

Exploring the Potential of AI in Education

Digital technology has emerged as a powerful force in education. Intel's focus on robust and responsible AI makes the next wave of progress possible.

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Introduction: AI Goes to School

It's no secret that the education field faces mounting challenges. Many teachers find themselves overburdened, while students struggle to connect to curriculum in a meaningful way. Equally troubling, [proficiency scores are dropping](#). Amid these circumstances, awareness is growing that digital technologies, including artificial intelligence (AI), can change teaching and learning for the better.

Expanded access to AI has prompted widening recognition that the technology, used effectively, can support, augment, and empower humans. In education, AI is already making its presence felt—most prominently through generative AI technologies such as ChatGPT and Llama 2. In the coming years, AI tools will alter how teachers and students access information and resources. New AI tools will also introduce more efficient ways to manage learning, lead to highly targeted decision-making and content, and boost productivity by reducing manual and rote tasks that generate little or no value.

What makes AI so attractive is its power to personalize content, deliver real-time feedback, and guide coaching and skills development. These capabilities can establish stronger links between curriculum and learning while enhancing student-teacher connections.

The key to success, of course, is understanding how, when, and where to use AI. Artificial intelligence cannot address all the problems in today's educational system. In addition, there are practical concerns, ethical questions, and broader issues about how to use AI optimally and responsibly. Yet, already, teachers, students, and others are turning to AI tools—and education is changing.

AI Offers New Possibilities

A starting point for any journey into AI is to understand what it *is* and what it *isn't*. The term "AI" refers to a machine's ability to perform the cognitive functions we usually associate with human minds, such as perceiving, reasoning, learning, interacting with an environment, problem-solving, and even exercising creativity.¹ AI can take different forms, including reactive data and reporting (reactive AI), predictive analytics (predictive AI), and generative AI content.

In many respects, AI is already here. Between 15 and 25 percent of training processes already incorporate some form of AI, and 44 percent of institutions include AI in their short- to medium-term plans.² Generative AI's ability to produce ultra-realistic text, images, and videos is pushing the field forward. Generative AI also allows participants to engage in natural language conversation with an AI model.

Regardless of its exact shape or form, the goal is to harness AI to promote critical thinking and equip today's students for a digitally immersive future. In this paper,

we'll explore the opportunities and challenges of using AI to arrive at next-generation smart classrooms and digital schools. Getting there requires evolving beyond a one-size-fits-all approach and using AI responsibly as a teaching assistant, professional development tool, and way to gain operational efficiency.

Educators will play a central role in defining how the technology is used to deliver customized instruction—and installing the human guardrails necessary to optimize AI's impact. This includes recognizing its limitations and potential for bias. In the following pages we'll take a look at some of the tools and technologies that serve as a foundation for this more personal—and personalized—educational framework.

We'll also examine ethical and practical concerns that intersect with AI, such as the possibility of plagiarism by students using generative AI to aid in research or writing. Finally, we'll discuss ways to use AI to effect positive results in the classroom—and beyond. This includes how to use AI with existing tools and methods, and how to construct a robust ecosystem of partners and solutions that help to expand thinking and spark imagination.

When used appropriately, AI can serve as a powerful change agent, closing education system gaps, engaging students more deeply, and moving educators closer to their goals. For example, in the role of virtual assistant, AI can help busy teachers maximize their time and resources. This is a meaningful step forward in today's education environment, where a typical teacher works 54 hours per week, yet only 46 percent of the time spent at a school involves teaching³, and up to three-quarters of U.S. states face a teacher shortage.⁴ AI can play a major part in solving these problems.

Let's take a closer look at how AI tools are transforming learning.

