



Artificial Intelligence (AI) in K-12

SPRING 2023

VERSION 1.1

AI

Prepared by
CoSN in Partnership with
Microsoft and with thanks to The
Blaschke Fund for its support

CoSN
LEADING EDUCATION INNOVATION

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**Developed especially
for CoSN members**



We are grateful to Microsoft for their support in preparing this publication.

This publication is funded in part by The Blaschke Fund, which supports emerging leaders in education technology policy and advocacy. The memorial fund honors the late-industry giant Charles Blaschke, who conducted pioneering research and analysis on the ever-changing U.S. education landscape for over 50 years.

EXECUTIVE SUMMARY

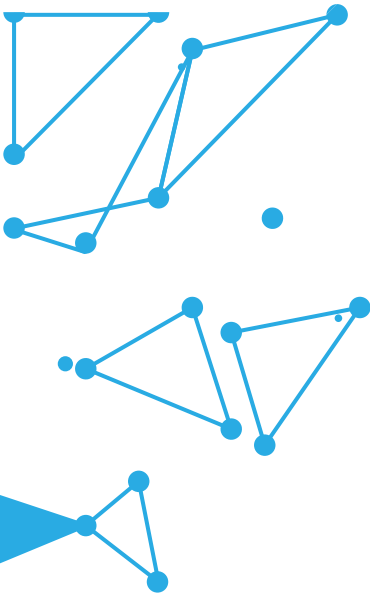
Artificial Intelligence (AI) has the potential to influence practically every aspect of education and society as it rapidly expands both inside and outside of school. While it holds the potential to augment education to provide every student with personalized instruction at scale, it also brings a host of new challenges and considerations. Through this publication, we hope to support school and district leaders as they respond to the influx of AI in education and determine how it might impact their students, teachers, and families.

Though some narratives around AI leave teachers fearing for their jobs, both economists and education experts argue the opposite. The real potential for education lies in how AI augments what teachers and leaders do in schools, allowing them to be more adaptive to the needs of their students and less consumed by routine, repetitive tasks. If adopted with the idea of augmentation in mind, AI could help to solve administrative problems, automate certain tasks, afford teachers the time to construct more meaningful face-to-face learning opportunities, and realize that promise of personalization at scale through the implementation of adaptive assessments, intelligent tutoring systems, and platforms that support adaptive learning.

However, much of the current discussion around AI comes from futurists, business leaders, economists, and technologists. These conversations have celebrated the promise of AI with minimal conversation about critical questions and concerns. Before adopting new AI systems, school and district leaders need to not only consider some of the social and moral components but also three more immediate concerns: privacy, bias, and literacy.

First, most AI technologies have been built for commercial purposes and not education environments. As a result, they have not been designed to support school system compliance with state and federal privacy legislation nor with state student data privacy laws. Second, AI “learns” by applying algorithms to large data sets; and yet, there is ongoing concern about flaws and biases in the data itself. Finally, given all of these questions and concerns, algorithmic literacy will be increasingly important for administrators, teachers, and students, raising questions about the resources and knowledge educators need to make effective use of AI.

The promise (or over-promise) of AI is that it could potentially provide some types of learning experiences without the presence of a high-quality teacher. Given teacher shortages and retention issues, AI could be viewed as a means of providing “something” where “nothing” exists, inadvertently perpetuating education inequity by advancing a cheaper but inferior education system. Although international organizations have celebrated AI as a potential technology to transform education at scale, across multiple reports lies a recurring theme: the potential of AI lies in its ability to support great teachers and create new learning opportunities for students that take advantage of meaningful human relationships. The Education Commission explained, the true promise of AI lies in a combination of *high-tech and high-touch*.



Artificial Intelligence (AI) has the potential to influence practically every aspect of education and society as it rapidly expands both inside and outside of school. From the navigation apps in our cars to the voice assistants on our phones, AI allows all of us to avoid traffic, send text-messages by voice, and even remember our to-do lists. Within education, it can recommend new ways to solve a math problem, translate text or audio into a different language, suggest words while writing and engage in simulated conversations through natural language processing. AI holds the potential to augment education to provide every student with personalized instruction at scale, yet it also brings a host of new challenges and considerations.

