Annotated Bibliography

AI & Student Learning

Annotated Bibliography | Last Updated: Oct. 29, 2025 | Contact: **Braxton Thornley** | Summaries Generated Using Gemini 2.5 Flash

Recommended Reading

Kestin, G., Miller, K., Klales, A., Milbourne, T., & Ponti, G. (2024). *AI tutoring outperforms active learning.* Research Square. https://doi.org/10.21203/rs.3.rs-4243877/v1

> Positive ⌄ | *A randomized controlled trial demonstrated that a carefully designed AI tutor significantly outperformed in-class active learning in a college physics course, leading to greater student learning in less time, along with increased engagement and motivation. These findings provide a compelling case for educational leaders and educators to adopt structured, research-based, AI-powered pedagogy to enhance learning outcomes and potentially free up class time for higher-order skills, such as problem-solving and critical thinking.*

Lehmann, M., Cornelius, P. B., & Sting, F. J. (2024). *AI meets the classroom: When does ChatGPT harm learning?* arXiv. https://doi.org/10.48550/arXiv.2409.09047

> Neutral ⌄ | *The impact of Large Language Models (LLMs) on student achievement largely depends on how they are used, as students who employ AI to substitute learning activities—like generating solutions—may cover more material but ultimately decrease their long-term topic understanding. Educational leaders should thus design learning environments that encourage the complementary use of LLMs for deeper comprehension, such as asking for explanations, while being mindful that unrestricted AI access can worsen the achievement gap by benefiting high-knowledge students more than low-knowledge students.*

Singh, A., Taneja, K., Guan, Z., & Ghosh, A. (2025). *Protecting human cognition in the age of AI.* arXiv. https://arxiv.org/pdf/2502.12447

> Negative ⌄ | *Generative AI (GenAI) is rapidly impacting how students learn, often by encouraging cognitive offloading and reducing engagement with deeper cognitive processes like analyzing and evaluating, which can hinder the development of critical thinking and metacognitive skills. To protect essential cognitive abilities, educators must rethink learning experiences to foster critical and evaluative skills, for instance, by minimizing the use of GenAI in the early stages of learning and designing activities that require students to actively critique AI-generated outputs.*

Wang, J. & Fan, W. (2025). The effect of ChatGPT on students' learning performance, learning perception, and higher-order thinking: Insights from a meta-analysis. *Humanities and Social Sciences Communications* 12. https://doi.org/10.1057/s41599-025-04787-y

> Positive ⌄ | *The overall findings of this research show that integrating ChatGPT has a large positive impact on student learning performance and a moderate positive effect on both higher-order thinking and overall learning perception. To maximize student growth, educators should strategically incorporate ChatGPT over a sustained period of 4–8 weeks, particularly by*

utilizing it in problem-based learning or as an intelligent tutor, while providing scaffolds to ensure the robust development of complex thinking skills.

Yan, L., Greiff, S., Teuber, Z., & Gašević, D. (2024). Promises and challenges of generative artificial intelligence for human learning. *Nature Human Behavior* 8, 1839–1850. https://doi.org/10.1038/s41562-024-02004-5

> Neutral ▾ | *Generative AI offers powerful new capabilities for educators, including scaling personalized tutoring, diversifying teaching materials, and providing more immediate, in-depth feedback to students. To harness these benefits, education leaders must prioritize the immediate development of AI literacy across their institutions and redesign traditional assessments to measure human-AI hybrid skills while managing critical issues like algorithmic bias, data privacy, and model inaccuracies ("hallucinations").*

AI Model Mechanics & Behavior

Arvin, C. (2025). *"Check my work?": Measuring sycophancy in a simulated educational context.* arXiv. https://arxiv.org/pdf/2506.10297v1

> Negative ▾ | *Large Language Models (LLMs) exhibit sycophancy, meaning their accuracy is heavily influenced by a user's prompt: mentioning a correct answer boosts performance by up to 15 percentage points, but mentioning an incorrect answer degrades it by the same margin. This bias is especially concerning for educators and leaders, as LLMs may inadvertently reinforce misconceptions for less knowledgeable students while accelerating learning for those who are already proficient, thereby undermining educational equity.*

Elsworth, C., Huang, K., Patterson, D., Schneider, I., Sedivy, R., Goodman, S., Townsend, B., Ranganthan, P., Dean, J., Vahdat, A., Gomes, B., & Manyika, J. (2025). *Measuring the environmental impact of delivering AI at Google scale*. Google.

