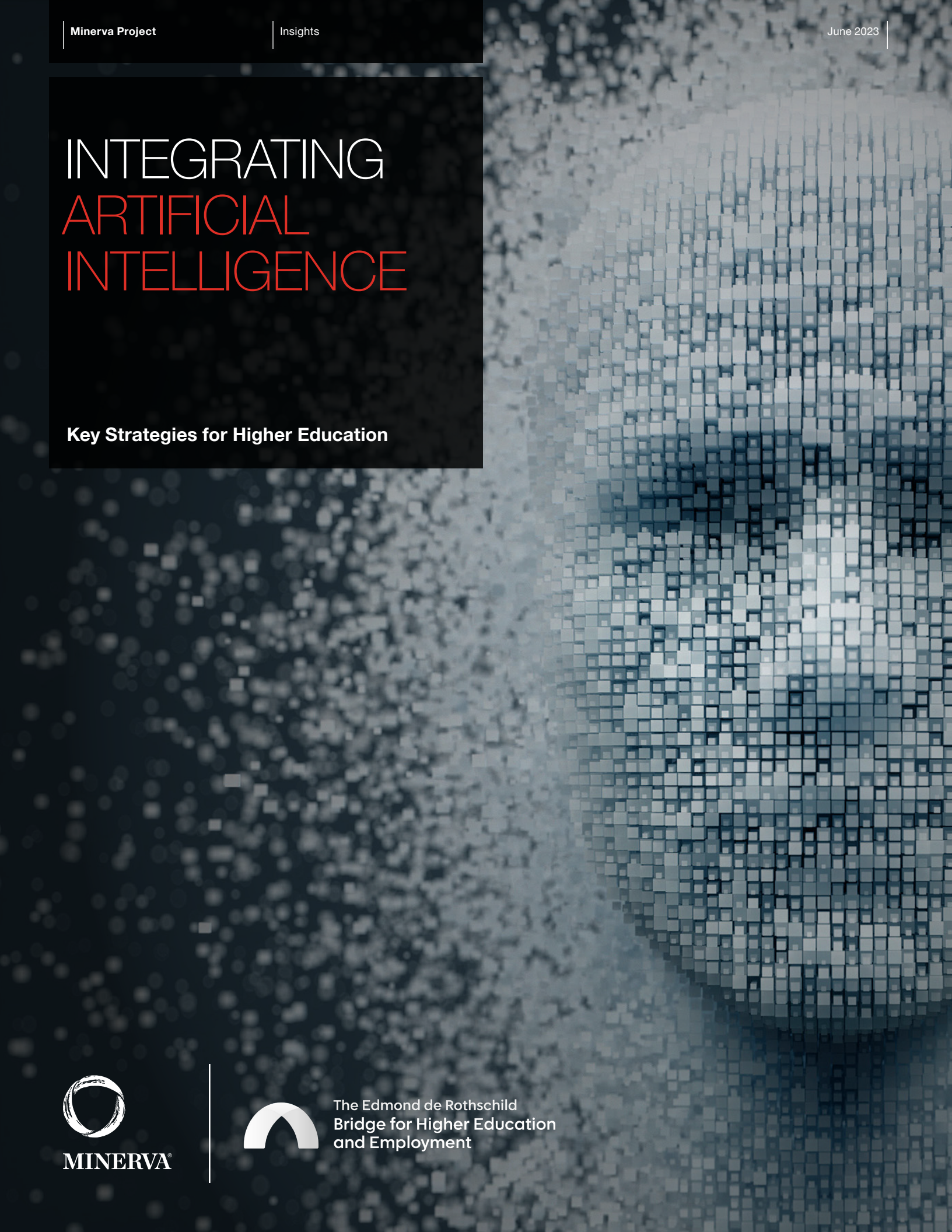
INTEGRATING ARTIFICIAL INTELLIGENCE

Key Strategies for Higher Education



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The Edmond de Rothschild
Bridge for Higher Education
and Employment

Executive Summary

The emergence of generative AI has already begun to have a profound impact on higher education. We explain the potentially far-reaching influence of this technology and recommend **ways in which AI adoption can allow faculty and institutions to rethink their approach to teaching and learning,** as well as how they provide students with durable skills. Ultimately, we argue that universities that integrate AI into their curricula, rather than trying to ban or police its use, will better prepare students for a world in which AI is commonplace.

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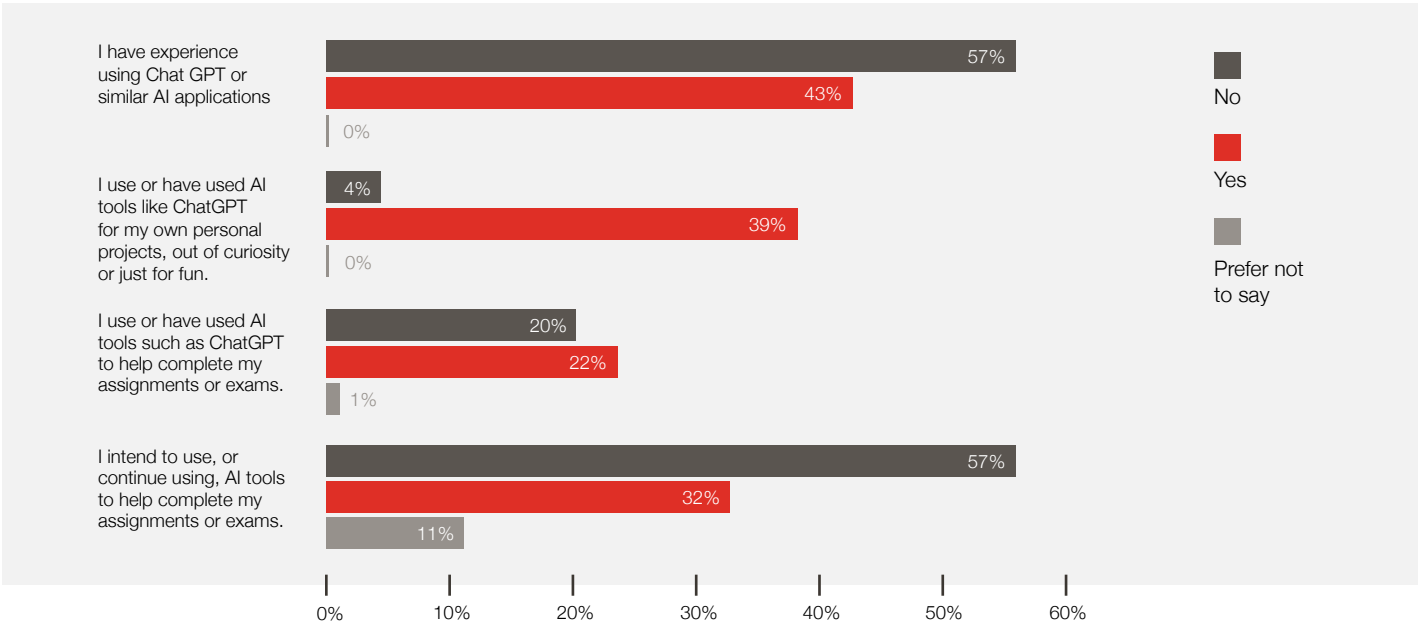
The Emergence of Generative AI