With this publication, CoSN hopes to support school and district leaders as they respond to the influx of AI in education and determine how it might impact their students, teachers, and families.

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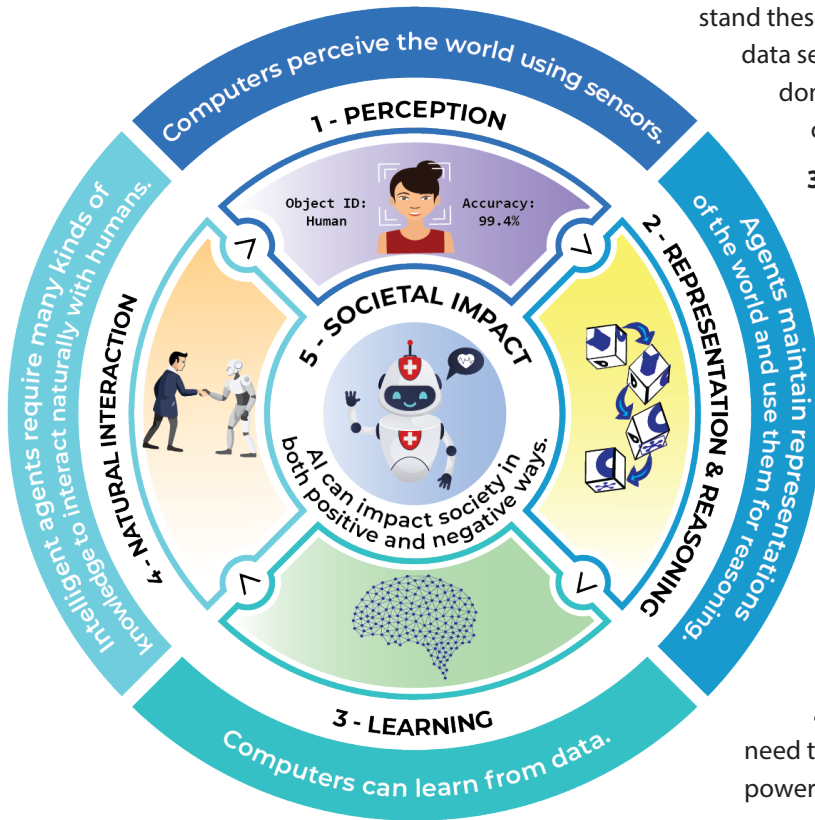
THE CHALLENGE OF DEFINING AI

In 1950, Alan Turing first suggested that computers could learn to think and behave like humans – effectively launching the science of artificial intelligence (AI). Throughout the 60s and 70s, researchers developed what they considered “intelligent systems” in fields that ranged from biology to the military, ultimately informing the AI applications and platforms seen today. However, the field of AI faces a unique challenge known as the “odd paradox.” As AI supports the development of new technologies that become socially accepted, the tools are no longer considered *artificial intelligence*. As an example, consider the calculator. When developed, it represented intelligent computation. Now, it has been relegated to the position of an operating system “widget.”

Technically, AI is considered a branch of computer science and a set of computational technologies. It functions in a manner similar to humans in that it can sense, learn, reason, and then take actions. However, unlike humans, AI is comprised of algorithms, rules, and data sets that operate within a specific domain. While it might seem “intelligent,” that intelligence only exists within a specific subject or in conjunction with a set of rules like how to complete specific steps to solve a math problem or how to check grammar in an essay. In fact, within education, most of what is considered artificial intelligence is actually Machine Learning.

