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Yoshija 24 (Walter Yoshika is a researcher at the University of Kalaidos., "Embracing the future of Artificial Intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education", SpringerOpen, 2-25-2024, https://educationaltechnologyjournal.springeropen.com/articles/10.1186/s41239-024-00448-3 // DOA 3-27-2025 // [sai] **In** the **evolving landscape** of **education**, the integration of Artificial Intelligence (**AI**) represents a transformative shift, stipulating a **new era in learning and teaching** methodologies. This article delves into the multifaceted role of AI in the classroom, focusing particularly on the primacy of prompt engineering, AI literacy, and the cultivation of critical thinking skills.The advent of AI in educational settings transcends mere technological advancement, **reshaping** the **educational experience at** its **core**. AI's role extends beyond traditional teaching methods, offering personalized learning experiences and supporting a diverse range of educational needs.

Verma 23 (Nikita Verma, "How Effective is AI in Education? 10 Case Studies and Examples", Axon Park, 2-8-2023, https://axonpark.com/how-effective-is-ai-in-education-10-case-studies-and-examples/ // DOA 3-27-2025 // [sai]

99.4% of 509 higher **education institutions** in the US **say** that artificial intelligence (**AI**) in education and learning will be **instrumental to** their

institution's **competitiveness** in the next three years. In a world where technology is advancing at an unprecedented pace, it's no surprise that AI is making its way into the classroom. As educators and researchers continue to explore the possibilities of AI in education, they are discovering its potential to revolutionize the way we learn. The AI education market is predicted to cross 20 billion USD by 2027. In this article, we will explore some real-life examples of how **AI** is being used to improve education and how it can help students succeed.**80%** **accurate** recommendations to help students, when **compared** **to** **expert** human advice A **Stanford** researcher developed an AI program to provide students with assistance when they get stuck in self-paced digital learning. The **study** tested a machine-learning program that would predict when a student was likely to get stuck and start "wheel-spinning", at which point it would recommend a relevant solution. The program was trained by analyzing performance data from 1,170 Ugandan school children who had used tablets to learn English reading skills through videos and mini-games. The program was able to predict whether a child would fall into "wheel-spinning", even before they had begun a new lesson. **In** **four** **out** **of** **the** **six** **cases**, the **model** **and** the human **expert** **came** **up** **with** the **same** **recommendations**. The study concludes that AI can be used to identify student problems and make it easier for a limited number of human teachers to help a large number of students. With 91% accuracy, AI-enhanced Chatbots provided personalized help and guidance to students

The University of Murcia in Spain recently implemented an AI-powered chatbot to assist students with inquiries about the campus and academic programs. To the surprise of administrators, the chatbot demonstrated a high level of proficiency, answering over 38,708 questions correctly more than 91% of the time. Keep in mind, this was before ChatGPT, and we can **only** expect these **metrics** **to** **improve** even **further**. This implementation not only provided students with prompt responses outside of standard office hours but also resulted in an increase in student motivation. Additionally, the **implementation** **of** the **chatbot** did **not** **require** any **changes** **to** the existing

staff structure.62% Increase in Test Scores Through Adaptive LearningA study by Knewton, an adaptive learning company, found that **students using** their **AI**-powered adaptive learning program **improved** their **test scores by 62%** compared to students who did not use the program. The program provided personalized feedback and instruction to students, tailoring the learning experience to their individual needs and abilities.**AI Improved** Students' **Grades** by 30% **While Reducing** Their **Anxiety by 20%**

Pai et al. (2020) proposed an intelligent tutoring system to help fifth-grade students learn the mathematical unit of multiplication and division. They found that the intelligent tutoring system (ITS) improved students' mathematics learning performance and increased their learning motivation.