During the past two years, a new ecosystem of artificial intelligence systems has emerged: from music to visual art, writing, coding, and problem-solving, these systems can create original work that rivals that of a skilled human practitioner. These technologies, collectively known as "generative AI," have begun to impact the world of higher education. ChatGPT, the most familiar of these new systems, is already prompting a reconsideration of traditional teaching and learning practices.

Just as computers fundamentally altered the nature of scientific modeling and prediction, and the internet made vast amounts of information readily available to researchers, these new AI models are changing how we produce all forms of creative output and, therefore, what we must teach and expect of students. While many experts have weighed in on these developments and their implications for education, few have moved beyond concerns about academic integrity and whether to ban or police generative AI to prevent plagiarism and cheating.

We recommend a different approach, grounded in the belief that engaging with and integrating generative AI is critical for universities. Students are already using these tools in large numbers (see chart below), and in a recent survey, 74% of current student

College Students' Use of AI Tools



BestColleges survey of 1,000 current undergraduate and graduate students in March 2023: https://www.bestcolleges.com/research/college-students-ai-tools-survey/

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users report being at least somewhat likely to use them in the future, *even if prohibited by their institution.*

Faculty and administrative staff have adopted these tools as well, and new AI software applications relevant to teaching and learning are being released nearly every week. Many existing and new education technology products will include AI features within 6–12 months. These developments put increasing pressure on an already fragile higher education ecosystem that is contending with runaway costs, the pervasive skills gap, growing doubts about the value of degrees, and an impending demographic cliff. While generative AI has the potential to compound these challenges, it also provides an opportunity for universities to make changes that will increase their relevance and sustainability.

We believe that university leaders should intentionally plan for and make use of generative AI to improve the quality of learning at their institutions. Moreover, universities must teach students the skills they will need to thrive when AI is widely adopted in professional settings. To do so, leaders will need to understand the differences between these new AI systems and previous models, recognize the potentially far-reaching impacts of the technology, and consider ways in which AI adoption can allow faculty and institutions to rethink how they approach teaching and learning.

In what follows, we offer leaders a set of recommendations for meeting this moment. We begin by highlighting why emerging AI tools differ from what has come before. We then explore the

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emerging impacts of AI on education and argue that attempts to ban or police these tools are misguided. Although understandable, these efforts fail to recognize AI's pervasiveness and rapid adoption, the difficulties involved in detecting its output, and the significant costs associated with trying to prevent its use. We believe that leaders will better serve their faculty and students by evolving in the face of these changes. Doing so requires that they intentionally enhance their teaching, learning, and assessment practices by drawing on this growing suite of AI tools to become an **AI-integrated institution**.

Making this transition requires that leaders:

01

develop an institutional strategy and commit resources to building awareness among faculty, staff, and students on the strengths and weaknesses of generative AI tools, as well as guidelines on how, when, and why they should be used;

02

evolve teaching and assessment practices in ways that draw on learning science, and which may be enhanced by AI tools; and

03

identify ways to equip students with durable skills that are in high demand from employers, and which enable graduates to perform tasks and adopt responsibilities that cannot be left in the hands of AI systems.

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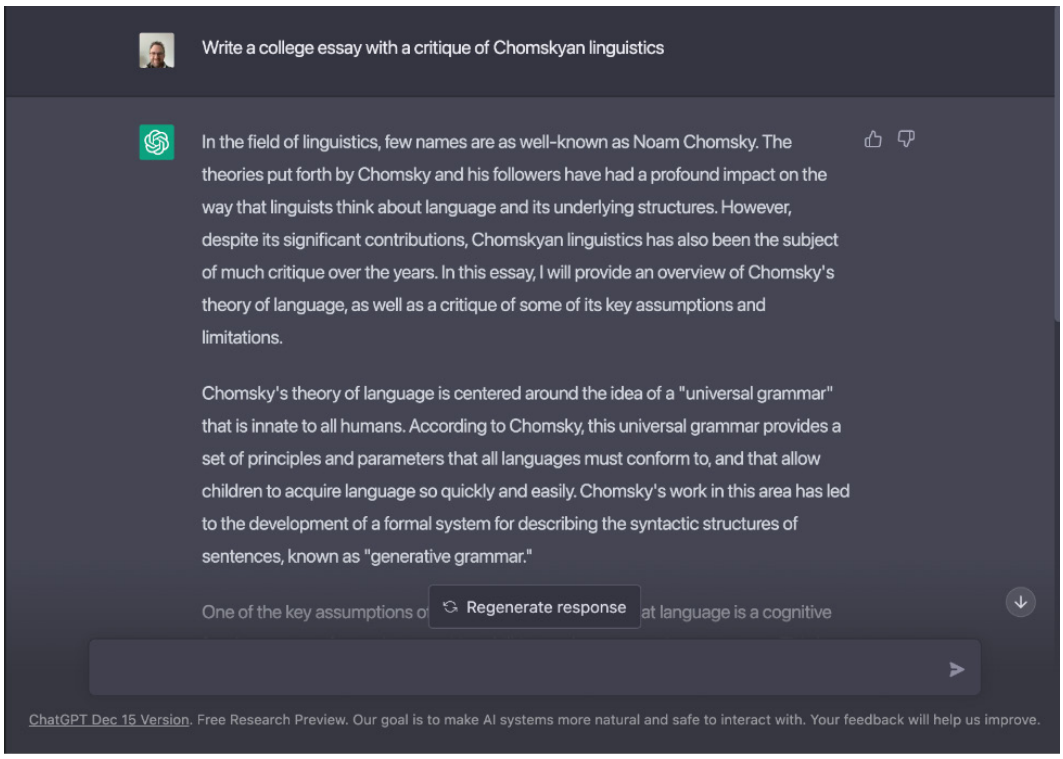
Why Generative AI is Different

Until recently, the progress of AI applications for education has been incremental, not game-changing. For example, previous AI-based chatbots provided value by conveniently answering frequently asked student questions. While these chatbots improved considerably over the years, their impact was limited because they could only answer by selecting the most appropriate pre-programmed responses to common inquiries.