1 Students Gain Digital Skills

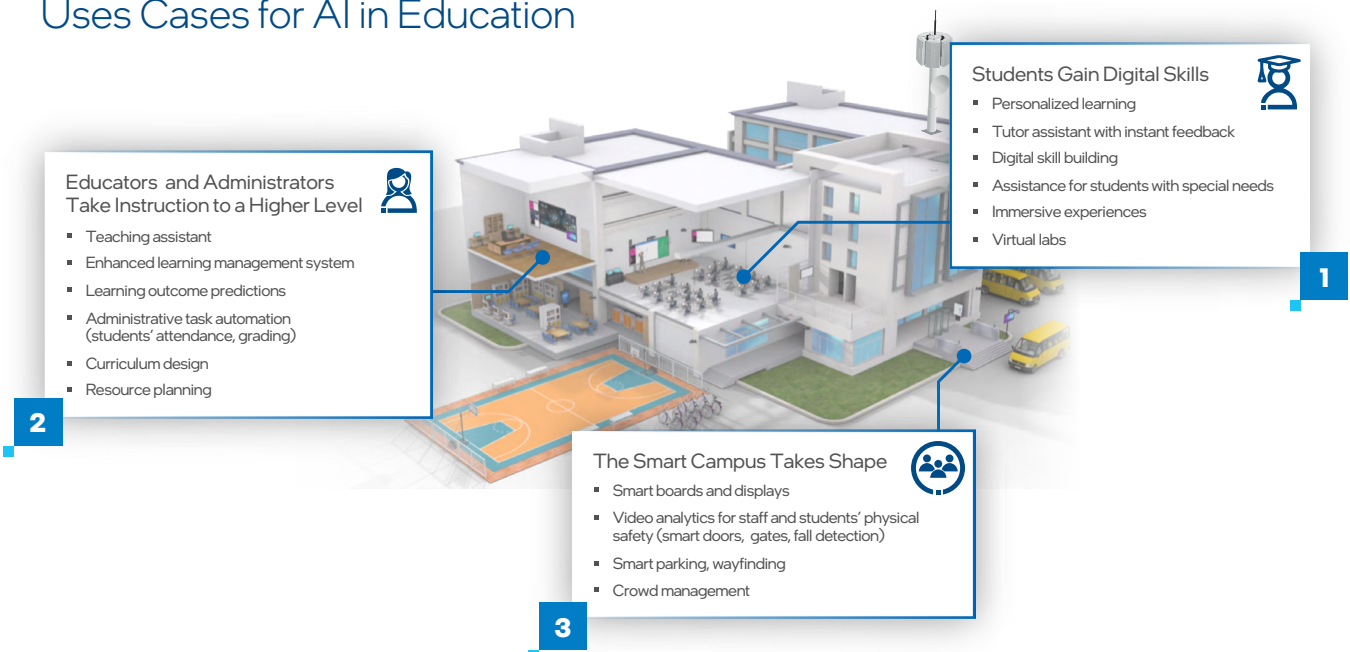
Technology is now common in the classroom. Personal computers, software, and the Internet have profoundly reshaped education over the last quarter century. These resources have accelerated 1:1 learning in schools and made it easier for students to learn at an optimal pace. In many cases, the result is increased engagement and collaboration.

AI represents the next phase in this evolution. As with earlier technologies, ensuring equitable access to AI for all students will require educational institutions to take proactive steps. Currently, generative AI tools are in the news, but other innovations that leverage AI, such as [virtual reality](#), [augmented reality](#), and [the metaverse](#), also are being used, primarily for tutoring and training. These technologies deliver immersive, hands-on learning that helps students discover the internal workings of a nuclear power plant or the chambers of the human heart. Such real-world applications motivate students and inspire a love of learning as they teach critical new skills.

An emerging class of AI software also focuses on skill building. For instance, the application [AI Playground](#) teaches students to solve complex problems using AI. Participants receive realistic challenges, such as constructing a mini-Mars rover with physical LEGO blocks and then operating the module inside a computer simulation to handle complex tasks. Along the way, students create their own AI and engage in classroom conversations about how to build better systems.

Non-native speakers and students with learning impairments can now learn English with help from specially designed AI solutions. Such solutions use text-to-voice technology to deliver multi-sensory reading and comprehension tools. Other solutions, such as [AI Autism Assistant](#), support people with disabilities.

Uses Cases for AI in Education



On a broader scale, the curriculum program Intel **AI for Youth** (AI4Y) equips K-12 students with AI tech knowledge and social skills required for a digital world. Through more than 200 hours of hands-on content covering computer vision, natural language processing, and data analytics, the program enhances AI awareness while demystifying and democratizing the technology. Teachers can design activities based on their own pedagogy and preferred method of delivery, using AI to enrich the learning experience for students with different styles of learning.

2 Educators Take Instruction to a Higher Level

By introducing new ways to manage work and improve learning, AI is changing the way educators approach instruction.