Professors Kraft and Lyon in 2024 explain [Matthew A. Kraft, Melissa Arnold Lyon (Dr. Matthew Kraft is an Associate Professor of Education and Economics at Brown University, a Research Associate at the National Bureau of Economic Research, and a Research Fellow with IZA – Institute of Labor Economics, and an Invited Researcher at J-PAL North America. His primary work focuses on efforts to improve educator and organizational effectiveness in K-12 public schools. Melissa (Mimi) is an assistant professor of public policy at the Rockefeller College of Public Affairs and Policy at the University at Albany, SUNY. Mimi studies the political economy of education, focusing on inequality, governance, and teacher politics and policy.), The Rise and Fall of the Teaching Profession: Prestige, Interest, Preparation, and Satisfaction over the Last Half Century, 4-1-2024, Annenberg Institute At Brown University, https://edworkingpapers.com/ai22-679] accessed 2-19-2025 // bellaire FL

Across **every single indicator** we measure, our findings show that the overall wellbeing of the teaching profession today is at or near **historically low levels**. Perceptions of teacher prestige 6 have fallen between 20% and 47% in the last decade to be at the lowest levels recorded over the last half century. Interest in the teaching profession among high school seniors and college freshman has fallen 48% since the 1990s, and 40% since 2010, reaching the lowest level in the last 50 years. The number of prospective teachers earning a teaching license each year fell by over 100,000 between 2006 and 2021, and the proportion of college graduates that go into teaching is at a 50-year low. Teachers' job satisfaction **reached the lowest level in five decades** in 2022, declining by 26% in the past 10 years alone. Although recent attention has focused on how the pandemic has made teachers' work substantially more challenging, most of these declines occurred steadily throughout the last decade suggesting they are a function of larger, structural issues. In our view, these findings should be cause for serious national concern.

Marken and Agrawal 22 [Marken, Stephanie, and Sangeeta Agrawal. Stephanie Marken is a senior partner at Gallup leading its U.S. custom research division, which includes research programs Gallup performs on behalf of foundations, agencies, corporations and higher education institutions. "K-12 Workers Have Highest Burnout Rate in U.S." Gallup, 13 June 2022,

news.gallup.com/poll/393500/workers-highest-burnout-rate.aspx. Accessed 19 Feb. 2025.] //ibby

WASHINGTON, D.C. -- **More than four in 10 K-12 workers in the U.S.** (44%) **say they "always"** or "very often" **feel burned out at work, outpacing all other industries nationally**. **College** and university workers **have the next-highest burnout level, at 35%, making educators among the most burned out groups in the U.S. workforce.**

These results are based on the Gallup Panel Workforce Study, conducted Feb. 3-14, 2022, with 12,319 U.S. full-time employees, including 1,263 K-12 workers. Within the K-12 employee population,teachers are the most burned out, at 52%.

Unfortunately,

Alexander **Slagg 23** 11/14/2023, freelance writer specializing in technology and education, "AI for Teachers: Defeating Burnout and Boosting Productivity", EdTech Magazine, https://edtechmagazine.com/k12/article/2023/11/ai-for-teachers-defeating-burnout-boosting-productivity-perfcon, DOA: 02/09/2025] Borja

The past several years have been a rollercoaster ride for teachers. Hailed as heroes at the height of the COVID-19 pandemic, the return to the classroom has been rocky, and teacher shortages continue to make headlines.

HMH's 9th Annual Educator Confidence Report suggests a reason and a solution: "**Burnout is a critical issue, with 82% of educators citing that what they need most is a more balanced workload."**

That is why teachers quit so much

But! AI holds the potential to revitalize teaching as a career

Twinkl 23 [Twinkl Educational Publishing (), Report: Adopting AI could prevent $77 billion of unpaid teacher overtime, 12-11-2023, K-12 Dive, https://www.k12dive.com/press-release/20231211-report-adopting-ai-could-prevent-77-billion-of-unpaid-teacher-overtime/] accessed 2-18-2025 // bellaire FL