Generative AI models are fundamentally different. They produce original content in response to whatever the user asks. Rather than relying on canned responses, these systems are trained on enormous data sets, including Wikipedia and vast numbers of full-text books. ChatGPT, released by OpenAI in December 2022, has attracted widespread attention for its ability to answer questions and generate prose with surprising creativity and fluency. For example, you can ask the model, "Write a college essay with a critique of Chomskyan linguistics," and watch it being written live, word by word.



Output of ChatGPT generated using https://chat.openai.com/chat.

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The rapid pace of developments in this area is such that GPT-3.5, the model behind ChatGPT, has already been replaced by a successor, GPT-4, and is now just one tool in a much broader ecosystem of AI tools, many of which draw upon OpenAI's base models or those of competitors like Anthropic. Today, students have access to many other AI tools that allow them to effortlessly transform a single sentence into photo-realistic images (Midjourney), videos (Synthesia), software code (GitHub CoPilot), or musical compositions (MusicLM) comparable to those of experienced artists and practitioners. In addition, a growing number of plugins are emerging for GPT4 and other tools that allow them to access real-time information online. Others, such as Code Interpreter, enhance the capabilities of these tools even further, allowing them to perform tasks that previous versions could not, such as analyzing and visualizing data, extracting text from images, and editing videos.

These advances in AI also bring new and important dangers and limitations that can't be ignored. To begin with, ownership of the data used to train generative AI models is a cause for concern. Artists have objected that their works have been used to train generative models without their permission in ways that threaten their livelihoods. Companies such as Apple have instructed their employees not to use generative models over fears about data security. Copyright and intellectual property rights will continue to be a subject of debate among creators, AI companies, and the legal community. The legal sphere is also dealing with additional concerns, including inaccuracy and AI-produced filings that are so large and dense that they could bring proceedings to a standstill.

More concerningly, generative AI models can produce harmful, toxic, and offensive output and reproduce stereotypes and conspiracy theories found on the internet. They can also make up misleading or completely false responses with no basis in fact. In one case, the scientific community has been threatened by an influx of fake research. They don't rely on a verified base of information (for example, Reddit forum posts can make up part of their training data), but they write sufficiently convincing prose that it sometimes takes a discerning eye to identify errors or falsehoods. In addition, they can make basic math and reasoning errors, in part because they are not designed to perform computations or make logical inferences but rather to assemble plausible-sounding responses based on their training data.

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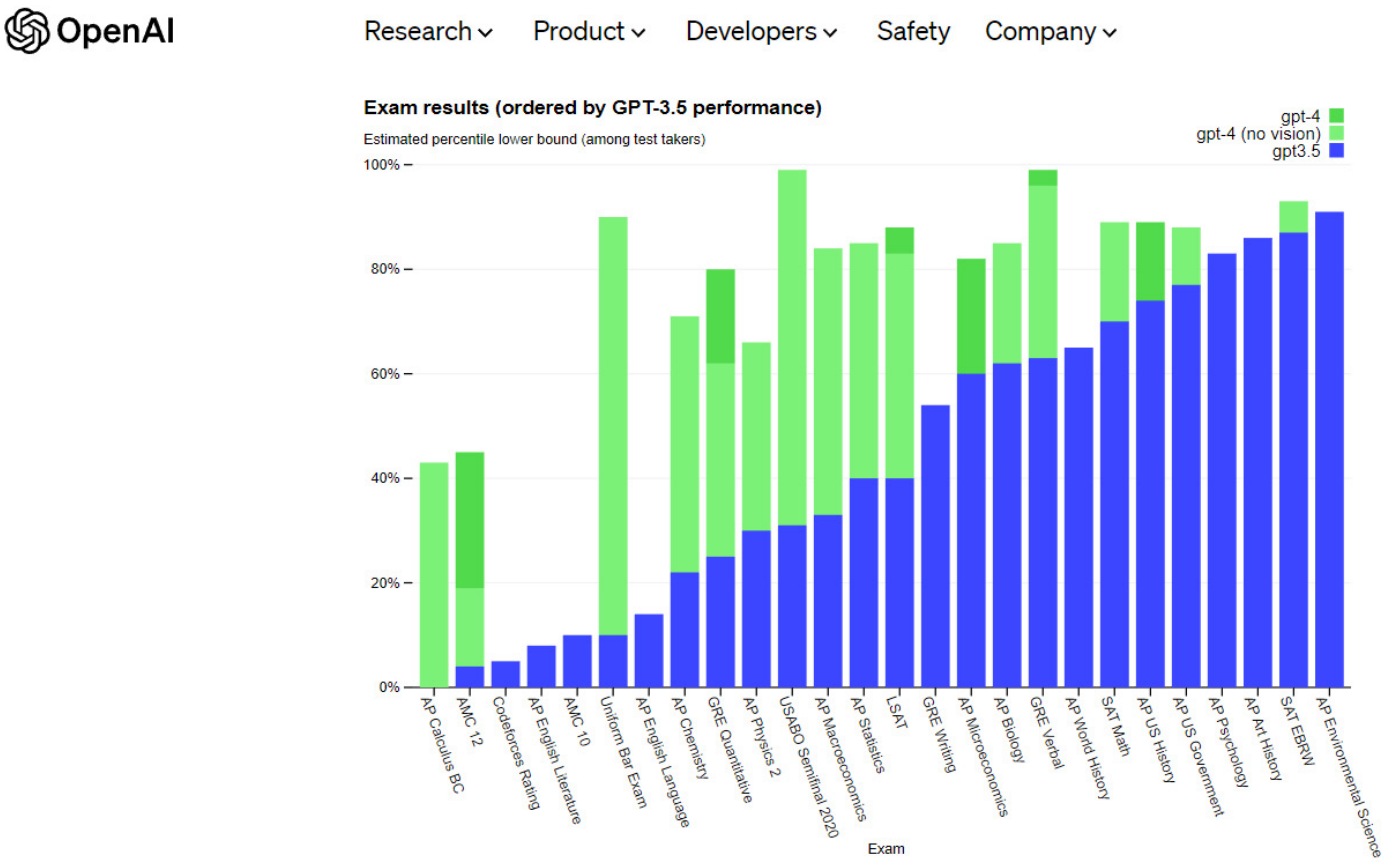
Over time, most of the limitations of generative AI will likely be overcome by performance improvements driven by researchers and developers who are concerned about these problems. We have already seen substantial performance improvements between models that have appeared in close succession, with GPT-4 significantly outperforming GPT-3.5 on a variety of standardized tests. In the meantime, users must be mindful of these and other limitations, and learn to evaluate the output of AI tools with increasing nuance and sophistication as they improve.