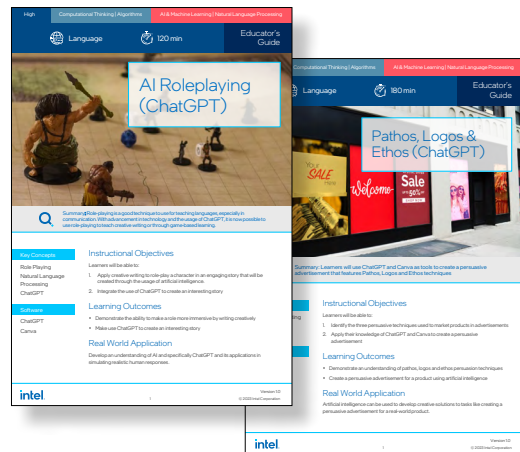
Consider this example: Few organizations in the education space are more recognizable than Khan Academy. The non-profit offers upwards of 8,000 videos and other content that more than 70 million students have used to learn about mathematics, science, and other topics. Now Khan has developed **Khanmigo**, an AI-driven teaching assistant that assesses a student's learning style and progress, identifies knowledge gaps, and responds like a personal tutor to guide the student toward critical thinking and other learning.

As the Khanmigo example suggests, AI-based teaching assistants and chatbots help students and teachers in myriad ways. For students, these tools provide additional tutoring and answer questions anytime. For teachers, they allow more time for teaching by automating more routine tasks such as taking attendance and scoring exams and essays. Further, they support teachers' efforts to create livelier and more engaged classrooms. For instance, an AI teaching assistant might ask probing questions that prompt students to reflect more deeply on a topic or guide them through their learning process. The AI assistant's ability to adapt and interact in real time makes it an engaging and effective complement to human instruction.

In the classroom, AI solutions can help gauge student progress and provide real-time feedback. As a result, a teacher can adapt instruction dynamically, while a school district can tap machine learning and analytics for insights that can guide coursework and content development.

Not only can chatbots using generative AI answer student questions during or after school, but through the use of conversational AI, they can respond to parents' questions for teachers or a school district. Similarly, they can proactively keep parents informed. In a recent example, Los Angeles Unified Public School District launched Ed, an AI Chatbot student advisor that informs parents about their child's grades, test results, and attendance. On a school or district scale, AI systems can automate messaging about events, bus schedules, and other tasks in highly personalized ways. Instead of sending out a single email or text blast to everyone, the system ensures that parents and students receive only what's relevant for them.

Professional development also is more engaging and easier to access with AI-infused course design and multi-disciplinary collaboration and lesson planning. **Intel® Skills for Innovation** (Intel® SFI) framework, for example, helps educators understand new skill requirements, create action plans, test the viability of learning environments, develop competencies, and adopt technology-supported, skills-based learning models across the entire education ecosystem. Educators can use **21 Starter Packs** with AI-infused content for elementary, middle, and high school as well as develop their own AI skills through the Intel SFI professional development offering.



Harnessing Immersive, Multimodal AI Research to Personalize Learning

Understanding how to use AI effectively is critical for developing transformative educational tools and software. Yet, the challenge is enormous because AI touches so many elements, including interfaces, performance, and human factors. Rigorous research and development (R&D) is needed to address these factors responsibly.

This R&D is a task that receives intense focus at **Intel Labs**. For example, at the Labs, ongoing research called **Kid Space** delivers a highly interactive state-of-the-art math learning experience in early childhood education. Kid Space is designed to minimize screen time and increase engagement with physical learning elements—thus making learning experiences developmentally appropriate for young children.

The Kid Space environment relies on multimodal sensing and sense-making technologies to understand physical

cues from children and respond with personalized learning opportunities. Children collaborate with their peers to solve age-appropriate math problems while a conversational digital peer accompanies their learning journeys. The digital peer supports the children when needed using voice, touch, gestures, and vision-based technologies.

The system adapts in real time so that the children stay focused on what they need to learn. This ongoing research has demonstrated impressive results, including increased levels of engagement, physical activity, and social interaction, and better problem-solving with limited screen time. Rooted in social science and taking a multi-disciplinary approach to research, Intel Labs is continuing to study Kid Space responsibly, evaluating and addressing issues such as bias, misuse, security, and privacy while looking for additional opportunities for researching personalization and long-term educational outcomes.