NEW YORK CITY, N.Y. — A new report has revealed that U.S. teachers work a combined 1.75 billion hours of overtime every year - equivalent to $84 billion in unpaid hours - but that the support offered by AI tools could shrink that figure by over 85 percent. According to the analysis published by educational publisher Twinkl, U.S. teachers work an average of 15.1 hours a week above what they're contracted to work - but are exempt from receiving overtime pay under current Department of Labor regulations. The findings reference 2023 data from the Department of Education, which suggests teachers could each regain as many as 13 hours a week by embracing AI tools. The repercussions of high work hours for America's 3.2 million teachers have severely impacted teacher turnover, which has experienced highs over the past three years. During the 2021-2022 school year, national turnover rates reached 10%, while in some of the most underserved

schools, teacher turnover exceeded 16 percent. "The numbers speak for themselves. **Teachers are leaving** the profession **in unprecedented numbers, and unpaid overtime is a major** contributing **factor**," said Jude Schroeder, ex-teacher and now U.S. Manager at Twinkl. "Teachers will always be crucial, and AI will never replace the essential element of face-to-face instruction, but there are so many ways in which AI can help make teaching **a more sustainable and rewarding career**." These saved hours, the report says, are from saved time completing non-teaching activities such as lesson planning, grading papers, and reporting data. "It's not about taking teachers out of the classroom, but rather empowering them within the classroom. Teachers spend so much time completing administrative tasks that less and less energy is left for actual in-class teaching. AI is fantastic for eliminating the time-draining aspects of teaching, which are causing teacher burnout and, ultimately, driving them out of the profession," added Schroeder. Several AI-powered tools supporting educators have been released in recent months by EdTech organizations aiming to create teaching efficiency. These tools save time and allow educators to tailor materials to individual skill levels, which is especially critical as educators work to address gaps in students' knowledge caused by pandemic disruptions. Twinkl offers a teacher report writer tool that generates student report cards based on raw performance information and a personal AI teaching assistant, "Ari," which can create adapted lesson materials aligned with curriculum standards and differentiated to meet the needs of all learners.

Iowa University 24 (August 27, 2024 08, "The role of AI in modern education", University of Iowa, 8-27-2024, https://onlineprograms.education.uiowa.edu/blog/role-of-ai-in-modern-education // DOA 3-27-2025 // [sai]

Traditional grading for written work often involves subjectivity and biases, as teachers' evaluations **can be** influenced by personal preferences, moods, and unconscious prejudices. This lack of objectivity can result in inconsistent and unfair assessments. Additionally, the **time-consuming** nature of grading large numbers of assignments **limits teachers' capacity to provide thorough feedback**, potentially **hindering student learning**.[7]Integrating **AI** into the grading process is **revolutionizing traditional approaches** to evaluating student performance. AI can **enhance grading efficiency, precision, and fairness** by **significantly reducing** grading **time** and **providing instant**, detailed **feedback**. This allows teachers to assign more writing tasks and offer timely, constructive feedback, which fosters better writing skills in students.However, it's essential that **teachers** critically **review** AI-generated **feedback** to ensure it aligns with educational goals and addresses individual student needs. AI tools should be seen as **assistants rather than replacements**, helping **teachers focus on** assessing **creativity and critical** thinking while **AI assists** teachers with **more objective metrics** like **grammar** and **structure**. By staying engaged in the grading process and spot-checking **AI** output, teachers can maintain the integrity of assessments and ensure students receive meaningful and accurate feedback.[8]Administrative applicationsArtificial intelligence **tools** can **streamline lesson planning and content creation**, saving teachers valuable time. These AI tools can generate high-quality images, customized content, and focused research materials under tight time constraints. By using AI for efficient research and content generation, **teachers can enhance** lesson **quality without increasing** their **workload**, ultimately **benefiting** both students and **resource-constrained schools**.[10]

Reading Readiness Centers, xx-xx-xxxx, "How Teacher Burnout Affects Student Outcomes: Understanding the Impact," https://www.readingreadiness.org/how-teacher-burnout-affects-student-outcomes-understanding-the-impact/ , accessed 3-4-2025 //Blvu ZS

Introduction: Understanding Teacher Burnout Teachers are an integral part of our education system, but the job can be demanding and overwhelming. Many teachers experience burnout, which can negatively affect both their well-being and their students' outcomes. In this article, we will explore the correlation between teacher burnout and student outcomes.