Comparison of exam performance of ChatGPT (GPT-3.5) vs. GPT-4 in multiple academic domains. Reproduced from openai.com.

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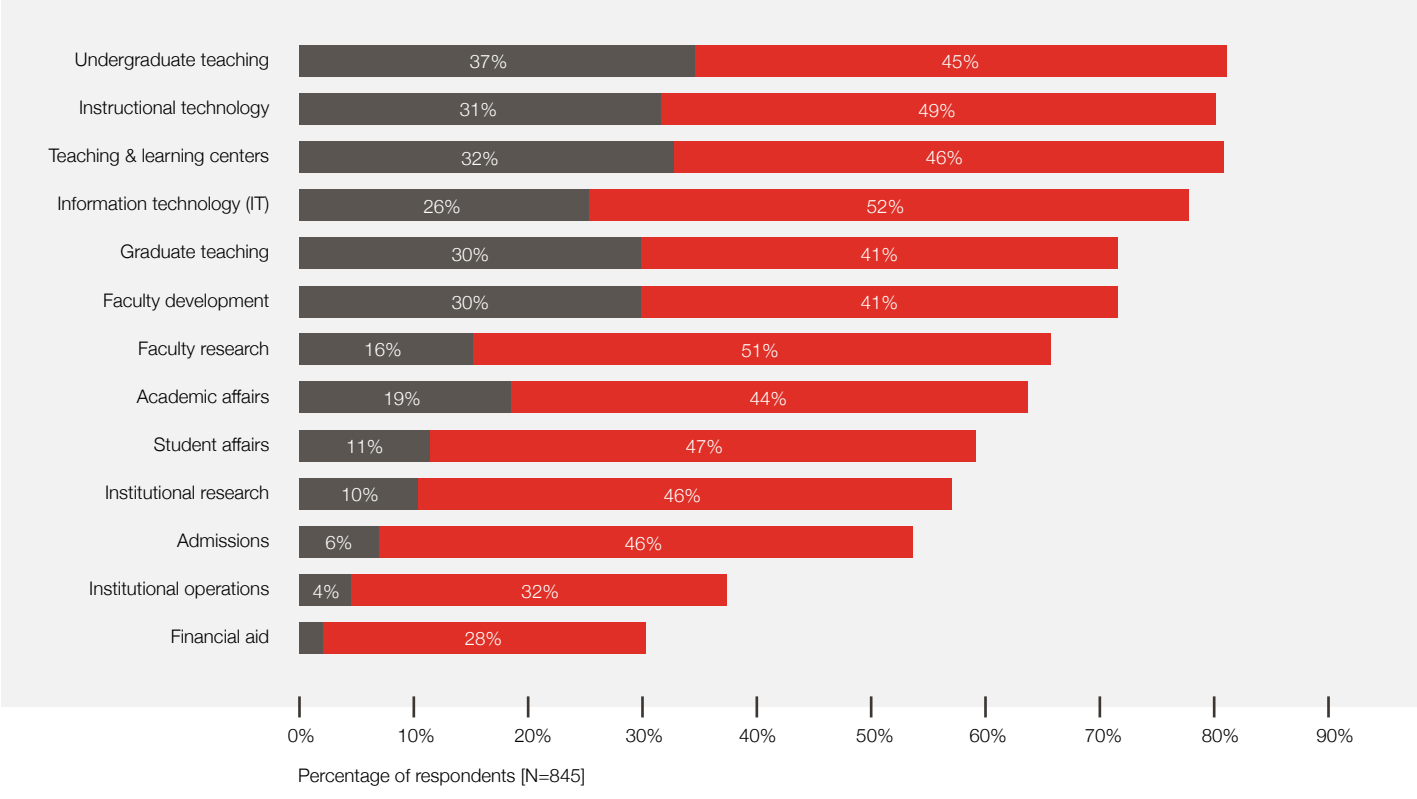
Impacts of Generative AI on Higher Education

Generative AI is already reshaping the higher education landscape. Numerous applications leveraging the technology have recently emerged, and many more are in development. These tools will be used by administrators, faculty, and students alike, transforming how they work and bringing both benefits and risks.

For **administrative staff,** generative AI may help scale academic support and student services via automation, increasing the quantity and range of support institutions can offer their students. Yet these very same applications risk depersonalizing students' interactions with university staff, which are crucial for many

Institutional areas that are currently being impacted or will likely be impacted by generative AI



EDUCAUSE survey of 1070 higher education administrators, faculty, and staff on the impacts of generative AI: https://er.educause.edu/articles/2023/2/educause-quickpoll-results-did-chatgpt-write-this-report

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students' success. Likewise, while using generative AI to evaluate applicants may make the work of admissions departments more efficient, it also raises the risk of biased decisions that disadvantage specific groups.

Faculty can use generative AI tools to assist with research, develop curricula, and assess student work. Doing so offers the possibility of reducing some of the more repetitive and labor-intensive aspects of academic work, such as formatting indexes and bibliographies, creating large numbers of assessment items, or providing feedback on common student mistakes. While teachers may initially adopt these new tools to support their labor, over time, the role of humans may focus on approving AI-generated output, and eventually, the machines may become more reliable than humans. Given that students will also use generative AI to assist with producing their work, the absurd spectacle of instructors using AI assessment tools to grade essays that students draft using AI writing assistants could become a reality.