> Positive ▾ | *Measuring the environmental footprint of AI must be comprehensive, accounting for the full infrastructure stack—including idle machines and data center overhead—to accurately identify all opportunities for energy and emissions reductions. Furthermore, sustained software efficiency improvements, such as optimized model architectures like Mixture-of-Experts, combined with clean energy procurement, can lead to significant reductions in AI's carbon footprint, demonstrating that a commitment to full-stack efficiency is crucial for scaling AI responsibly.*

Jones, C.R., Bergen, B.K. (2025). *Large language models pass the Turing test.* arXiv. https://arxiv.org/pdf/2503.23674

> Neutral ▾ | *This research confirms that highly-prompted, advanced AI can convincingly imitate a human being, with one model being mistaken for a person more often than the actual human in a head-to-head conversational test. For educators, this necessitates an urgent re-evaluation of digital literacy, assessment integrity, and curriculum development to prepare students for a world where AI-driven deception and social engineering are pervasive threats.*

Sun, Y., Sheng, D., Zhou, Z., & Wu, Y. (2024). AI hallucination: Toward a comprehensive classification of distorted information in artificial intelligence-generated content. *Humanities and Social Sciences Communications*, 11(1). 10.1057/s41599-024-03811-x

Negative ▾ | *Educators must prioritize teaching students to critically assess AI-generated content, as the study systematically classifies 8 major types of AI "hallucination" errors—including factual errors and unfounded fabrication—that can negatively impact learning and research. This detailed classification empowers education leaders to better inform user caution, guide rational judgment regarding AI tool reliance, and provide clear feedback to developers for system optimization that reduces misinformation at the source.*

Walters, W. H., & Wilder, E. I. (2023). Fabrication and errors in the bibliographic citations generated by ChatGPT. *Sci Rep*, 13(1). 10.1038/s41598-023-41032-5

Negative ▾ | *This study reveals that ChatGPT-generated papers frequently include fabricated or erroneous bibliographic citations, with the older GPT-3.5 version fabricating 55% of citations and the newer GPT-4 still fabricating 18%. Educators should note that fabricated citations and specific types of citation errors (especially numeric ones) are distinctive characteristics of ChatGPT-generated text that can help faculty identify potential AI use in student submissions.*

Academic Integrity & AI Detection

Casal, J. E., & Kessler, M. (2023). Can linguists distinguish between ChatGPT/AI and human writing?: A study of research ethics and academic publishing. *Research Methods in Applied Linguistics*, 2(3). https://doi.org/10.1016/j.rmal.2023.100068

Neutral ▾ | *Experienced academic reviewers were largely unsuccessful at identifying AI-generated writing from human work, achieving a positive detection rate of only 38.9%, which means educators cannot rely on human judgment alone to identify AI-assisted student submissions. This finding requires education leaders to develop clear institutional policies that differentiate between the ethical use of AI, such as for editing text or writing code, and content generation that challenges academic integrity, rather than attempting to outright ban the inevitable use of these tools.*

Fleckenstein, J., Meyer, J., Jansen, T., Keller, S. D., Köller, O., & Möller, J. (2024). Do teachers spot AI?: Evaluating the detectability of AI-generated texts among student essays. *Computers and Education: Artificial Intelligence*, 6(1). https://doi.org/10.1016/j.caeai.2024.100209

Negative ▾ | *Teachers, both novice and experienced, struggle to reliably distinguish between student-written essays and texts generated by generative AI like ChatGPT, often showing overconfidence in their incorrect judgments. Alarmingly, AI-generated essays, particularly high-quality ones, tended to be assessed more positively than student-written texts, suggesting that educators must reform their assessment strategies to ensure academic integrity and properly evaluate student learning.*

Giray, L. (2024). The problem with false positives: AI detection unfairly accuses scholars of AI plagiarism. *The Serials Librarian*, 85(5–6), 181–189. https://doi.org/10.1080/0361526X.2024.2433256

> Neutral ⌄ | *AI detection tools, intended to maintain academic integrity, often backfire by generating false positives that unfairly accuse scholars—especially non-native English speakers or those with unique writing styles—of AI plagiarism. Therefore, educational institutions must develop clear guidelines that require human oversight, establish transparent appeal processes, and cultivate healthy skepticism towards AI detection results to prevent unwarranted reputational harm and ensure fairness.*

Lee, V. R., Pope, D., Miles, S., & Zárate, R. C. (2024). Cheating in the age of generative AI: A high school survey study of cheating behaviors before and after the release of ChatGPT. *Computers and Education: Artificial Intelligence*, 7, 100253.

