



FUTURE TRENDS

Report

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Future Trends Report

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1 Prospective research

AI in Reshaping Higher Education

Zhu, Y., Zhu, Z., & Xu, W. (2025). Cross-border higher education cooperation under the dual context of artificial intelligence and geopolitics: Opportunities, challenges, and pathways. *Frontiers in Education*, 10, Article 1656518.

This paper examines the role of artificial intelligence in reshaping cross-border cooperation in higher education in an increasingly geopolitical world.



The authors frame their research as an intersection of digital transformation and international politics, where artificial intelligence creates both new opportunities for cooperation in higher education and a new level of fragmentation in the global higher education system. The main argument of the article is that artificial intelligence platforms are becoming a key infrastructure for both connecting and disconnecting higher education systems in different nations.

The research takes a forward-looking analytical approach, which conceptualizes the role of AI as a "key technological driver reshaping the ecology of global higher education cooperation" (Zhu et al., 2025). The authors observe that the use of AI improves the scalability of transnational education through adaptive learning, automated assessment, and data-driven student services, but these capabilities have also given rise to a new geopolitics of vulnerability, especially in the areas of data, technology, and regulation.

In terms of methodology, the article employs a policy analysis approach, which incorporates a scenario-based strategic analysis. The authors examine the major policy documents on the development of AI and education in various countries,

focusing on China, the USA, and the European Union. Empirically, the paper indicates an emerging tension between cooperation and fragmentation in AI-based international partnerships and virtual mobility. While AI holds promise for expanded international partnerships and program delivery across borders, geopolitical mistrust and differing export controls are contributing to a "fragmented digital education order" (Zhu et al., 2025). Threats include issues of algorithmic bias across cultures, unequal access to AI-based infrastructure, and weaponization of education data.

The policy recommendations include strengthening international AI governance in education, promoting ethical standards in the use of data across international borders, and developing digital resilience in institutions. The conclusion the authors arrive at is that the spatial and political organization of higher education is being completely reshaped by AI. Instead of leading to the creation of a globalized education space, the authors contend that the use of AI is likely to lead to the creation of a hybrid education space. Zhu et al. offer an important prospective contribution to the discourse by linking the use of educational technology to geopolitical changes.



AI as a key technological driver reshaping the ecology of global higher education cooperation.



AI governance in education must be strengthened, cross-border data ethics promoted, and institutional digital resilience enhanced.

AI, Future Studies, and Social Sciences

Pink, S. (2025). Artificial intelligence and the futures turn. *Journal of Cultural Economy*. Advance online publication.

Pink offers a conceptual and prospective analysis of the role that artificial intelligence (AI) plays in shaping the field of futures studies and the social sciences more generally.



The article contends that AI is not only a focus of prospective research and inquiry but also a key driver in shaping the epistemology, methodology, and imagination that influences how the future is produced and governed. Situating the analysis in the broader "futures turn," the author argues that it is imperative to grasp AI as a "technological and methodological intervention that reorganizes the way in which the future is anticipated and acted upon."

The key argument offered in the article is that AI systems are increasingly integrated into the everyday practices of anticipation, ranging from policy modeling to consumer prediction. Pink argues that AI is playing an active role in the "everyday production of the future," a phenomenon that has created a blurring effect between expert prediction and algorithmic prediction. In terms of methodology, the article follows an interdisciplinary approach, as indicated by the theories drawn from anthropology, science and technology studies, and future research. The article does not present any fresh data regarding the empirical cases of the deployment of AI systems, as it mainly synthesizes existing data regarding the emergence of such systems, focusing on the notion of anticipatory systems in various fields.

One of the main contributions of the article is the distinction between the notion of predictive systems of AI, as they are commonly understood, and the notion of "anticipatory infrastructures," as proposed by Pink. The main point is that existing AI systems not only predict the results of decisions taken by individuals but also configure possible futures, as the decision environment is impacted by the presence of such systems.

Moreover, the article draws attention to the rising risks. These risks include the normalization of obscure algorithmic decision-making, the concentration of anticipatory power in technology companies, and the possible marginalization of alternative futures. Pink writes that there is a risk that AI could actually constrict the variety of socially imaginable futures, especially those that are data-rich and commercially viable.