Machine Learning refers to the process of training AI by developing algorithmic responses based on a set of programmed rules within the context of a data set. It is the technology that drives tools like adaptive learning platforms and automatic essay graders. Within Machine Learning is Deep Learning, a technology that uses inter-connected sets of algorithms similar to a neural network to look for and recognize complex patterns. As a result of Deep Learning, AI can classify images and detect objects, such as with facial recognition. It can also recognize speech patterns and use Natural Language Processing – the technology that drives voice assistants like Siri or Alexa, automatic translation services, and virtual support agents. When educators and edtech vendors talk about artificial intelligence, they are most likely referring to Machine Learning or Deep Learning.

To simplify the conversation in schools, the Computer Science Teachers’ Association (CSTA) and the Association for the Advancement of Artificial Intelligence (AAAI) suggests defining AI as a set of five themes instead of specific technologies.



1. Perception. Computers perceive the world via sensors and then extract meaning from that information. Sensors can include motion detectors, cameras, or microphones. When paired with Deep Learning technologies, they can result in facial recognition systems, motion-activated lights, or speech recognition programs that trigger a virtual assistant like Cortana or Alexa.

2. Representation & Reasoning. AI systems or intelligent agents maintain different models or representations and then apply algorithms to those models as a form of "reasoning." Students and teachers need to understand these representations as they are only as credible as the data set that formed them. These models can include the domain knowledge, student knowledge, and pedagogical models that drive instruction.

3. Learning. Computers learn from data based on statistical inferences made through Machine Learning. The learning is based on explicit rules and algorithms that attempt to represent expert systems such as those found in an Intelligent Tutoring System or adaptive learning platform. In these instances, the AI guides students to different content or activities based on their responses to a set of prompts or questions.

4. Natural Interaction. Developers struggle to make AI interact in a natural way, including how it attempts to make inferences, understand emotion, and process natural language. Teachers and students need to understand this limitation when interacting with AI powered systems.

5. Societal Impact. AI can have both positive and negative impacts on society, raising new questions about ethics, privacy, and bias. Beyond simply understanding the effects of AI on education and society, teachers and students should also be aware of unintended consequences.

THE PROMISE FOR AI IN EDUCATION

Though some narratives around AI leave teachers fearing for their jobs, both economists and education experts argue the opposite. As Robert Murphy, a senior policy researcher explained in [Artificial Intelligence Applications to Support K-12 Teachers and Teaching](#), the real potential lies in how educators leverage AI to augment what they do in the classroom, allowing them to be more adaptive to the needs of their students and less consumed by routine, repetitive tasks. If adopted with the idea of augmentation in mind, AI could help to solve administrative problems, automate certain tasks like formative assessment feedback, and afford teachers the time to construct more meaningful face-to-face learning opportunities for students.

CoSN is vendor neutral and does not endorse products or services. Any mention of a specific solution is only provided to illustrate the point, not as a recommendation.

According to *Intelligence Unleashed: An Argument for AI in Education*, a report released by researchers from Pearson and the University College London, AI plays three roles in guiding student learning: recommending next steps, presenting scaffolds or supports, and offering differing feedback.

Another promise of AI in education is personalization at scale. Similar to how entertainment systems ranging from Spotify to Netflix make recommendations based on past behaviors, AI in education will expand through the use of cognitive tutors and Intelligent Tutoring Systems. Not only might this provide students with more timely feedback and support, but it may also free up more time for teachers to provide individualized instruction. The promise, therefore, lies in the development of blended environments that leverage both the power of AI for low-skill/low-cognitive instruction and the meaningful personal interactions that address high-skill/deeper-learning challenges.

Finally, AI could allow teachers as well as administrators to develop and track indicators of student progress beyond traditional test scores or outcome measures. This application of AI can potentially revolutionize assessment by providing just-in-time feedback to students and provide data to help teachers improve instruction. Ultimately, once AI and assessment become more tacitly embedded in systems, the amount of time required to take formal assessments will decrease as teachers and schools access an ongoing stream of data instead of having to “stop and test.” This will both create more opportunities for inquiry, creativity, and deeper learning and allow educators to efficiently identify the most effective strategies for supporting specific students.