3 The Smart Campus Takes Shape

Another aspect of education that benefits from harnessing AI is campus operations. “Smart” buildings and infrastructure can reduce and even eliminate manual tasks through automation. Digital systems that tap AI can detect issues and problems proactively or in real time.

Intel® RealSense™ technologies and connected sensors improve physical security via smart doors, fall detection, and smart gate access, among other uses. These capabilities lead to increased efficiency and a higher level of safety and security campuswide.

Smart classrooms draw on recent innovations to merge collaboration, streaming, and gaming in novel ways. They introduce entirely new types of content and interactions that boost student engagement. Intel technology is at the foundation of this advancement, which includes AI training and inferencing frameworks like Intel® Geti™ AI solution and Intel® Distribution of OpenVino™ Toolkit. It also includes high-performance purpose-built Intel Habana chips, such as Gaudi® and Gaudi®2. These systems accelerate AI workloads by optimizing speed, memory, and scalability.

The emergence of smart classrooms, dormitories, cafeterias, offices, parking facilities, and stadiums will undoubtedly change the face of education. New ways of teaching and learning will transform classrooms and campuses. The promise that this future will be better and safer can only be realized with the responsible use of AI. It’s a concept that’s at the core of Intel’s mission to make the world better through technology.

Distance Learning Demands AI-Based Security

As methods of instruction evolve, security needs are also growing and changing. AI-based tools designed to protect data and privacy are helping meet these needs as well.

The concept of the classroom has expanded in recent years, and it’s clear that online education and distance learning are here to stay. Throughout this evolution, providing the highest level of security and privacy has remained paramount. AI-based tools can help. **The Swiss Distance University of Applied Sciences (FFHS)** understands just how urgent these protections are—particularly in remote learning environments.

As a result, FFHS has joined forces with Intel to bolster the strength of its security framework. It has introduced fraud detection and other tools that elevate security and reduce complexity. The school, which provides 80 percent of its content online, is now at far less risk of criminal hacking, fraud, and inadvertent errors that could lead to a data breach or other security problem.

Responsible AI Requires a Comprehensive Approach

Responsible Artificial Intelligence (RAI) is an approach to developing, assessing, and deploying AI systems in a safe, trustworthy, and ethical way. Responsible AI isn’t easy to achieve and no one company or organization has all the answers. Nevertheless, it’s a critical element in designing functional and trusted systems. Recognizing this, Intel established a [Responsible AI Program](#) to create a strategic framework for RAI. The multidisciplinary Responsible AI Advisory Council addresses core issues including the ethical use of systems and human rights. As artificial intelligence marches forward, Intel is continuing to adapt and adjust its approach to this technology based on insights from key learnings.

Intel approaches Responsible AI through a framework of four critical pillars: internal and external governance; research and collaboration; products and solutions; and inclusive AI. This model utilizes rigorous multidisciplinary reviews to assess potential ethical risks within AI projects and mitigate these risks as early as possible. Intel seeks to collaborate with academic organizations across the world to conduct research in areas that can have the greatest impact like privacy, security, human/AI collaboration, and transparency.

In addition, Intel develops platforms and solutions to make responsible AI pragmatic and manageable for developers. These include software tools and algorithmic methods that simplify responsible AI development and improve privacy, security, and transparency to reduce bias. This is all possible through ethnographic research that delves into human thinking and reactions—and ultimately helps researchers understand and address pain points.

In order to foster positive global change while mitigating the potentially harmful uses of AI, Intel focuses on a Responsible AI framework with clearly defined and widely accepted global human rights principles, a [security-first framework, product quality and reliability standards](#), and an environment that promotes [diversity and inclusion](#). This model helps unlock the full constructive potential of AI technology.

Building Trust through AI

One facet of AI that makes it so valuable—yet challenging—is that it interacts with nearly every aspect of digital technology. This is important in the education space because as software, robotics, and other areas advance, their overlaps with AI grow. The result is remarkable opportunities for advancing learning, certainly, but also for addressing education-related issues that ripple into the broader society—issues such as sustainability and equity.