The article concludes that AI represents an important inflection point in the development of the study of the future. Instead of replacing human futurity, AI is reshaping the context in which the production, contestation, and regulation of futures knowledge occur. Pink's contribution can thus be seen as largely conceptual but with important implications.

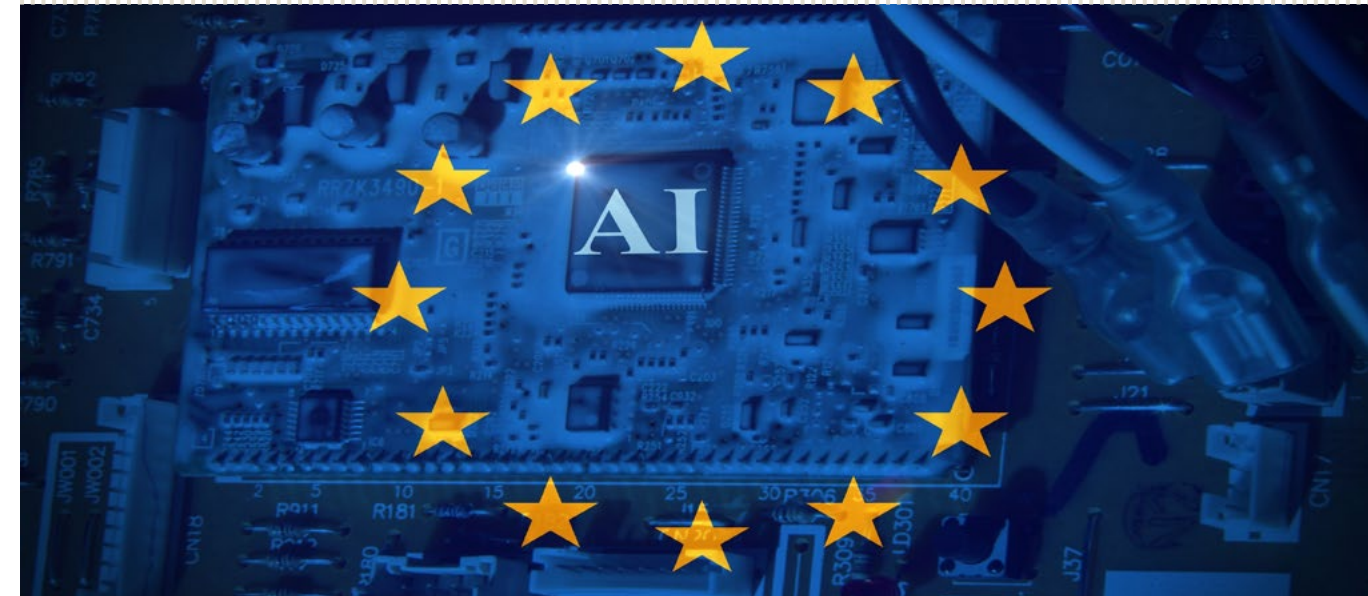


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Rather than replacing human visions of the future, AI is transforming the environment in which knowledge about the future is produced, contested, and governed.
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AI Governance in the EU

Kim, B.-J., Jeong, S., Cho, B.-K., & Chung, J.-B. (2025). AI governance in the context of the EU AI Act: A bibliometric and literature review approach.

This study looks at how the world governs artificial intelligence. It presents what the European Union's AI Act means for rules and regulations.



The authors want to understand how research and policy on intelligence are changing. They also want to find out what will shape the rules for intelligence in the future.

Empirically, the results show that after 2018, as deep learning and generative AI systems proliferated, there was a significant surge in AI governance research. The literature demonstrates a strong focus on a number of fundamental themes, including international policy coordination, risk regulation, accountability systems, and ethical AI. With the AI Act serving as a focal point for discussions on global governance, the authors note that the European Union has become a particularly powerful regulatory actor. The EU framework is increasingly influencing "norm diffusion beyond its territorial jurisdiction," as Kim et al. (2025) point out, demonstrating the growth of regulatory authority in the AI space. Growing geopolitical aspects of AI governance research are also identified by the analysis. More recent publications place an emphasis on standards-setting, digital sovereignty, and strategic competition, whereas earlier work was mainly concerned with ethics and technical safety. According to the authors, this change is proof that larger

geo-economic rivalries are incorporating AI governance.