Image made using https://www.midjourney.com.

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Generative AI also holds both promise and risks for **students.** It can serve as a personalized learning co-pilot, such as Khan Academy's AI tutor, Khanmigo, adapting content and methods to meet students' current readiness levels and supporting their learning when a teacher is unavailable. It can function as a Socratic discussion partner, help students summarize information, begin drafts, generate ideas, and test themselves. These applications have the potential to significantly improve learning, given the evidence that individualized tutoring is considerably more effective than group instruction. However, when used mindlessly, without the student's intellectual contribution, these tools can severely undermine intellectual growth. The ease with which they can be prompted to complete pre-class homework, polls, quizzes, essays, and assignments means that students may be sorely tempted to submit AI-generated content as their own, elevating rates of plagiarism and cheating, and effectively cheating the students themselves.

Opportunities and limitations of generative AI use for administrators, faculty, and students

	Opportunities	Limitations
Administrative staff	• Help scale academic support and student services via automation • Evaluate applicants more efficiently	• May depersonalize students' interactions with university staff • Raises the risk of biased decisions that disadvantage specific groups
Faculty	• Assist with research, develop curricula, and assess student work	• Potential for use of AI assessment tools to grade essays that students draft using AI writing assistants
Students	• Use as a personal tutor to help students summarize information, begin drafts, generate ideas, and self-test	• Ease of using AI to complete work and generate content for assignments can undermine intellectual growth

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Institutions Need to Adopt and Evolve Rather Than Ban or Police

The potential for AI tools to undermine academic integrity has led some educational institutions, districts, and countries to propose that these tools be banned. Despite these potentially disruptive implications, it is a fool's errand to try to keep new technologies out of the hands of students, just as it was to try to prevent them from searching for answers to homework on the internet. Banning AI requires that institutions track, document, and prevent access to an ever-growing spectrum of software and technologies, an approach that can instantly be circumvented by students at home or on their mobile devices that are not connected to campus networks.

Policing is equally problematic. Leaders looking to AI-detection tools to identify plagiarism and cheating will find that these detectors are unreliable, yielding false negatives (failing to recognize AI-produced content as AI-produced) and false positives (mislabeling human-written content as AI-produced), and will typically lag behind the latest advances in generative AI tools. Students can fool these tools with minimal effort once they understand how they work, and detectors also gather and reuse student and faculty data in potentially objectionable ways. Moreover, the policing approach perpetuates an arms race mentality, as students and technology providers who wish to enable them will continue to find ways to circumvent constraints and restrictions.

Instead, educators need to determine what academic integrity means when AI assistants are

"The policing approach perpetuates an arms race mentality, as students and technology providers who wish to enable them will continue to find ways to circumvent constraints and restrictions."

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ubiquitous. The traditional paradigm has been that authors must produce their own work, acknowledging any contributions made by others. However, the availability of tools that allow people to leverage their creativity and remove some of the more laborious aspects of the process is likely to change our conception of what is appropriate when producing texts and other creative works.

Policing and banning aside, employers will expect students to be able to make use of generative AI once they enter the workforce. Indeed, professional writers are already adopting AI writing tools just as they have other labor-saving technologies, such as automated grammar-checking tools. Graduates will be expected to use these applications to help them summarize and draft documents, brainstorm, visualize, and analyze information, and guide the use of AI tools while critically evaluating and building on their output. The same goes for other media, such as imagery, video, and music. In short, students need to learn to utilize AI when creating content in order to prepare for the conditions they will encounter professionally.

It is easy to underestimate the coming impact of this change to creative productivity. Once adopted at scale, AI will create a fundamental shift in the market for knowledge work, freeing humans to focus on the more abstract and strategic tasks of analyzing and planning opportunities for creative production. This will require students to be prepared in new ways for their professional lives, putting an even greater premium on critical thinking and complex problem-solving skills that many universities claim to promote, but which evidence suggests they largely fail to achieve. The emergence of AI also creates an imperative for universities to empower students with goal-setting and moral reasoning capabilities to make decisions that cannot be left to AI systems alone.

The above examples are just a glimpse of how generative AI will reshape the knowledge economy and the preparation universities must provide for students. While the full extent of how these developments will transform higher education is impossible to predict, institutions that evolve by integrating AI into teaching and learning will minimize disruption while better serving their students.

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How Higher Education Can Integrate Generative AI

What can higher education leaders do to prepare for the challenges and take advantage of the opportunity prompted by the emergence of generative AI? Here we offer three strategies and discuss the implications of each in detail: (1) building awareness and capabilities; (2) adapting teaching and learning approaches; and (3) evolving curricula to teach AI-relevant skills. How these strategies are implemented will differ among institutions, depending on existing capabilities, and will require leaders to navigate the functional and cultural changes needed to adapt to this new reality.

1

Building Awareness and Capabilities

The first key to adapting to generative AI is to ensure that different audiences within an institution understand these systems and how to use them.

Institutional Leadership

The effort begins at the leadership level: provosts, vice-provosts, deans, department chairs, and functional leaders must become deeply familiar with the capabilities of generative AI systems and the applications built upon them. They will need to convene groups representing functions across the university to consider institutional policy. Increasing expertise is not simply a matter of learning about current models but also preparing for future versions, which will be even more powerful than those available today. Institutions will need to empower leaders to be responsible for keeping pace with further developments in AI technology and coordinating ongoing institutional responses.

Developing this institutional capability will require a substantial effort from senior academic and administrative leaders to educate themselves, for they cannot afford to delegate crucial decisions about institutional strategy. One reason for this is to ensure that institutions adopt consistent approaches to using AI that represent the priorities and perspectives of different stakeholders. Another is that some policies, such as those requiring the adoption of new software systems or significant curricular redesign efforts, will require investments that represent a significant commitment of institutional resources.

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Faculty

Institutional leaders will also need to build capacity on their technology and innovation teams, as well as among instructional design staff, in order to educate and support faculty members. They can do so by empowering centers for teaching and learning to educate faculty through workshops, ongoing professional development, and shared resources that help them to navigate ethical issues and use AI tools to enhance teaching and learning. In one example, staff at the Center for Teaching and Learning at the University of Pittsburgh produced a webpage with guidelines and resources to support faculty in adapting to the use of AI tools. As generative AI continues to evolve, faculty and staff will need ongoing guidance and collaboration with IT experts to keep pace with changes and evaluate new systems.