Intel works closely with an array of academic and commercial collaborators to identify and address problem areas and best practices to encourage adoption of

responsible AI. This includes organizations such as [The Private AI Collaborative Research Institute](#), the [DARPA Guaranteeing AI Robustness Against Deception \(GARD\) program](#), the [Trusted Media initiative](#), [DSAIL at MIT](#), the [National Science Foundation \(NSF\) National Artificial Research Institutes](#), the [UC Berkeley Center for Long-Term Cybersecurity](#) and others.

False news, fake images, and fraudulent videos are good examples of how a collaborative industry approach pays dividends. Consider increasingly common “deepfake” videos that insert a real person’s image and voice into a video in an ultrarealistic way—even though the person hasn’t been filmed for the video. Without strong AI protections in place, students, teachers, and others are at risk for believing that what they are seeing is real—when in fact it is completely fictional.

Recognizing the great harm deepfakes can cause, Intel is collaborating with groups such as the [Project Origin Alliance](#), the [Content Authenticity Initiative \(CAI\)](#) and [The Coalition for Content Provenance and Authenticity \(C2PA\)](#) to detect and filter out deepfakes. In addition, Intel has also developed a [real-time deepfake detector](#) that has a 96 percent accuracy rate for catching fake videos.

The Future of AI Arrives

Responsible AI delivers benefits that extend far beyond designing trustworthy systems. It supports an overall framework for increased societal trust through a comprehensive approach involving people, processes, systems, data and algorithms. Intel CEO Pat Gelsinger has stated: “We see our role at Intel is to responsibly scale AI technology for as many people as possible [in order] to create positive global change.”

Intel Technology Drives AI in Education

Intel software and hardware components are at the core of AI in education. They serve as the engines that help scale and drive AI forward. Advances in technology will soon make more AI processing available in PCs, bringing AI everywhere in the compute continuum. Given the rapid pace of this evolution, thoughtful planning and purchasing decisions are essential to maximizing the value of new IT investments.

Here are some of the key technologies:

Intel® Core™ Ultra Processors (CPUs): Intel’s next generation of processors will deliver [advanced AI functionality](#), with state-of-the-art CPU performance, integrated graphics processing units (GPUs) and neural processing units (NPUs).

Intel® Xeon® Scalable Processors with Intel® AI Engines: The 4th Gen Intel Xeon Scalable processors combine powerful compute performance for the entire AI pipeline plus built-in accelerators for specific AI workloads in machine learning, data analysis, and deep learning.

Intel® Data Center GPU: These graphical processing units are crucial for AI. They accelerate deep learning, graphics processing, and other high-performance workloads.

Gaudi® and Gaudi® 2: Habana®, an Intel company, offers two specialized deep learning and inference processors that serve as a high-performance alternative to expensive GPUs. In many cases, these highly scalable systems actually outperform GPUs in the data center and the cloud.

Intel® Neural Processing Unit (NPU): These NPUs accelerate AI workloads on PCs, thus improving performance, responsiveness, and efficiency. The technology also boosts data security and privacy. It will be available on select Intel Core processors.

Secure AI: The training of Large Language Models (LLMs) for AI applications in academic research spotlights the importance of data security. 4th Gen Intel Xeon Scalable processors, hardened with Intel Software Guard Extensions (Intel SGX) or Intel Trust Domain Extensions (Intel TDX), provide deep, silicon-level protection for today’s emerging AI workflows.

Intel® AI Analytics Toolkit (AI Kit): This powerful toolkit accelerates end-to-end machine learning and optimizes data science pipelines. It is powered by a single API, and it works with Python.

OpenVINO™ Toolkit: (Open Visual Inference and Neural Network Optimization): This write-once, deploy-anywhere toolkit optimizes deep learning using a sophisticated Intel inference engine. It accommodates a wide range of

tasks, including data classification and segmentation, object and action detection, and depth estimation.

Intel® Geti™ Platform: The software platform supports the rapid development of AI models through advanced training methods. It includes active learning features and task chaining that reduce the complexity of datasets speed development.

Modin: This Intel open source software library accelerates data analytics and optimizes software performance on the desktop and in the cloud.

WebNN: The Intel-led neural network web API accelerates AI workloads on the web using NPUs, GPUs and CPU. WebNN aims to deliver near-native AI inference performance on a Web Platform.

Intel® Neural Compressor: This open-source library tool reduces model size and speeds inference tasks on CPUs and GPUs.