Crucially, the study identifies a number of structural deficiencies in the state of the field. These include fragmentation across disciplinary silos, a lack of empirical assessment of policy effectiveness, and a failure to give Global South perspectives enough consideration. The authors caution that AI governance may develop in uneven and possibly contradictory ways in the absence of increased methodological integration and international cooperation.

The article's policy recommendations include more empirical research on the application of AI in the real world, more flexible regulatory frameworks, and improved multilateral cooperation. The authors stress that risk mitigation and innovation incentives must be balanced for effective governance.

The paper concludes that while AI governance is rapidly institutionalizing, there are still conceptual and empirical ambiguities. Kim et al. provide a useful prospective map of where AI governance research is going and where important knowledge gaps still exist in the developing global regulatory order by fusing bibliometric evidence with policy analysis.



The EU framework is increasingly influencing "norm diffusion beyond its territorial jurisdiction,"



AI governance may evolve unevenly and inconsistently without stronger methodological integration and international cooperation.

AI and Science Education Research

Kubsch, M., Kastaun, M., Wulff, P., Graulich, N., Ariely, M., Gregorcic, B., ... Zhai, X. (2025). Report on the scoping workshop on AI in science education research 2025.

Kubsch et al. (2025) present the outcomes of an international scoping workshop that examines how artificial intelligence (AI) is transforming science education research and outlines priority directions for future inquiry.



The article adopts an explicitly forward-looking orientation, seeking to map emerging research needs as AI systems—particularly generative models and learning analytics—become increasingly embedded in educational environments. The authors argue that AI is not merely an instructional tool but a structural force reshaping research methodologies, epistemologies, and pedagogical design within science education. The paper is based on a structured expert workshop bringing together researchers in science education, learning sciences, and AI. Methodologically, the study uses collaborative horizon scanning and thematic synthesis to identify key opportunities, risks, and research gaps. Participants analyzed current AI capabilities, reviewed existing empirical studies, and collectively developed a research agenda. The authors emphasize that the workshop was designed to support what they describe as "community-level foresight" regarding AI's educational impacts (Kubsch et al., 2025).

The findings highlight several transformative domains. First, AI-driven adaptive learning environments are expected to significantly personalize science education, enabling fine-grained feedback and real-time assessment. However, the authors caution that these systems raise concerns about transparency, bias, and the over-automation of pedagogical judgment. Second, generative AI tools are rapidly altering students' epistemic practices, including how they search for information, construct explanations, and engage in scientific argumentation. As Kubsch et al. (2025) note, AI may fundamentally reshape "what counts as evidence and authorship" in science learning contexts. A major contribution of the article is its identification of methodological disruptions. Traditional education research designs may struggle to keep pace with rapidly evolving AI systems. The authors call for new mixed-methods approaches capable of capturing human-AI