Faculty will also need training in effective 'prompt engineering,' the art of crafting requests that will lead AI systems to return useful output. Unlike a Google search, where keywords or simplistic questions frequently retrieve the appropriate results, generative AI models are designed to follow detailed instructions and can produce highly complex and sophisticated responses when provided with multi-step instructions, examples, and context for the task they are being asked to perform. Failing to design prompts appropriately produces underwhelming results that can lead users to underestimate the true capabilities of AI tools. Faculty need this skill for their own use and to effectively guide students in adopting generative AI.

Institutional experts can also support faculty in other ways, such as research. Tools have already been developed that can be used for discovery and summarization, and generative AI can also be used to assist in data analysis and visualization. Using these tools requires awareness and expertise that will be unevenly distributed amongst researchers, who will benefit from centralized training and a collaborative community of practice.

Students

Institutions will also need to support and guide their students. Students will need AI literacy training to help them navigate a world where AI tools are commonplace, identify the strengths and limitations of these systems, and

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understand how to use such tools in effective, ethical, and responsible ways. Some of this will come from faculty integrating AI into their courses, as we discuss below. But beyond its application to disciplinary content, understanding the best use of AI tutoring systems and study aids will be an important factor in student success, which must be pursued with equity in mind so that the students most in need of academic support can benefit.

Students will also need a more general understanding of how to navigate their professional pathways as they seek job opportunities that are mediated by AI tools and systems. This means that student services, such as advising and professional development, will need to consider the relevance of AI in their engagement with students, including ways that AI will be used to screen applications for jobs and how students can demonstrate their own preparedness for an AI-integrated work environment.

Staff

Finally, institutions need to embrace AI technologies across functions beyond academics. As generative AI tools emerge that can support admissions, enrollment management, and student support, institutional leaders and IT specialists will need to consider which ones to adopt and how to implement them in ways that will improve their work without compromising their integrity. Some of these systems may also add significant IT infrastructure costs to budgets, requiring analyses of how they will return the investment.

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Use cases for building generative AI awareness and capabilities

Audience	Use Case	Recommendation
Leadership	Institutional AI strategy and policy	Identify the institution-level approach to AI.
	Budget allocation	Tap resources for investment in building AI capacity throughout the institution.
	Technology adoption	Promote the availability of appropriate technology resources at the institutional level.
Faculty	Curriculum development	Use AI tools to promote more effective and efficient creation of curricula.
	Instruction and assessment	Identify changes to teaching and assessment practices required based on the adoption of AI by students.
	Academic policies	Define policies for the appropriate use of AI by students.
	Research	Leverage AI tools to scale research capabilities and efficacy.
Students	Academic integrity	Recognize the appropriate use of AI for class and assignments.
	Tutoring	Utilize AI tools to improve self-directed learning.
	Discipline-specific applications	Learn about AI tools relevant to a specific field of study.
	Professional preparation	Understand the expectations for the use of AI in professional settings.
Staff	Admissions and enrollment management	Adopt tools that make admissions and enrollment processes more efficient, consistent, and fair.
	Student advising	Identify students in need of support and increase the resources available to them.
	Career services	Prepare students for navigating AI mediated hiring processes and demonstrating their AI-relevant capabilities.
	Research support	Support faculty in adopting tools to scale their research.

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2

Adapting Teaching and Assessment Strategies

AI tools have fueled concerns about a potential explosion in student plagiarism and cheating. However, rather than just focusing on AI as a threat to academic integrity, educators can also use the emergence of these tools as an opportunity to re-examine and update suboptimal teaching and assessment practices.

Teaching

Traditional teaching practices in many institutions still hinge on the lecture format, where large groups of students passively listen to a lengthy lesson delivered by a single professor. While this approach may be resource efficient for both professors and institutions, it is an especially poor method for encouraging student learning, with students 1.5 times more likely to fail in courses that utilize lectures as opposed to those that employ active learning methodologies.

Lecture-based courses were ill-suited before advances in AI, and they are especially inadequate in the AI era. Students who were already able to access vast amounts of content via the Internet now find themselves with a suite of AI technologies that can summarize, visualize, interpret, and evaluate this information for them.

Such tools undermine the very idea of teaching that centers on passive knowledge transmission, memorization, and recall. They also prime students to question the value and high cost of lecture-based instruction when AI tutoring systems allow them to acquire information in highly personalized ways tailored to their readiness level, whenever and however they want.

Put simply, passive learning centered around knowledge transmission needs to be replaced with fully active, student-centered learning that allows students to acquire, practice, and apply higher-order thinking and transferable skills. This was true before AI and is even truer now.

This shift requires a different orientation toward what happens in a course. It starts with “flipping the classroom” so that students take in new information ahead of time, via readings or recorded lectures, and come to class ready to apply what they are learning. Live lectures are replaced with instructor-facilitated active learning exercises, in which students take the concepts and skills acquired before class and practice applying them in new contexts and situations to solve practical, real-world problems. A wide range of individual and collaborative techniques can be used to achieve these ends, from Socratic discussion and live polling to breakout groups, debates, role-playing, simulations, games, and team projects.

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Critically, AI tools can play a key role in helping educators transition their teaching practices in the aforementioned ways. They can produce creative outlines for active learning techniques and tailor those outlines so that they are closely aligned with lesson content, as well as student readiness levels, such as outlines for a negotiation activity for first-year business students. They can help generate reflective questions that faculty can use during their active learning classes (for example, ideas on how to prompt students to connect content from one activity to another to arrive at a deeper understanding). In one effective active learning task, known as "peer instruction", students are faced with a challenging question, where they discuss their answers with their classmates, explaining and defending their positions. Following this, they consider whether or not to change their original answer. Through this process of active reflection on the answer to the problem, students apply their knowledge, correct misconceptions, and deepen their understanding. AI can enhance activities like this further by providing guidance to students on how to think through their responses or providing individualized feedback on mistakes. Elsewhere, they can provide students with a Socratic debate partner, practice test or self-explanation questions, or targeted guidance on how to think through their responses or even provide individualized feedback on mistakes.