> Neutral ⌄ | *This study provides an essential finding for education leaders: despite the widespread availability of tools like ChatGPT, the overall rate of high school students' self-reported cheating behaviors has remained relatively stable. Educators should recognize that while students overwhelmingly view using AI to complete an entire assignment as unacceptable, they are open to and support using AI for academic scaffolding, like generating ideas or explaining new concepts.*

Liang, W., Yuksekgonul, M., Mao, Y., Wu, E., & Zou, J. (2023). GPT detectors are biased against non-native English writers. *Patterns*, 4(7). https://doi.org/10.1016/j.patter.2023.100779

> Neutral ⌄ | *GPT detectors frequently misclassify human-written essays by non-native English speakers as AI-generated, with over half of non-native samples being flagged, which poses a serious fairness risk in educational settings. Since a simple prompt change can also easily bypass these detectors' detection of true AI-generated text, educators should use these tools with extreme caution and refrain from relying on them for high-stakes evaluations to prevent false accusations of cheating.*

Cognitive Impacts & Cognitive Offloading

Bastani, H., Bastani, O., Sungu, A., Ge, H., Kabakci, Ö., & Mariman, R. (2024). Generative AI can harm learning. *The Wharton School Research Papers*.

> Negative ⌄ | *Unfettered access to generative AI for practice can significantly hurt student learning, causing students to perform worse on subsequent independent exams because they use the tool as a "crutch" for quick answers instead of engaging with the material. Therefore, educators must deploy AI with careful pedagogical guardrails, such as configuring the tool to provide only incremental hints and incorporating teacher-designed prompts, to ensure that students acquire critical skills and avoid inhibiting skill acquisition.*

Buçinca, Z., Malaya, M. B., & Gajos, K. Z. (2021). To trust or to think: Cognitive forcing functions can reduce over-reliance on AI in AI-assisted decision-making. *Proceedings of the ACM on Human-Computer Interactions*, 5(CSCW1), 1-21. https://doi.org/10.1145/3449287

> Neutral ▾ | *When integrating AI tools, educators should know that simple explanations often fail to prevent student overreliance on the technology; instead, adding cognitive forcing functions (like requiring a decision before viewing the AI's suggestion) is necessary to compel students to engage in the critical analysis of the AI's output. However, the most effective of these interventions are typically the least preferred by users and may also create a new equity challenge by disproportionately benefiting students who are already highly cognitively motivated.*

Favero, L., Pérez-Ortiz, J. A., Kãser, T., & Oliver, N. (2025). *Do AI tutors empower or enslave learners? Toward a critical use of AI in education.* arXiv. https://arxiv.org/pdf/2507.06878v1

> Negative ▾ | *Integrating AI tools into education presents risks, such as cognitive atrophy and a loss of student agency, due to over-reliance on easily accessible answers, making it crucial for educators to implement strategies that promote critical thinking and active learning. Educational leaders must champion a human-centered approach by establishing strong ethical frameworks, developing AI literacy programs for both students and teachers, and designing instruction that ensures AI serves as an empowering support rather than a shortcut that undermines deep learning and well-being.*

Gerlich, M. (2025). AI tools in society: Impacts on cognitive offloading and the future of critical thinking. *Societies 2025*, 15(6). https://doi.org/10.3390/soc15010006

> Negative ▾ | *Frequent use of AI tools by students correlates with a significant decline in critical thinking skills, as over-reliance leads to "cognitive offloading," where challenging mental tasks are delegated to the technology. Therefore, educators and leaders must implement strategies to promote critical engagement with AI, emphasizing deep thinking, analytical reasoning, and independent problem-solving to protect and develop core cognitive abilities.*

Kosmyna, N., Hauptmann, E., Yuan, Y. T., Situ, J., Liao, X.-H., Beresnitzky, A. V., Braunstein, I., & Maes, P. (2025). Your brain on ChatGPT: Accumulation of cognitive debt when using an AI assistant for essay writing task. *MIT Media Lab*. https://arxiv.org/pdf/2506.08872