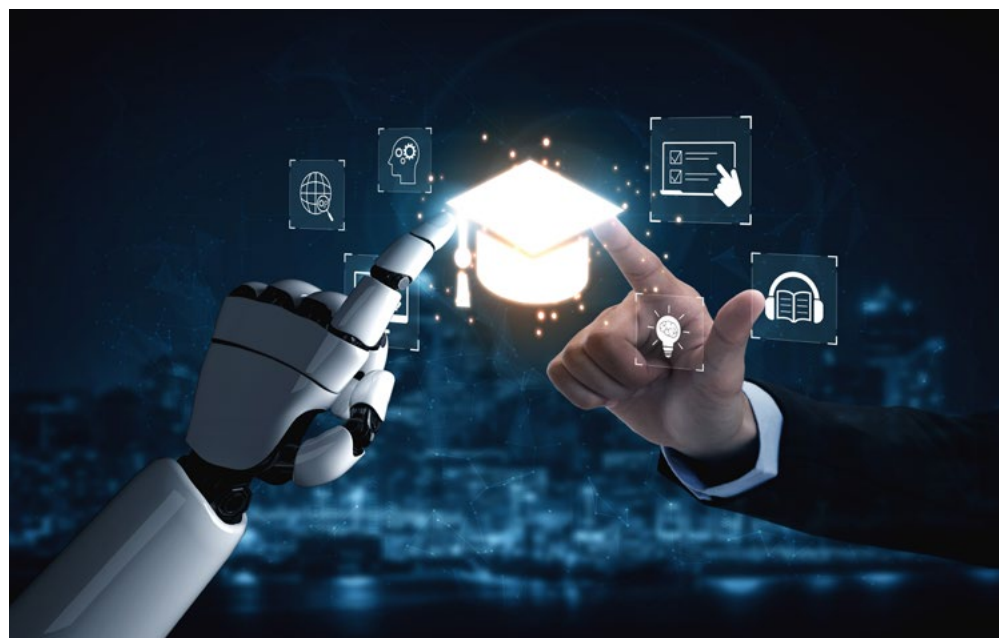
interaction dynamics over time. They also stress the need for interdisciplinary collaboration between education researchers, computer scientists, and ethicists. The workshop participants further identify equity as a critical future challenge. Unequal access to AI infrastructure, uneven data representation, and culturally embedded algorithmic bias could widen educational disparities if left unaddressed. The authors, therefore, recommend embedding fairness auditing and participatory design into future AI education research programs. Kubsch et al. conclude that AI represents a paradigm shift for science education research rather than an incremental innovation. By articulating a structured research agenda grounded in expert consensus, the article provides an important prospective roadmap for scholars and policymakers seeking to navigate the rapidly evolving intersection of AI and education.

Prospective research

Emerging Research on AI and Higher Education

Dai, K. (2026). Generative AI in higher education: A bibliometric review of emerging research trends (2022-2025). Computers and Education: Artificial Intelligence. Advance online publication.

Dai takes a broad, data-driven look at how quickly generative AI (GenAI) research has been taking off in higher education. The central point is pretty clear: GenAI is already pushing big changes in teaching, assessment, and university-level planning, and that shift is only picking up speed.



Using an applied foresight lens, the study treats GenAI as a disruptive, general-purpose technology—one that's still unfolding in terms of what it will really mean for education.

On the methods side, the author runs a bibliometric analysis on studies published from 2022 to 2025 and indexed in major academic databases. With tools like co-citation analysis, keyword clustering, and trend mapping, the paper spots the biggest research themes as well as newer, fast-growing areas. Then it adds a layer of qualitative interpretation to make sense of what the numbers are actually saying about the field's direction.

When huge language models like ChatGPT were made publicly available, the number of articles increased dramatically, according to empirical data. Academic integrity, AI-assisted pedagogy, student learning behavior, institutional governance, and ethical regulation are some of the main topics that run across the literature. Among these, plagiarism and assessment integrity issues stand out as the most pressing institutional concerns. Universities are facing "a fundamental reassessment of existing evaluation processes" in reaction to generative AI capabilities, as Dai (2026) points out.

Significant geographic concentration in research output is also identified

by the study, with the United States, China, and the United Kingdom controlling publication networks. Global knowledge asymmetries and the possible marginalization of viewpoints from the Global South are issues raised by this pattern. In spite of geopolitical difficulties, the author notes an increase in international cooperation, indicating that GenAI is evolving into a common global research agenda.

Crucially, the paper shows how early zeal gave way to more critical and governance-focused research. Policy frameworks, ethical standards, and institutional adaptation tactics have become increasingly important in recent research. According to Dai, this shift shows that generative AI is being incorporated into higher education more systematically rather than just being adopted experimentally.

According to the article's conclusion, generative AI is probably going to become ingrained in higher education systems all over the world. The crucial question is how colleges will oversee and shape the integration of GenAI, not if they will embrace it. Thus, Dai's bibliometric insight offers a useful evidence-based roadmap for comprehending the changing research and policy environment of higher education facilitated by AI.

GenAI is already transforming teaching, assessment, and university planning, and this shift is accelerating.



The issue is not whether colleges will adopt GenAI, but how they will govern its integration.

2 Applied research

AI-Powered Learning Assistant in Engineering

Sajja, R., Sermet, Y., Fodale, B., & Demir, I. (2025). Evaluating AI-powered learning assistants in engineering higher education: Student engagement, ethical challenges, and policy implication

The study seeks to move beyond speculative discussions of educational AI by empirically assessing student engagement, usability perceptions, and ethical concerns in a real instructional context. The authors argue that while AI learning assistants hold significant pedagogical promise, their successful integration depends on careful attention to student trust, transparency, and instructional alignment.