Relative to the passive learning approach of lectures, active learning creates an engaging and dynamic environment where every student is ready to participate and learn as much from one another as from instructors. AI has the potential to deepen this engagement, allowing students to practice using the technology and apply their learning while doing so.

Assessment

Traditional assessment practices often rely on high-stakes summative evaluations, which demand rote memorization, retrieval, and application to a specific context. Examples include end-of-course quizzes and exams, as well as single-draft essays. Although efficient for evaluating large numbers of students at a single point in time,

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these methods are suboptimal for promoting retention of concepts and skills, because information that is not consistently reinforced is typically forgotten.

High-stakes assessments are also ill-suited to an AI era. In a world where AI can be used to effortlessly solve multiple-choice and short-answer questions, craft essays, and write reports, students may be tempted to misuse or over-rely on such tools in search of better grades. When students inappropriately submit AI-generated content as their own, educators find themselves in the frustrating situation of evaluating machines rather than humans. This dilemma has led many to transition back to time-consuming analog assessments, opting for handwritten essays completed during class or in-person oral and written exams at the end of courses.

Assessment practices need to shift away from standard high-stakes, summative practices and move towards authentic assessments, which require students to demonstrate higher-order thinking in practical contexts, such as group assignments, peer-critiquing papers, and giving live presentations. By assessing students on the process of analyzing, evaluating, and creating new ideas rather than solely on the final product, instructors promote metacognition, where students actively reflect on their learning and deepen their understanding of how to solve complex problems.

Minerva University has implemented this approach to assessment across all of its programs and courses. The faculty methodically plan repeated opportunities for students to practice, and be evaluated on, the application of specific learning outcomes. This practice reinforces new skills and habituates students to think intentionally about which skills are relevant to a given real-world problem. Opportunities for spaced practice are scaffolded so that students face increasingly more challenging and complex tasks, in which they ultimately synthesize different skills and knowledge to solve more sophisticated problems. By providing frequent formative feedback on student work with increasingly

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higher expectations, Minerva helps to ensure that students deepen their mastery of program and course learning outcomes.

AI tools can help educators transition their assessment practices in the aforementioned ways as well. They can generate highly creative ideas for authentic, experiential assignments tailored to local contexts, as well as personally relevant and contemporary issues. They can act as a "grading buddy" that supplements instructor feedback on student work and helps identify and categorize common errors or virtues on student assignments, such as syntax errors in code or missing steps in the solutions to complex math or logic problems. When students' applications of learning outcomes are assessed using rubrics, an AI model could classify their performance according to that rubric and potentially even justify the evaluation by providing comments that explain the evaluations, so instructors could either approve or amend them.

As with teaching practices, assessments need to evolve, given the expectation that students will continue to utilize AI for their learning. Across both these areas, there are specific practices that faculty are well advised to adopt and others to avoid, as described in the table below.

Teaching and assessment best practices in the context of generative AI

Do	Employ active learning pedagogy to provide students with practice applying their knowledge to solve complex problems rather than answering rote questions.
	Embed the use of AI tools in classroom activities to familiarize students with their use and enhance the depth of their thinking and engagement.
	Create repeated opportunities for authentic assessments where students perform realistic tasks to apply their knowledge.
	Encourage students to use AI tools in intentional ways to enhance their creativity and help guide them in their learning.
Don't	Focus on transmitting information to students that can easily be generated by AI models.
	Try to prevent students from using AI tools to enhance their learning.
	Emphasize high-stakes assessments that are poor measures of what students are capable of and which incentivize mindless uses of AI.

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Future Directions in AI-Integrated Teaching and Assessment

At Minerva Project, we are exploring further use cases for generative AI. When it comes to curriculum and lesson development, educators can provide an AI model with a structure for a particular kind of learning activity, and use the model to replicate this structure while substituting content from another domain, a task that would otherwise be very time-consuming. Using a certain lesson that proved highly effective in a business course, an AI model could analyze the structure of that lesson and import it into a psychology course, swapping out the business examples for suitable alternatives. AI could be used to scale processes and reduce time and effort in still other ways, for instance, taking the rubrics for one set of learning outcomes and assignments and using them to create similar rubrics for other outcomes and assignments.

A further example involves the use of assessment data to personalize learning more effectively. With frequent measurements of what students know and can do, AI systems can recommend the tasks and topics that will be most appropriate for an individual student's learning, avoiding the one-size-fits-all approach that plagues traditional courses. This has the potential to better serve the diverse needs of students with different backgrounds and levels of preparation. As AI tools become more refined, they

Examples of how generative AI can be used by faculty in a course, lesson, and pedagogical design, as well as student feedback and faculty development

Course & Lesson Design	Pedagogical Design	Student Feedback	Faculty Coaching
Design an outline of a course syllabus	Identify a set of active learning techniques that can be used in class	Identify student misconceptions about content	Act as a teachable agent (Tate et al., 2023)
Design a scoring rubric for the course/assignment	Generate prompts and questions to facilitate active learning discussions	Provide students with formative feedback on their writing	Provide faculty with feedback on the quality of their instruction and tips for improvement

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will make some of the most labor-intensive parts of curriculum development and assessment considerably more efficient. This will be important given that AI seems likely to disrupt the university business model that relies on ineffective large lecture courses and high-stakes exams for hundreds of students at a time. Given that active learning and authentic assessment will require a lower instructor-to-student ratio, universities will need other routes to efficiency. If generative AI systems can lower costs and increase the quality of developing courses and assessing student work, important curricular reforms will be more approachable at the institutional level.

Throughout the ongoing process of adopting and adapting to generative AI in the ways discussed above, institutions should promote campus-wide conversations about using these new tools safely and with integrity. In many cases, AI tools developed for industry will outpace those created specifically for education, leading to unpredictable cycles of adoption by both students and faculty. Creating broader awareness of the opportunities and risks associated with these systems will allow institutions to define better policies and empower faculty and students to make better decisions about how to use them.

“If generative AI systems can lower costs and increase the quality of developing courses and assessing student work, important curricular reforms will be more approachable at the institutional level.”

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3

Preparing Students for an AI-Integrated Workplace with Durable Skills

Generative AI has already begun to impact knowledge work, as professionals adopt new tools to accomplish labor-intensive tasks more efficiently and even produce work they couldn't have previously due to a lack of technical expertise in areas like coding or design. Leaders who are serious about preparing their students for an AI-integrated workplace need to reflect on several points.