The Correlation Between Teacher Burnout and Student Outcomes

Research has shown that teacher burnout is linked to lower student achievement and higher dropout rates. A study by the University of British Columbia found **that students of burned-out teachers had lower scores on standardized tests** and were less likely to pursue higher education. Teachers who experience burnout may have lower levels of engagement, patience, and creativity, which can have a negative impact on their students.

Effects of Teacher Burnout on Student Academic Performance When teachers are burned out, it **can lead to decreased motivation and lack of enthusiasm for teaching.** This can translate into lower student engagement and participation. Burned-out teachers may struggle to manage their classroom, leading to disciplinary problems and disruptions that can further undermine student learning. Additionally, teachers experiencing burnout may not have the energy to provide individualized attention or to go the extra mile to support their students' success. The impact of teacher burnout on student outcomes Reading Readiness **The Long-Term Impact of Teacher Burnout on Student Success** The effects of teacher burnout can be long-lasting. **Students who are taught by burned-out teachers are less likely to graduate from high school and pursue higher education.** This can have a significant impact on their future opportunities and success. Furthermore, **the** negative effects of teacher burnout can be passed down to future generations, as students who experience poor outcomes may be less likely to value education or to become engaged citizens. **Addressing Teacher Burnout** Preventing and addressing teacher burnout is crucial for

the well-being of teachers and the success of their students. Some strategies that can help include providing professional development opportunities, creating a supportive school culture, and encouraging work-life balance. It is important for school administrators to prioritize the well-being of their teachers and to provide them with the necessary resources to manage stress and avoid burnout. **Become a Franchisee** At Reading Readiness, we understand the importance of teacher well-being in promoting student success. We provide our franchisees with the tools and resources necessary to create a supportive and engaging school culture that benefits both teachers and students. As a franchisee, you will have access to our proven curriculum and ongoing support to help you manage stress and prevent burnout. Join our community of educators and make a positive impact on the lives of your students. Visit our website to learn more about becoming a franchisee. **Conclusion** Teacher burnout is a critical issue that affects not only teachers but also their students. Burned-out teachers can have a negative impact on student engagement, academic performance, and long-term success. It is essential for school administrators to prioritize

teacher well-being and provide them with the necessary resources to avoid burnout. By taking action to address teacher burnout, we can create a more supportive and engaging learning environment for our students.

DoSomething.org, 2-18-2015, "11 Facts About High School Dropout Rates," https://dosomething.org/article/11-facts-about-high-school-dropout-rates, accessed 3-4-2025 //Blvu ZS

Every year, over 1.2 million students drop out of high school in the United States alone. That's a student every 26 seconds – or 7,000 a day.^[Miller, Tony. "Partnering for Education Reform." U.S. Department of Education. Accessed February 18, 2015. .]

Web Administrator, xx-xx-xxxx, "Facts About High School Dropout Rates in the U.S.," High School of America - High School Diploma Online | Online High School and Homeschool Curriculum, https://www.highschoolofamerica.com/15-facts-about-high-school-dropout-rates/ , accessed 3-4-2025 //Blvu ZS

High school dropouts are more likely to live in poverty than high school graduates. **In 2021, the poverty rate for high school dropouts was 27%, while the poverty rate for high school graduates was just 16%.**

The poverty rate for college graduates was even lower, at 10%. High school dropouts often have difficulty finding good jobs and supporting themselves, which can lead to them living in poverty.

Definition of Research.

Cambridge Dictionary [Cambridge Dictionary, "Meaning of education in English", Cambridge Dictionary, https://dictionary.cambridge.org/us/dictionary/english/education]

the process of teaching or learning, especially in a school or college, or the knowledge that you get from this: receive an education *As a child he received most of his education at home. It's a country that places great importance on education. She lectures in education (= the study of education) at the teacher training college. It's important for children to get a good education.*

Research key to education.