The research is grounded in an authentic university implementation in which students interacted with an AI assistant designed to support course learning. Methodologically, the study combines system usage analytics, structured student surveys, and qualitative feedback. This triangulated design allows the authors to capture both behavioral and perceptual dimensions of AI adoption. As the authors note, the goal is to provide "evidence-based insight into the educational impact of AI-powered assistants" (Sajja et al., 2025). Empirical findings indicate generally positive student engagement with the AI tool. Usage data show frequent consultation for concept clarification, problem-solving support, and exam preparation. Survey responses further reveal that many students perceive the assistant as helpful for immediate feedback and self-paced learning. However, the study also uncovers important areas of concern. Students express uncertainty about the reliability of AI-generated explanations and report varying levels of trust in automated responses. According to Sajja et al. (2025), perceived accuracy and transparency emerge as key determinants of user confidence. The qualitative component provides additional nuance. Some students value the assistant's availability and responsiveness, while others worry about

overreliance and potential impacts on deep learning. Ethical concerns also surface, particularly regarding data privacy and the appropriate boundaries between human and AI instructional roles. The authors interpret these findings as evidence that the pedagogical integration of AI must address not only functionality but also student epistemic expectations. Importantly, the study identifies design implications for higher education institutions. Effective AI learning assistants should incorporate explainability features, clear usage guidelines, and alignment with course learning objectives. Faculty mediation remains critical; the authors emphasize that AI tools function best when embedded within structured pedagogical frameworks rather than deployed as standalone solutions. The article concludes that AI learning assistants can enhance student engagement and support flexible learning, but their educational value is contingent on trust-building and ethical governance. By grounding the discussion in real classroom data, Sajja et al. make a significant applied contribution to the emerging evidence base on AI in higher education. Their findings underscore the need for institutions to adopt a socio-technical approach that integrates technical performance with pedagogical and ethical considerations.



AI learning assistants offer strong pedagogical potential, but their effective integration requires student trust, transparency, and instructional alignment.



AI tools function best when embedded within structured pedagogical frameworks.

Beyond Automation: Socratic AI, Epistemic Agency, and the Implications of Orchestrated Multi-Agent Learning Architectures

Degen, P.-B., & Asanov, I. (2025). Beyond automation: Socratic AI, epistemic agency, and the implications of orchestrated multi-agent learning architectures

Degen and Asanov conduct a controlled experimental study evaluating the pedagogical effects of a Socratic artificial intelligence (AI) tutoring system designed to enhance reflective and critical thinking in teacher education.



The article responds to growing concerns that many AI chatbots promote surface-level learning by providing direct answers rather than fostering epistemic engagement. The authors, therefore, develop and test a multi-agent AI architecture intended to guide learners through structured questioning processes rather than simple solution delivery. The study is grounded in an experimental research design involving pre-service teachers who interacted with the Socratic AI tutor during instructional tasks. Participants were assigned to conditions comparing the Socratic system with more conventional AI support tools. Methodologically, the authors combine quantitative performance measures with qualitative analysis of student reasoning processes. This design enables them to assess not only learning outcomes but also the depth of cognitive engagement. As the authors explain, the objective is to evaluate whether AI can support what they term "epistemic agency" rather than passive answer consumption. Empirical results indicate that the Socratic AI condition produced

measurable improvements in higher-order thinking. Students using the guided questioning system demonstrated stronger reflective reasoning and more elaborated conceptual explanations compared with those using standard AI assistance. The authors report that participants exposed to the Socratic tutor showed "significantly deeper critical engagement with the learning material" (Degen & Asanov, 2025). These findings suggest that AI design architecture plays a decisive role in shaping educational outcomes. The qualitative analysis further reveals important process differences. Learners interacting with the Socratic AI engaged in longer reasoning chains, posed more self-generated questions, and exhibited greater metacognitive awareness. However, the study also identifies implementation challenges. Some students initially experienced cognitive friction when adapting to the questioning format, indicating that pedagogical scaffolding remains necessary. The authors caution that without proper instructional

