potential/.

- Sidoti and Gottfried, "About 1 in 5."

- EdChoice and Morning Consult, *Teens and Their Schooling Perspectives: A National Polling Report*, September 2023, https://www.edchoice.org/wp-content/uploads/2023/09/EdChoice-Teens-August-2023.pdf.

Contents

Introduction

Key Takeaways

Overview

- What is AI?
- Growth
- Concerns
- Adoption Rates
- Evolving Education Sector Needs

Conclusion

Sources

Acknowledgments

About the Authors

About Bellwether

Interviews

Interviews were conducted May through August 2024. The following individuals lent their perspectives and expertise on this series, including:

Aaron Cuny
AI for Equity

Aasim Shabazz
Twin Cities Innovation Alliance

Adam Feiler
DREAM PCS

Adeel Khan
MagicSchool AI

Alejandro Gibes de Gac
Paloma

Amanda Lenhart, Beth Sears, Ellen Pack, Merve Lapus, Samantha Ketcham, and Yvette Renteria
Common Sense Media

Angela Duckworth, Ethan Mollick, and Lilach Mollick
University of Pennsylvania

Benjamin Riley
Cognitive Resonance

Bobby Moore and Luis Pérez
CAST

Bree Dusseault and Robin Lake
Center on Reinventing Public Education

Brent Maddin
ASU School of Ed

Brent Milne and Tom Fischaber
Saga Education

Cameron White and Erin Stark
NewSchools

Claire Zau
GSV Ventures

Dale Schmidt, Elaine Perea, Robert Runcie, and Shayla Cannady
Chiefs for Change

Dan Effland
Summit PCS

Dan Meyer
Amplify and Mathworlds

David Fields
Northeastern University

Dylan Kane
Five Twelve Thirteen Substack

Erin Mote
InnovateEDU

Jack Shaw
Comprendo.dev

Jennie Magiera and Kristal Ayres
Google, Education Impact

Jeremy Roschelle
Digital Promise

Jimmy Fisher
Seckinger High School

Josh Clark
Landmark School

Kim Smith
LearnerStudio

Kristen DiCerbo
Khan Academy

Kumar Garg
Renaissance Philanthropy

Lorne Rodriguez and Peter Leonard
Chicago Public Schools

Maheen Sahoo and Peter Gault
Quill

Matthew Marino
University of Central Florida

Michelle Rojas-Soto
KIPP SoCal

Pat Yongpradit
Code.org

Rebecca Finlay
Partnership on AI

Rob Waldron
Curriculum Associates

Stacy Kane
Washington Leadership Academy

Sue Krause
Cognia

Yusuf Ahmad
Playlab.ai

About the Authors

AMY CHEN KULESA

Amy Chen Kulesa is a senior associate partner at Bellwether in the Strategic Advising practice area. She can be reached at **amy.chenkulesa@bellwether.org**.

MICHELLE CROFT

Michelle Croft is an associate partner at Bellwether in the Policy and Evaluation practice area. She can be reached at **michelle.croft@bellwether.org**.

BRIAN ROBINSON

Brian Robinson is a senior analyst at Bellwether in the Policy and Evaluation practice area. He can be reached at **brian.robinson@bellwether.org**.

MARY K. WELLS

Mary K. Wells is a co-founder and managing partner at Bellwether in the Strategic Advising practice area. She can be reached at **mary@bellwether.org**.

ANDREW J. ROTHERHAM

Andrew J. Rotherham is a co-founder and senior partner at Bellwether in the Policy and Evaluation practice area and External Relations team. He can be reached at **andy@bellwether.org**.

JOHN BAILEY

John Bailey is a nonresident senior fellow at American Enterprise Institute. He can be reached at **john@vestigopartners.com**.

About Bellwether

Bellwether is a national nonprofit that exists to transform education to ensure systemically marginalized young people achieve outcomes that lead to fulfilling lives and flourishing communities. Founded in 2010, we work hand in hand with education leaders and organizations to accelerate their impact, inform and influence policy and program design, and share what we learn along the way. For more, visit **bellwether.org**.

ACKNOWLEDGMENTS

We would like to thank the many individuals who gave their time and shared their knowledge with us to inform our work, including interview participants for being generous in providing their perspective and expertise. Thank you also to the Bezos Family Foundation, Charter School Growth Fund, Charles and Helen Schwab Foundation, Oak Foundation, and Raikes Foundation for their financial support of this project.

We would also like to thank our Bellwether colleagues Marisa Mission, Shruti Nagarajan, Alex Spurrier, Daniela Torre Gibney, and Christine Wade for their input and Kaitlin Beeson for her support. Thank you to Amy Ribock, Kate Neifeld, Andy Jacob, Zoe Campbell, Julie Nguyen, Mandy Berman, and Amber Walker for shepherding and disseminating this work, and to Super Copy Editors.

The contributions of these individuals and entities significantly enhanced our work; however, any errors in fact or analysis remain the responsibility of the authors.

DISCLOSURE

Bellwether works with organizations and leaders who share our viewpoint-diverse commitment to improving education and advancing equity for all young people — regardless of identity, circumstance, or background. As part of our commitment to transparency, a list of Bellwether clients and funders since our founding in 2010 is publicly available on our website. An organization's name appearing on our list of clients and funders does not imply any endorsement of or by Bellwether.

Similarly, examples of tools, companies, and nonprofits featured in this three-part AI analysis do not imply any endorsement of or by Bellwether for specific products or services.

Separate from the creation of this three-part AI analysis, Bellwether has worked with CRPE and receives funding from the Walton Family Foundation. In addition, a co-founder and partner is an adviser to RAND.

© 2024 Bellwether

This report carries a Creative Commons license, which permits noncommercial reuse of content when proper attribution is provided. This means you are free to copy, display, and distribute this work, or include content from this report in derivative works, under the following conditions:

Attribution. You must clearly attribute the work to Bellwether and provide a link back to the publication at **www.bellwether.org**.

Noncommercial. You may not use this work for commercial purposes without explicit prior permission from Bellwether.

Share Alike. If you alter, transform, or build upon this work, you may distribute the resulting work only under a license identical to this one.

For the full legal code of this Creative Commons license, please visit **www.creativecommons.org**. If you have any questions about citing or reusing Bellwether content, please contact us.