Rosowsky 22 [David Rosowsky, "The Role Of Research At Universities: Why It Matters", 2022, Forbes, https://www.forbes.com/sites/davidrosowsky/2022/03/02/the-role-of-research-at-universities-why-it-matters/]

Universities engage in research as part of their missions around learning and discovery. This, in turn, **contributes directly and indirectly to their primary mission of teaching**. Universities and many colleges (the exception being those dedicated exclusively to undergraduate teaching) have as part of their mission the pursuit of scholarship. This can come in the form of fundamental or applied research (both are most common in the STEM fields, broadly defined), research-based scholarship or what often is called "scholarly activity" (most common in the social sciences and humanities), or creative activity (most common in the arts).

AI has become crucial to research

Oxford University Press [Oxford University Press, "Researchers and AI Survey Findings", Oxford, https://fdslive.oup.com/www.oup.com/academic/pdf/Researchers-and-AI-survey-findings.pdf]

Just over three-quarters (**76%) of researchers report using some form of AI tool in their research at present.** Machine translation (49%) and chatbot tools (43%) are the most popular, followed by AI-powered search engines or research tools (25%).

Especifically, in the medical field.

M. Currie 25 [Geoffrey M. Currie, "Generative Artificial Intelligence in Nuclear Medicine Education", February 2025, Journal of Nuclear Medicine Technology, https://tech.snmjournals.org/content/early/2025/02/05/jnmt.124.268323#sec-2]

Generative artificial intelligence (**genAI**) **has become assimilated into the education, research,** and clinical **domains** of nuclear medicine and **health care**. Understanding the principles, limitations, and applications of genAI is important for capitalizing on its transformative potential in student education and impact on sustainability within both the education and the clinical sectors. In this article, the fundamental principles and applications of artificial intelligence are explored from the context of nuclear medicine. GenAI technologies are defined and capabilities outlined. A detailed investigation of the potential and limitations of both text-to-text and text-to-image genAI based in empiric and anecdotal research is provided. Specific examples of applications of text-to-text and text-to-image genAI are provided. GenAI has the potential to reinvigorate nuclear medicine education by supporting and enriching student learning and to be transformative in nuclear medicine education, but at the time of writing, both text-to-text and text-to-image genAI are far from revolutionary. Nonetheless, the horizon promises transformative education applications of genAI. GenAI can enhance nuclear medicine education and student learning and provide economies to improve sustainability in the education and clinical sectors. Although there are some limitations to current capabilities, this rapidly evolving space will soon offer potential benefits to education.

AI accelerates Medical Research

A James 23 [Ted A James, "How Artificial Intelligence is Disrupting Medicine and What it Means for Physicians", April 2023, Harvard Medical School, https://postgraduateeducation.hms.harvard.edu/trends-medicine/how-artificial-intelligence-disrupting-medicine-what-means-physicians]

Artificial Intelligence (**AI**) **has the potential to transform health care and disrupt the field of medicine in significant ways.** It has shown remarkable progress in tasks such as diagnostics, data analysis, and precision medicine and is already being applied in areas ranging from patient triage to cancer detection.

However, the recent availability of AI to the public, including language models like ChatGPT, has increased the awareness of AI and its potential capabilities in medicine. The continued growth of AI has spurred interest and debate concerning its broader use in patient care.

ChatGPT successfully passed the USMLE and can solve internal medicine case files, indicating its versatility and potential for future clinical applications. In fact, Google and DeepMind developed the Med-PaLM language model trained on several existing medical Q&A datasets to offer "safe and helpful answers" to questions posed by health care professionals and patients.

Language models, like ChatGPT and Med-PaLM, generate responses in a conversational manner to written statements, referred to as prompts, entered by users in a chat window. This is achieved without the need for coding, as the models utilize their training and data to generate contextually relevant responses.