framing, students may perceive Socratic AI systems as less efficient despite their deeper learning benefits. From a design perspective, the article emphasizes the importance of moving beyond answer-centric AI toward dialogic learning architectures. The findings support the view that AI can be aligned with constructivist pedagogy when interaction structures are carefully engineered. At the same time, the authors acknowledge limitations related to sample size and short intervention duration. The article concludes that AI in education should be evaluated not only on accuracy or convenience but on its capacity to cultivate meaningful cognitive engagement. By providing controlled experimental evidence, Degen and Asanov make a strong applied contribution to debates on human-AI pedagogy. Their work demonstrates that thoughtfully designed AI tutors can enhance reflective learning while also highlighting the need for continued research on long-term educational impacts and classroom integration strategies.

AI in Higher Education: Experimental Findings in Philosophy Teaching

Vehrer, A., & Palfalusi, Z. (2025). The application of virtual environments and artificial intelligence in higher education: Experimental findings in philosophy teaching

This paper investigates the pedagogical impact of combining artificial intelligence tools with virtual learning environments in higher education philosophy courses. The article aims to provide empirical evidence on whether immersive AI-supported instruction can improve student performance, motivation, and engagement compared with more traditional teaching formats.



Responding to widespread but often speculative claims about educational AI, the authors adopt an experimental classroom approach to assess measurable learning outcomes.

The study is based on an intervention conducted with undergraduate students enrolled in philosophy courses. Participants engaged with course materials delivered through a virtual environment enhanced by AI-supported instructional features. Methodologically, the research employs a mixed quantitative-qualitative design, including performance assessments, student feedback surveys, and observational data. This approach allows the authors to evaluate both academic achievement and learner experience. As Vehrer and Palfalusi state, the goal is to examine the "practical educational effectiveness of AI-supported virtual learning environments" in a humanities context.

Empirical results indicate generally positive learning effects. A substantial proportion of students achieved high course grades following exposure to the AI-enhanced environment,

and survey responses suggest increased motivation and perceived engagement. Students particularly valued the interactive features and the flexibility afforded by the virtual platform.

According to the authors, the integration of AI contributed to more individualized learning pathways and more immediate feedback mechanisms. However, the findings also reveal important nuances. While many students reported improved engagement, some expressed concerns about cognitive overload and the complexity of navigating immersive digital environments. The authors note that technological sophistication does not automatically translate into pedagogical effectiveness; instructional design and user experience remain critical mediating factors. Vehrer and Palfalusi emphasize that AI tools must be carefully aligned with course objectives to avoid superficial digital enhancement. The qualitative feedback highlights the continued importance of instructor presence. Students indicated that AI-supported environments

were most effective when complemented by active teacher guidance and structured learning activities. This supports the authors' broader argument that AI should augment rather than replace human pedagogical roles.

In terms of implications, the article recommends incremental and evidence-based adoption of AI in humanities education. Institutions should invest in faculty training, usability testing, and ongoing evaluation of learning outcomes. The authors also call for further longitudinal research to assess whether observed engagement gains translate into sustained conceptual understanding.

The article concludes that AI-enabled virtual environments hold significant promise for higher education but require careful pedagogical integration. By grounding the analysis in classroom data, Vehrer and Palfalusi provide a valuable applied contribution demonstrating both the opportunities and the practical constraints of AI-driven innovation in the humanities.

Critical Analysis of Student Motivations and Ethical Boundaries in Educational AI Use

Mazaheriyah, A., & Nourbakhsh, E. (2025). *Beyond the hype: Critical analysis of student motivations and ethical boundaries in educational AI use in higher education.*

Mazaheriyah and Nourbakhsh provide an empirical investigation of university students' motivations, usage patterns, and ethical perceptions regarding generative artificial intelligence (AI) in higher education.