AI IN EDUCATION TODAY

As mentioned, AI already exists in schools and society, even if it is not always recognized. From cars that use sensors to make “intelligent” decisions about traction control, changing lanes, or parallel parking to personal health monitors, AI exists relatively undetected and yet provides the benefits of convenience and safety. In education, AI can be found in learning analytic platforms, online courseware, voice assistants, and support structures within other apps. More obvious applications of AI in education include adaptive or intelligent platforms to support student learning and teaching as well as facial recognition and sensor systems to address school security.

Adaptive and Intelligent Platforms

The concept of leveraging technology to individualize learning can be traced back to the 1920s and early behavioral psychologists such as Sidney Pressey, B.F. Skinner, and Edward Thorndike. They argued that providing immediate feedback based on a students’ response to a given question or problem would directly support learning. Their early “teaching machines” eventually led to the development of modern systems that leverage Machine Learning and Deep Learning to provide individualized student support. According to *Intelligence Unleashed: An Argument for AI in Education*, a report released by researchers from Pearson and the University College London, AI plays three roles in guiding

student learning: recommending next steps, presenting scaffolds or supports, and offering differing feedback. These roles often manifest in adaptive platforms and Intelligent Tutoring Systems.

By taking advantage of rule-based systems, machine learning has resulted in platforms such as Worcester Polytechnic Institute's [ASSISTments](#). With this program, teachers assign students different sets of math problems that they complete at their own pace. The platform offers immediate feedback and hints based on student responses to the questions, essentially guiding them through the content at their own pace. However, algorithms can also provide scaffolding and latent assessment in the form of an Intelligent Tutoring System. Much like a personal tutor, as a student progresses or struggles, AI might suggest tools such as video tutorials or dictionaries to support or challenge their efforts while also tracking student performance. For example, Carnegie Learning's [MATHia](#) pro-gram not only identifies whether or not students can solve math problems but also coaches them through the problem-solving process by offering scaffolds and supports.

Finally, based on student performance, AI provides differing levels of feedback. This feedback can be specific to a task, such as solving a math problem, or more nuanced, such as an automatic essay grader that may provide some students with basic grammatical support and others with more advanced recommendations.

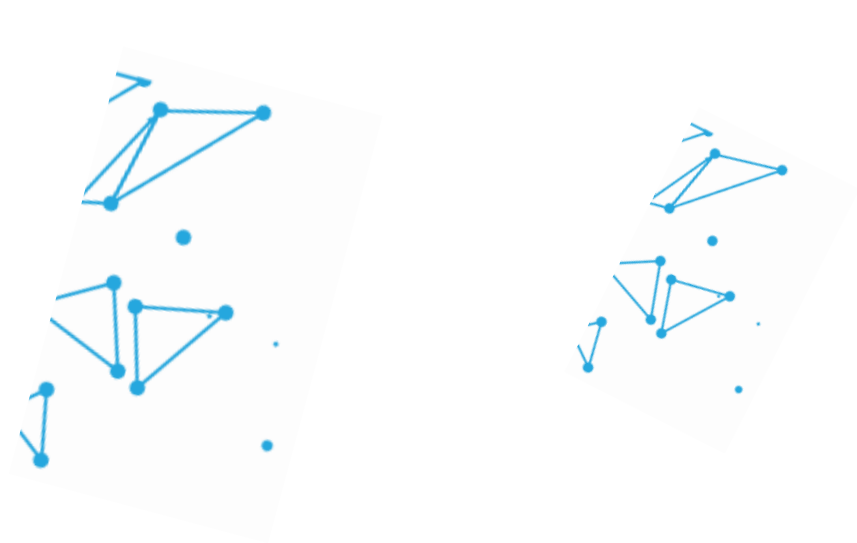
Beyond providing feedback and support, AI has the potential to support collaborative learning. AI technologies embedded within platforms can help teachers form groups based on past performance, model effective collaboration, suggest problem-solving strategies, and prompt teachers to intervene as a result of data analysis. Similarly, by leveraging virtual reality or augmented reality, AI might manifest as an intelligent tutor to provide scaffolding or serve as a virtual guide. Whether AI is built into an online platform or used as a more obvious virtual assistant, it has already entered the classroom.