In the near future, physicians may leverage medical-grade AI language models for consultations, receiving valuable insights and assistance in various aspects of patient care. We may even see prompts like the following become commonplace in health care:

> Provide advice on the diagnosis and treatment for these symptoms.
>
> Create a personalized treatment plan based on the patient's age and lifestyle.
>
> Analyze this X-ray to detect abnormalities.
>
> Identify risk factors from this patient's EHR.
>
> Write a letter explaining the medical necessity of this treatment.

By leveraging these powerful tools, doctors can improve the quality of care while saving time on tasks that can be automated with AI. With further development and refinement, AI technology could play an important role in enhancing the standard of care.

Physician-Machine Collaboration in Medicine

There is speculation about AI eventually replacing physicians, particularly in fields like radiology, pathology, and dermatology, where AI's diagnostic ability can match or even exceed that of clinicians. However, research suggests that physician-machine collaborations will outperform either one alone.

It's unlikely that AI will completely replace physicians anytime soon. The human aspects of care, including empathy, compassion, critical thinking, and complex decision-making, are invaluable in providing holistic patient care beyond diagnosis and treatment decisions.

I often ask participants in our digital transformation course if they would choose to have a serious medical diagnosis delivered by an AI trained to provide textbook empathy. Most participants would prefer to hear the news from a human doctor.

So, rather than fully replacing physicians, AI will likely empower the practice of medicine, with physicians leveraging the technology to enhance clinical care. To this point, the American Medical Association recommends that technology be used to augment, rather than replace, human intelligence.

AI also has the potential to address physician burnout by automating repetitive and monotonous administrative tasks, allowing physicians to focus on patient care. Moreover, AI could play a valuable role in improving access to care and addressing clinician workforce shortages.

As AI advances, physicians may be relied upon for higher-level decision-making, patient interaction, and interdisciplinary collaboration while working alongside AI systems.

Considerations of AI in Health Care

Despite the potential benefits of AI in health care, there are significant safety, privacy, reliability, and ethical considerations. Furthermore, without appropriate precautions, AI may perpetuate inherent biases in diagnosis and treatment.

Physicians will likely continue to play a critical role in ensuring that the ethical and moral implications of medical decisions are carefully considered and that patients receive the highest quality of care.

To achieve this, physicians must be prepared to take on new roles and responsibilities in the era of AI, including expanded opportunities in medical informatics. Physicians can also guide patients on how to use AI to obtain reliable health information and receive appropriate care.

Enhancing Medicine with AI

AI has the potential to transform health care for the better. It's a powerful tool that can lead to better patient outcomes when complemented with physician expertise. AI can also facilitate scientific discovery and breakthroughs in disease prevention and treatment through vast data analytics.

Integrating AI into routine clinical practice will require careful validation, training, and ongoing monitoring to ensure its accuracy, safety, and effectiveness in supporting physicians to deliver care.

While AI can be a valuable asset in the medical field, it cannot replace the human element. However, AI can and should be used to enhance the practice of medicine, empowering doctors with the latest technological tools to serve our patients better.

AI helped solve iMCD

University of Pennsylvania School of Medicine 25 [University o, "AI tool helps find life-saving medicine for rare disease", February 5 2025, Science Daily, https://www.educationevolving.org/files/Whitehead-AimsOfEducation.pdf]

After combing through 4,000 existing medications, an artificial intelligence tool helped uncover one that saved the life of a patient with idiopathic multicentric Castleman's disease (iMCD). This rare disease has an especially poor survival rate and few treatment options. The patient could be the first of many to have their lives saved by an AI prediction system, which could potentially apply to other rare conditions. Detailed in a new paper published in NEJM, a group led by researchers at the Perelman School of Medicine at the University of Pennsylvania used an AI technique called machine learning to determine that adalimumab -- a monoclonal antibody which is FDA-approved to treat conditions ranging from arthritis to Crohn's disease -- was the "top-predicted" new treatment that was likely to work for iMCD.