The study addresses a critical gap between the rapid student adoption of AI tools and the slower development of institutional governance frameworks. The authors argue that understanding how students actually use AI is essential for designing effective academic integrity policies and pedagogical responses. The research employs a mixed-methods design centered on a structured student survey complemented by qualitative analysis of open-ended responses. Participants were asked about the frequency of AI use, primary purposes, perceived benefits, and ethical boundaries. This approach enables the authors to capture both quantitative behavioral trends and nuanced student reasoning. As Mazaheriyah and Nourbakhsh (2025) note, the objective is to move "beyond speculative debates" toward an evidence-based understanding of AI use in real academic contexts. Empirical findings reveal widespread and normalized adoption of generative AI among students. A large majority reported using AI tools regularly, primarily for time-saving purposes such as summarizing readings, brainstorming ideas, and drafting assignments. The authors report that approximately 92% of respondents identified efficiency gains as their main motivation (Mazaheriyah & Nourbakhsh, 2025). This indicates that AI is becoming embedded

in everyday study practices rather than remaining an occasional support tool. At the same time, the study uncovers significant ethical ambiguity. Many students expressed uncertainty about what constitutes acceptable AI use under current institutional rules. The authors describe the emergence of what they term a "shadow pedagogy," in which students develop informal norms and workarounds in the absence of clear guidance (Mazaheriyah & Nourbakhsh, 2025). This gap between policy and practice represents one of the article's most important applied insights. From a policy perspective, the authors argue that prohibition-based approaches are unlikely to succeed given the scale of adoption. Faculty training and institutional communication are identified as urgent priorities. The article concludes that generative AI is already deeply embedded in student learning ecologies, creating a mismatch between technological reality and institutional policy. By providing systematic empirical evidence of student behavior, Mazaheriyah and Nourbakhsh make a significant applied contribution. Their findings highlight the need for proactive governance strategies that align pedagogical design, ethical standards, and student practices in the emerging AI-enabled university.



Understanding how students actually use AI is crucial for developing effective academic integrity policies and pedagogical strategies.



~92% of respondents identified efficiency gains as their main motivation.

Integrating AI in Higher Education

Schmidt, D. A., et al. (2025). Integrating artificial intelligence in higher education: Perceptions, applications, and adoption strategies. Computers and Education: Artificial Intelligence

Schmidt et al. investigate how artificial intelligence (AI) is being adopted and perceived within higher education institutions, with the aim of identifying practical strategies for effective integration.



The article responds to the rapid diffusion of AI tools across universities by providing empirically grounded insight into how students and faculty understand, use, and evaluate these technologies. The study employs a qualitative field research design, combining semi-structured interviews, focus groups, and questionnaire data collected from higher education stakeholders. This multi-source approach allows the authors to capture both institutional perspectives and user-level experiences. As Schmidt et al. explain, the research seeks to develop "evidence-based adoption strategies" grounded in real-world educational settings rather than purely theoretical discussions. Empirical findings reveal broad awareness of AI's potential benefits alongside persistent uncertainty about appropriate use. Participants reported using AI tools for tasks such as content generation, administrative support, and personalized learning assistance. Many respondents perceived AI as capable of improving efficiency

and expanding instructional flexibility. However, the study also identifies significant concerns related to data privacy, academic integrity, and the reliability of AI-generated outputs. According to the authors, trust and transparency emerged as central conditions for sustainable adoption. A key contribution of the article is its identification of institutional readiness gaps. The authors find that many universities lack clear governance frameworks, staff training programs, and evaluation mechanisms for AI deployment. Faculty members, in particular, reported feeling underprepared to integrate AI into their teaching practices. This highlights what the authors describe as a "capability lag" between technological availability and pedagogical preparedness. The qualitative analysis further emphasizes the importance of organizational culture. Institutions with collaborative innovation environments and strong digital strategies were better positioned to experiment with AI tools. Conversely, fragmented governance structures and unclear policies tended to slow

adoption and increase user anxiety. The study, therefore, frames AI integration as a socio-technical transformation rather than a purely technical upgrade. In terms of practical recommendations, the authors advocate for comprehensive institutional AI strategies that include professional development, ethical guidelines, transparent procurement processes, and continuous impact assessment. They stress that successful implementation requires aligning technological infrastructure with pedagogical goals and stakeholder expectations. The article concludes that AI is likely to become a permanent feature of higher education ecosystems, but its benefits will depend heavily on institutional capacity and governance maturity. By grounding its analysis in field data, Schmidt et al. provide a valuable applied contribution that moves the debate from speculative promise toward operational reality. Their findings underscore the need for coordinated, evidence-based approaches to managing AI-driven transformation in universities.