Intel® RealSense™ Camera Technology: This computer vision camera technology, including stereo sensors and advanced AI algorithms, is used to gauge depth and motion.

In the educational arena, it's vital to get the formula right early on—and keep AI responsible and ethical.

For now, AI remains in its infancy. It has only begun to appear in classrooms and learning environments. However, over the next few years, AI will continue to flow into schools and take an array of shapes and forms.

As AI use cases and adoption accelerate, students, teachers and administrators are adapting. Savvy educators understand that the learning curve doesn't have to be overwhelming—and it's important to address personal fears and biases that can undermine progress. Yet, it's also vital to recognize that constructing a Responsible AI framework with appropriate guardrails and controls isn't just a good idea, it's absolutely essential.

In the end, with all the right pieces in place, it's possible to embrace the next phase of education and learning with confidence. It's possible to minimize and even avoid the negative impacts of AI. In this emerging world, it's possible to use AI to customize and adapt learning around what works best—while allowing educators to do what they do best...educate.

The future of education holds greater accessibility to knowledge and democratized learning. Intel delivers tools and technologies that unlock this future—in a highly accessible and responsible way.

Learn more about how AI is ushering in a new age of education and Intel's commitment to the technology:

- [Intel.com/education](https://www.intel.com/education)
- [Intel.com/ai](https://www.intel.com/ai)
- [Skillsforinnovation.intel.com](https://www.skillsforinnovation.intel.com)
- [Intel® Digital Readiness](#)
- [Intel Responsible AI Program](#)
- [Intel® Distribution of OpenVINO™ Toolkit Coursework](#)
- [Intel® Developer Cloud Training](#)



Endnotes

¹ McKinsey & Company. What is AI? April 24, 2023.

² Holon IQ. Artificial Intelligence in Education. 2023 Survey Insights. February 27, 2023. <https://www.holoniq.com/notes/artificial-intelligence-in-education-2023-survey-insights>

³ EducationWeek, How Teachers Spend Their Time: A Breakdown, Hayley Hardison, April 19, 2022. <https://www.edweek.org/teaching-learning/how-teachers-spend-their-time-a-breakdown/2022/04>

⁴ U.S. Department of Education. Teacher Shortage Areas. <https://tsa.ed.gov/#/reports>. (Select school year and all states to see shortages by geographic area, subject matter, discipline, and grades.)

Intel technologies may require enabled hardware, software or service activation.

No product or component can be absolutely secure.

Intel is committed to respecting human rights and avoiding complicity in human rights abuses. See Intel's Global Human Rights Principles. Intel's products and software are intended only to be used in applications that do not cause or contribute to a violation of an internationally recognized human right.

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Recommendations

Technology enables progress, but it's up to educators to adopt processes, controls, and workflows that maximize results and minimize risks. Here are seven essential elements for constructing an AI framework in education:

- ✓ **Establish a Responsible AI workgroup or committee.** It's important to use a multi-disciplinary approach to analyze different technology tools and options and ensure that they are right for your school. It's also important to deftly integrate AI with human instruction—and current content.
- ✓ **Publish AI policies and guidance.** The success of any AI program hinges on a clear set of standards, ethical guardrails, processes, and recommendations. This helps everyone stay on track and collaborate seamlessly and effectively as well as stay true to principles of equity and inclusion.
- ✓ **Encourage pilots.** Embrace AI and get started. Validating various tools, technologies and programs within a smaller pilot group is essential before rolling them out across a school or district. This way, educators can eliminate kinks and ensure that AI achieves the best possible results.
- ✓ **Audit your IT infrastructure.** Consider hardware and software requirements for current and future AI-based use cases. This includes compatibility with current and future AI systems, data storage, and cloud and edge connectivity.
- ✓ **Provide professional development for educators and staff.** Today, no professional is untouched by AI and digital technology. It's essential to provide training so that teachers and others can unlock the full potential of AI and other digital tools. It is also important for schools' leaders to consider educating the larger community.
- ✓ **Review policies regularly.** AI is advancing at a rapid rate. A workgroup or steering committee must review policies regularly and update them, as needed, to address issues, gaps and essential changes and keep the program operating well.
- ✓ **Celebrate success.** It's wise to acknowledge wins and promote success stories. This boosts morale and helps administrators, teachers, and students adopt methods that lead to superior outcomes.