AI helped to generate strongest bioprotein ever

Medicine 23 [UW Medicine, "AI generates proteins with exceptional binding strengths", December 18 2023, Newsroom, https://newsroom.uw.edu/news-releases/ai-generates-proteins-with-exceptional-binding-strengths]

A new study Dec. 18 in Nature reports an AI-driven advance in biotechnology with implications for drug development, disease detection, and environmental monitoring. Scientists at the Institute for Protein Design at the University of Washington School of Medicine used software to create protein molecules that bind with exceptionally high affinity and specificity to a variety of challenging biomarkers, including human hormones. Notably, the scientists achieved the highest interaction strength ever reported between a computer-generated biomolecule and its target. Senior author David Baker, professor of biochemistry at UW Medicine, Howard Hughes Medical Institute investigator, and recipient of the 2023 Frontiers of Knowledge Award in Biology and Biomedicine, emphasizes the potential impact: "The ability to generate novel proteins with such high binding affinity and specificity opens up a world of possibilities, from new disease treatments to advanced diagnostics." The team, led by Baker Lab members Susana Vazquez-Torres, Preetham Venkatesh, and Phil Leung, set out to create proteins that could bind to glucagon, neuropeptide Y, parathyroid hormone, and other helical peptide targets. Such molecules, crucial in biological systems, are especially difficult for drugs and diagnostic tools to recognize because they often lack stable molecular structures. Antibodies can be used to detect some of these medically relevant targets but are often costly to produce and have limited shelf lives. "There are many diseases that are difficult to treat today simply because it is so challenging to detect certain molecules in the body. As tools for diagnosis, designed proteins may offer a more cost-effective alternative to antibodies," Venkatesh explained. The study introduces a novel protein design approach that uses advanced deep-learning methods. The researchers present a new way of using RFdiffusion, a generative model for creating new protein shapes, in conjunction with the sequence-design tool ProteinMPNN. Developed in the Baker Lab, these programs allow scientists to create functional proteins more efficiently than ever before. By combining these tools in new ways, the team generated binding proteins by using limited target information, such as a peptide's amino acid sequence alone. The broad implications of this "build to fit" approach suggest a new era in biotechnology in which AI-generated proteins detect complex molecules relevant to human health and the environment. "We're witnessing an exciting era in protein design, where advanced artificial intelligence tools, like the ones featured in our study, are accelerating the improvement of protein activity. This breakthrough is set to redefine the landscape of biotechnology," Vazquez-Torres noted. In collaboration with the Joseph Rogers Lab at the University of Copenhagen and the Andrew Hoofnagle Lab at UW Medicine, the team conducted laboratory tests to validate their biodesign methods. Mass spectrometry was used to detect designed proteins that bind to low-concentration peptides in human serum, thereby demonstrating the potential for sensitive and accurate disease diagnostics. Additionally, the proteins were found to retain their target binding abilities despite harsh conditions including high heat, a crucial attribute for real-world application. Further showcasing the method's potential, the researchers integrated a high-affinity parathyroid hormone binder into a biosensor system and achieved a 21-fold increase in bioluminescence signal in samples that contained the target hormone. This integration into a diagnostic device highlights the immediate practical applications of AI-generated proteins. The study, which illustrates the confluence of biotechnology and artificial intelligence and sets a new precedent in both fields, appears in Nature under the title “De novo design of high-affinity binders of bioactive helical peptides.” This work was supported by the National Institutes of Health (T1D U01 DK121289, U19 AG065156, K99EB031913, P30 GM124165), National Science Foundation (EF-2021552), Department of Energy (BER-ERCAP0022018; DE-AC02-06CH11357), European

Molecular Biology Organization (ALTF 292-2022), Washington State General Operating Fund, Amgen, Audacious Project, AWS, Bill and Melinda Gates Foundation (INV-010680), Donald and Jo Anne Petersen, Howard Hughes Medical Institute, Microsoft, Novo Nordisk Foundation (NNF19OC0054441), Open Philanthropy Project, and Partnership for Clean Competition.