School Security and AI

In the wake of numerous school shooting tragedies, districts have turned to AI and sensing technologies in an effort to improve campus safety. Between fingerprint readers, drivers' license scanners, Bluetooth geolocation sensors, and cameras, AI can often be found within school security systems.

The WIRED article [The Delicate Ethics of Using Facial Recognition in Schools](#) elaborates on the challenges faced by Lockport and other districts adopting facial recognition platforms. While some systems are limited to checking images against private databases, such as the one in Lockport, others routinely scan students to potentially track their locations throughout the day, creating additional privacy concerns. However, the same WIRED article also describes how a facial-recognition system allowed security at Texas City Independent School District to quickly detect and remove a former student who had been previously identified as a potential security threat before an incident occurred. Although this technology has the potential to improve school security and help districts avoid potential catastrophe, it has also raised a number of concerns about student privacy, potential discrimination, and the long-term consequences of students learning in a constant state of surveillance.

Many students may already be taking advantage of AI-based writing supports – even if their teachers are not using automated essay systems – by using applications like [Grammarly](#).



Like all technologies, AI is developing faster than policy or oversight.

QUESTIONS AND CONSIDERATIONS FOR SCHOOL AND DISTRICT LEADERS

Like all technologies, AI is developing faster than policy or oversight. Although organizations such as [The Institute for Ethical AI in Education](#), [Data & Society](#), and [The Center for Humane Technology](#) have raised questions and concerns about the unintended consequences of AI, current regulation exists primarily in silos such as security or healthcare even though the technology spans across sectors. This inability for government to keep up with technology creates two issues that educators and education technology leaders need to consider: (1) how they might protect their students' data and privacy; and (2) how AI might further exacerbate the Digital Divide due to its unequal influence and impact on society.

Presently, much of the discussion around AI has come from futurists, business leaders, economists, and technologists. These conversations have celebrated the promise of AI with minimal conversation about critical questions and concerns. Before adopting new AI systems, school and district leaders need to not only consider some of these social and moral components but also three more immediate concerns: privacy, bias, and literacy.

Privacy

Most AI technologies have been built for commercial purposes and not education environments. For example, though educators have become excited about the potential for voice assistants such as Alexa in the classroom, these tools have not been designed with student data privacy in mind. As a result, they have not been built to support school system compliance with state and federal privacy legislation, including the Family Educational Rights and Privacy Act (FERPA) and Children's Internet Protection Act (CIPA), nor with state student data privacy laws. At the same time, adaptive platforms and Intelligent Tutoring Systems collect information ranging from student assessments to their behaviors within apps and programs, raising questions about the privacy of student data.

As students interact with more intelligent systems, everything from their voice to their handwriting to their browsing habits could be viewed as forms of digital fingerprints. With the rise of the Internet of Things (IoT) and the potential consolidation of data across multiple platforms and locations, there could be long-term

Before implementing any type of learning platform, school and district leaders should ask how the data sets were formed and be aware of the risk for bias or discrimination.

Questions for Educators on the effective use of AI

1. How can leaders and teachers recognize AI and critically assess its purpose and potential in education?
2. How does AI fit within the broader ecosystem of edtech?
3. How can AI literacy be incorporated as a component of broader literacy and equity training so that it does not become “just another thing” or “someone else’s topic” to teach?
4. How might AI spark dialog around broader media/ digital/ algorithmic literacies that will continue to impact students’ lives?

profiling ramifications, especially if school systems use products not specifically designed for the education environment. Despite the promise of using data to better inform instruction, create personalized learning experiences, and provide a more holistic picture of each student as a learner, district leaders need to consider how they will protect student privacy. The use of AI powered applications may put students, especially those from vulnerable populations, at risk of future discrimination.