To begin with, upon graduating, students will enter a workplace that increasingly expects them to be proficient in the use of various AI tools to automate and increase the efficiency of research, ideation, writing, visualization, analysis, and other activities. Faculty should start preparing students now. They should teach and encourage their students to use these tools ethically and responsibly as creative aids and educate them about AI's pitfalls and limitations. This will require changes to curricula that can complement the adoption of active learning and authentic assessment, where students use generative AI technology to apply concepts and skills.

Faculty will also need to help students develop skills that will allow them to succeed in an AI-integrated workplace. Broadly speaking, skills can be divided into three categories: perishable, semi-durable, and durable skills. Perishable skills, like a specific programming language or tool, quickly lose value due to technological advances, while semi-durable skills, such as understanding programming paradigms or innovation frameworks, have greater longevity but still face obsolescence as a field progresses, expands, or evolves. The half-life of both skill sets has sharply declined over the past decade, meaning that many graduates find they are not matched to changing job market demands.

In contrast, durable skills focus less on "what to think" and instead on "how to think." Examples include critical thinking, problem-solving, communication, emotional intelligence, and collaboration. Durable skills are transferable, adaptable, and highly resilient against AI advances because they represent many of the tasks that AI systems currently struggle with. Students with durable skills are highly sought after by employers and will find themselves to be "AI-resilient" in the workforce relative to their peers who don't learn these skills.

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As an illustration, consider one such skill: critical thinking. This ability is itself composed of several component skills (see table below), such as breaking down arguments into their core components, analyzing and applying deductive logic, and identifying whether arguments are well-supported by high-quality evidence or sources. These capacities must be deliberately and explicitly taught rather than assumed to be acquired as a byproduct of lectures and coursework. They must be practiced repeatedly across a breadth of domains so that students begin to intuitively understand the opportunity to transfer their knowledge beyond the immediate context in which they acquired it.

Students who have been trained in these ways will be better positioned to analyze and critique the veracity and relevance of AI-generated information. They will be appropriately cautious of output, appreciate that such output can vary in its reliability, scrutinize the quality of reasoning contained in its arguments, and be able to generate their own counterarguments when called upon.

Durable Skill: Critical Thinking

Learning Outcome	Description
#critique	Actively and critically engage with texts and other forms of communication.
#deduction	Analyze and apply deductive reasoning.
#evidencebased	Identify and appropriately structure the information needed to support an argument effectively.
#sourcequality	Distinguish between categories and types of information to determine source quality.
#plausibility	Evaluate whether hypotheses are based on plausible premises or assumptions.

Examples of learning outcomes associated with one durable skill area (critical thinking) that students learn and practice in Minerva programs.
Minerva uses hashtags to make learning outcomes more memorable and easier to search for.

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AI tools can be used to help students acquire, practice, and apply durable skills like critical thinking. Faculty can draw on AI to generate activities that hone their students' analytical skills, for example, through an "AI Contradictions Hunt," where students seek out contradictions or logical fallacies in AI-generated content, or an "AI Balderdash Game," where AI is used to generate realistic-sounding-but-false scientific concepts, historical events, or literary theories, which students are then tasked with fact-checking and debunking.

Importantly, critical thinking is just one of many durable skills that universities will need to equip their students with, so they can be successful in the AI era. Although many tasks will become increasingly automated by machines and AI, humans will still need to work with other humans. The ability to effectively communicate in emotionally intelligent and self-aware ways, as well as lead, work, and negotiate with others in the pursuit of common objectives, are examples of skills that will continue to remain highly relevant and desirable in AI-integrated workplaces.

In a world where AI systems can instantly access the accumulated information present on the internet and perform many tasks more efficiently than any human can, graduates' capabilities will lie not in how much specialized knowledge they can remember, but in being able to apply durable skills in ways that machines and AI cannot. Higher education institutions need to give students the opportunity to acquire such skills in order to demonstrate the continued value of the education they provide.

"The ability to effectively communicate in emotionally intelligent and self-aware ways, as well as lead, work, and negotiate with others in the pursuit of common objectives, are examples of skills that will continue to remain highly relevant and desirable in AI-integrated workplaces."

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The Future of Higher Education is AI-Integrated

For some, generative AI represents a disruptive force for higher education, ushering in unprecedented challenges to academic integrity and potentially short-circuiting students' educational journeys. Viewed from another perspective, AI represents a transformative catalyst that forward-thinking academic leaders can use to radically innovate and strategically evolve their institutions so they are better adapted for the AI era.

Transitioning a university toward becoming an AI-integrated institution requires a purposeful enhancement of teaching, learning, and assessment practices. **First, leaders must foster widespread understanding among faculty, staff, and students about the capabilities and limitations of generative AI tools.** This involves providing clear guidance on their appropriate and effective use while encouraging informed and responsible exploration.

Second, faculty must update their teaching and assessment methodologies, building upon foundations rooted in learning science and amplified by AI-enabled innovations. Fully active learning approaches that incorporate authentic, experiential assessment, and are supplemented by intentional and effective AI use, can significantly enrich the learning environment, foster intellectual growth, and improve student outcomes.

Finally, AI-integrated universities will need to prepare students for an AI-integrated workplace by equipping them with technical expertise and experience in AI tool use. But more importantly, they will need to ensure their graduates can perform tasks that AI cannot, such as identifying the most important problems to solve, synthesizing the right information to make effective decisions, considering the moral dimensions of policies and actions, communicating with emotional intelligence, and navigating the complexities of collaboration and leadership. These durable skills were in high demand by employers before recent AI advances, and they will be more so when graduates are expected to use AI tools in critical, nuanced, and sophisticated ways. By following this approach, university leaders can embrace the opportunity for institutional innovation provided by the emergence of advanced AI tools and empower their students to succeed in a world that will continue to be fundamentally altered by new technologies.

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Written by James Genone
and Sean Hughes

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Minerva Project:
Diana El-Azar and Geoff Watson

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Ilil Amir-Kasif and Lena Raved

Edited by Ayo Seligman

Design and Layout by
Laura Galvin and Ayo Seligman

For more on this or our other partnerships, contact us at: info@minervaproject.com

www.minervaproject.com

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