Impacts are tangible and life saving

AI crucial to MIT research

Trafton 23 [Anne Trafton, "Using AI, scientists find a drug that could combat drug-resistant infections", May 2023, MIT News, https://news.mit.edu/2023/using-ai-scientists-combat-drug-resistant-infections-0525]

Using an **artificial intelligence** algorithm, **researchers at MIT** and McMaster University **have identified a new antibiotic that can kill a type of bacteria that is responsible for many drug-resistant infections.**

If developed for use in patients, **the drug could help to combat *Acinetobacter baumannii***, a species of bacteria that is often found in hospitals and can lead to pneumonia, meningitis, and other serious infections. The microbe is also a leading cause of infections in wounded soldiers in Iraq and Afghanistan.

Acinetobacter baumannii very deadly.

Cornejo-Juárez 20 [Patricia Cornejo-Juárez, "High mortality in an outbreak of multidrug resistant Acinetobacter baumannii infection introduced to an oncological hospital by a patient transferred from a general hospital", July 2020, PLOS One, https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0234684#sec010]

Acinetobacter baumannii has become a major hospital pathogen, due to multidrug resistant (MDR) strains and it is now considered one of the six most important microorganisms that causes hospital-acquired infections worldwide, with **attributable mortality ranging from 8% to 35%** according to strain and type of infection as well as increase in hospital stays and health care expenditures [1,2]. Bloodstream infection (BSI) and pneumonia, especially ventilator-associated pneumonia (VAP), are the most severe infections caused by this gram-negative bacterium [3,4].

AI empirically increases research productivity

Lahart 24 [Justin Lahart, "Will AI Help or Hurt Workers? One 26-Year-Old Found an Unexpected Answer.", December 2024, WSJ, https://www.wsj.com/economy/will-ai-help-hurt-workers-income-productivity-5928a389?utm_source=chatgpt.com]

What Toner-Rodgers found was striking: **After the tool was implemented, researchers discovered 44% more materials, their patent filings rose by 39% and there was a 17% increase in new product prototypes.** Contrary to concerns that using AI for scientific research might lead to a "streetlight effect"—hitting on the most obvious solutions rather than the best ones—there were more novel compounds than what the scientists discovered before using AI.

Toner-Rodgers was a bit surprised himself. He had thought at best it would have just kept up with the scientists on novel discoveries. "You could have come up with a bunch of lame materials that are not actually helpful," he said.

AI empirically increases research citation

Gao 23 [Jian Gao, "Quantifying the Benefit of Artificial Intelligence for Scientific Research", April 2023, ARXIV, https://arxiv.org/abs/2304.10578?utm_source=chatgpt.com]

The ongoing artificial intelligence (AI) revolution has the potential to change almost every line of work. As AI capabilities continue to improve in accuracy, robustness, and reach, AI may outperform and even replace human experts across many valuable tasks. Despite enormous effort devoted to understanding the impact of AI on labor and the economy and AI's recent successes in accelerating scientific discovery and progress, we lack a systematic understanding of how AI advances may benefit scientific research across disciplines and fields. Here, drawing from the literature on the future of work and the science of science, we develop a measurement framework to estimate both the direct use of AI and the potential benefit of AI in scientific research, a**pplying natural language processing techniques to 74.6 million publications and 7.1 million patents**. We find that the use of AI in research is widespread throughout the sciences, growing especially rapidly since 2015, and **papers that use AI exhibit a citation premium, more likely to be highly cited both within and outside their disciplines.** Moreover, our analysis reveals considerable potential for AI to benefit numerous scientific fields, yet a notable disconnect exists between AI education and its research applications, highlighting a mismatch between the supply of AI expertise and its demand in research. Lastly, we examine demographic disparities in AI's benefits across scientific disciplines and find that disciplines with a higher proportion of women or Black scientists tend to be associated with less benefit, suggesting that AI's growing impact on research may further exacerbate existing inequalities in science. As the connection between AI and scientific research deepens, our findings may become increasingly important, with implications for the equity and sustainability of the research enterprise.