In addition, they may give students the perception that they are learning and living in a constant state of surveillance.

Bias

AI “learns” by applying algorithms to large data sets. However, there is ongoing concern about flaws and biases in the data itself, as explained in the New York Times article [“We Teach A.I. Systems Everything, Including Our Biases.”](#) Given the prevalence of racial, religious, and gender bias in society, AI algorithms that lever-age books, media, and even news articles could perpetuate this bias. As an exam-ple, Google’s BERT system cannot identify a woman within the context of a data set unless that female is performing what is considered a “traditional” gender role.

Before implementing any type of learning platform, school and district leaders should ask how the data sets were formed and be aware of the risk for bias or discrimination. Bias could manifest in how the platform teaches particular skills, corrects different answers, represents different individuals, and even attempts to interpret students’ emotions. In a [Harvard Business Review article](#), three researchers from Accenture discussed the challenges and implications of using AI to measure learners’ social-emotional responses. Bias in a dataset might lead to misinterpretation of engagement or attention and could wrongfully label a student just because the AI does not recognize their behavior.

Literacy

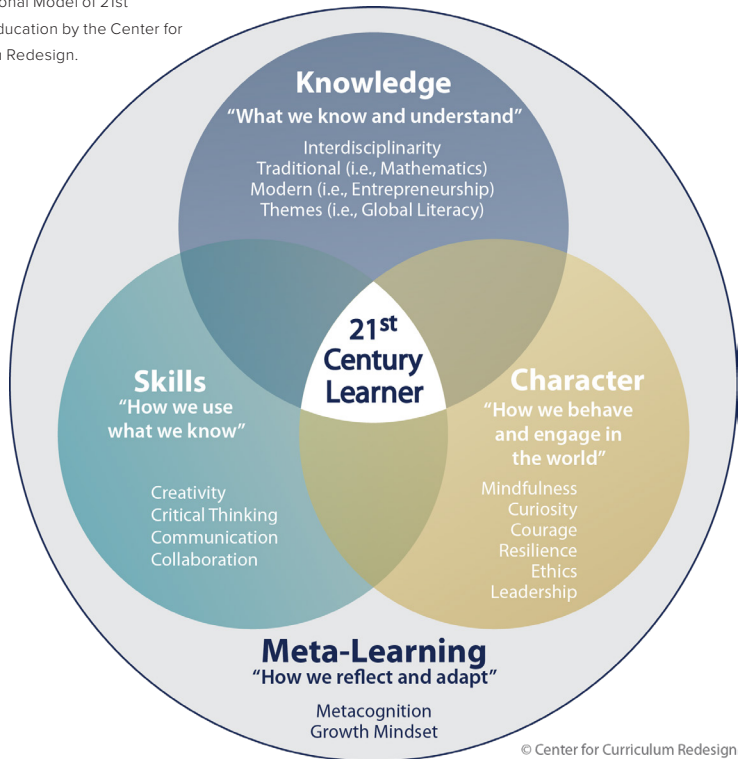
Given all of these questions and concerns, algorithmic literacy will be increasingly important for administrators, teachers, and students. All of these groups will need the language and knowledge to accept, analyze, and in some cases challenge AI outputs.

In their book, [Artificial Intelligence in Education: Promises and Implications for Teaching and Learning](#), Holmes, Bialik, and Fadel argue that advances in AI will ultimately affect what students need to know (knowledge); what students should be able to do (skills); how students should behave and engage both online and in the real world (character); and how students will be able to reflect and adapt so that they can learn how to learn (meta-learning). At the Center for Curriculum Redesign, the researchers represent these ideas through a Venn diagram and define 21st century education as 12 interdependent competencies.

MORE QUESTIONS FOR DISTRICT AND SCHOOL LEADERS

Since AI development has largely occurred in commercial contexts, education leaders need to consider even more questions around transparency, motive, privacy, and predictability. For example:

- What are the long-term ramifications if children are exposed to inadvertently or deliberately biased systems or inaccurate instructional models? Could AI magnify existing inequities and lead to greater achievement gaps?



- Do students have a right to privacy at school? And if so, do they and their parents or guardians understand what data is being collected, stored, and potentially shared or sold by AI-driven systems?
- Who controls how student data is captured, stored, and collected; and who should be held accountable for ensuring the privacy of that data?
- Since AI is increasingly embedded in cameras, sensors, and intelligent agents, what are the long-term effects on children growing up in a state of constant surveillance?
- If systems track student physical and emotional well-being in addition to their cognitive development, at what point does the technology become too intrusive?
- What are ethical and moral uses of AI, and what should not be allowed in classrooms and the school environment?
- Most important, who will educate children, teachers, and families about AI so that they use technologies appropriately, effectively, knowledgeably, and ethically?

The promise (or over-promise) of AI is that it could potentially provide some types of learning experiences without the presence of a high-quality teacher. Given teacher shortages and retention issues across the country, AI could be viewed as a means of providing "something" where "nothing" otherwise exists. And yet, this approach has the potential to further perpetuate education inequity by advancing a cheaper but inferior education system. Education leaders need to be aware that AI could lead to greater achievement gaps. These negative effects could stem from lack of access to AI, lack of access to meaningful face-to-face interactions, or both. CoSN provides updated recommendations for edtech leaders at <http://www.cosn.org>.

High-Tech High-Touch: The Real Potential of AI

Beyond considerations of personalization, efficiency, effectiveness, privacy, bias, literacy, and equity, the most critical question for education leaders remains WHY? What learning opportunity might AI create or facilitate? What is the educational goal, and how might AI help to achieve it? Put directly, if AI is the solution, what is the problem that it is trying to solve?

From the World Economic Forum to the United Nations Educational, Scientific, and Cultural Organization (UNESCO) to the European Union, international organizations have both celebrated AI as a potential technology to transform education at scale and warned of potential unintended consequences. Across these reports lies a recurring theme that the potential of AI lies in its ability to augment great teachers and create new learning opportunities for students that take advantage of meaningful human relationships.

RESOURCES TO LEARN MORE

Books

Beyond the books explicitly referenced in this guide, the following offer unique perspectives on the challenges and possibilities of AI in education as well as society.

[Algorithms of Oppression: How Search Engines Reinforce Racism](#) by Safiya Umoja Noble

[Artificial Intelligence in Education: Promises and Implications for Teaching and Learning](#) by Wayne Holmes Maya Bialik and Charles Fadel

[Race After Technology](#) by Ruha Benjamin

[Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy](#) by Cathy O'Neil

From Microsoft

[AI School](#) - AI School provides information, learning materials, and resources to better understand artificial intelligence.



From ISTE

[Preparing Students for an AI-Driven World](#) - Blog article from Nicole Kruger that addresses how to teach about AI and introduces the idea of AI stewardship.

[Teaching AI: Exploring New Frontiers](#) – In this book by Dr. Michelle Zimmerman, K-12 educators will learn what AI is, how it works, and how to use it to better prepare students in a world with increased human-computer interaction. Beyond presenting perspectives from educators and industry experts on how they are using AI, the book also presents approaches to teaching about AI, tools for exploring AI, as well as activities, reflection questions, and lesson ideas to introduce AI concepts.

[Artificial Intelligence Explorations and Their Practical Use in Schools](#) - This 30-hour course introduces educators to AI and its application in K-12 environments through presentations, examples of practical use, tools and resources for implementation, and interactive activities. It focuses on aspects of AI technologies that have the potential to facilitate and leverage learning and solve real problems in schools and communities. Throughout the course, educators acquire strategies to draw upon as they develop a project-based unit where students apply artificial intelligence to solve a problem using design thinking.

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Artificial Intelligence (AI) in K-12. Version 1.1

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