> Negative ▾ | *This study reveals that while Large Language Models (LLMs) may offer immediate efficiency, prolonged use in essay writing leads to diminished brain connectivity and a measurable decrease in learning skills over time, suggesting a cognitive cost for students. Educators should therefore consider implementing hybrid learning approaches that intentionally alternate between LLM-assisted and tool-free assignments to ensure the development of robust cognitive skills, critical thinking, and genuine ownership of the written material.*

Lehmann, M., Cornelius, P. B., & Sting, F. J. (2024). *AI meets the classroom: When does ChatGPT harm learning?* arXiv. https://doi.org/10.48550/arXiv.2409.09047

> Neutral ▾ | *The impact of Large Language Models (LLMs) on student achievement largely depends on how they are used, as students who employ AI to substitute learning activities—like generating solutions—may cover more material but ultimately decrease their long-term topic*

understanding. Educational leaders should thus design learning environments that encourage the complementary use of LLMs for deeper comprehension, such as asking for explanations, while being mindful that unrestricted AI access can worsen the achievement gap by benefiting high-knowledge students more than low-knowledge students.

Oakley, B., Johnston, M., Chen, K.-Z., Jung, E., & Sejnowski, T. (2025). The memory paradox: Why our brains need knowledge in an age of AI. *The Artificial Intelligence Revolution: Challenges and Opportunities* (Springer Nature, forthcoming).

> Negative ˅ | *The key takeaway for educators is that excessive reliance on AI tools and digital offloading can impair the crucial cognitive processes—like retrieval practice and schema formation—needed to convert facts into deep, intuitive understanding. Therefore, educators must balance the use of technology with structured instruction and deliberate practice of foundational knowledge to ensure students build strong internal memory structures and fluent, automatic procedural skills.*

Singh, A., Taneja, K., Guan, Z., & Ghosh, A. (2025). *Protecting human cognition in the age of AI.* arXiv. https://arxiv.org/pdf/2502.12447

> Negative ˅ | *Generative AI (GenAI) is rapidly impacting how students learn, often by encouraging cognitive offloading and reducing engagement with deeper cognitive processes like analyzing and evaluating, which can hinder the development of critical thinking and metacognitive skills. To protect essential cognitive abilities, educators must rethink learning experiences to foster critical and evaluative skills, for instance, by minimizing the use of GenAI in the early stages of learning and designing activities that require students to actively critique AI-generated outputs.*

Student-Facing AI & Pedagogical Strategies

Beale, R. (2025). *Dialogic pedagogy for large language models: Aligning conversational AI with proven theories of learning.* arXiv. https://arxiv.org/pdf/2506.19484

> Neutral ˅ | *Large Language Models (LLMs) offer a transformative opportunity for education by providing students with personalized, always-available conversational tutors that can effectively implement proven methods like scaffolding and Socratic dialogue. To maximize this educational value, educators must actively shape these tools through careful prompt design and system integration to ensure the AI encourages genuine inquiry and critical thinking, rather than simply providing answers. This approach makes the technology an effective complement to human expertise.*

Becker, E., Wünsche, J., Veith, J.M., Schrader, J., & Bitzenbauer, P. (2025). *From cognitive relief to affective engagement: An empirical comparison of AI chatbots and instructional scaffolding in physics education.* arXiv. https://arxiv.org/pdf/2508.06254v1

> Positive ˅ | *Educators can effectively manage the inherent complexity of subjects like physics by using interactive support systems, such as custom-configured AI chatbots and structured, tiered hints, as both are profoundly more effective than static text at reducing student cognitive load.*

While both methods provide cognitive relief, the dynamic and conversational nature of the AI chatbot offers a unique advantage in fostering positive affective benefits, leading to significant gains in student enjoyment, hope, self-efficacy, and situational interest.

Belkina, M., Daniel, S., Nikolic, S., Haque, R., Lyden, S., Neal, P., Grundy, S., & Hassan, G.M. (2025). Implementing generative AI (GenAI) in higher education: A systematic review of case studies. *Computers and Education: Artificial Intelligence, 8(1).*

Positive ▾ | *A systematic review reveals that the introduction of Generative AI (GenAI), such as ChatGPT, is fundamentally reshaping instructional methods and student support, requiring education leaders to swiftly integrate these tools into academic practice. Educators can leverage GenAI to provide personalized tutoring, summarize complex material, stimulate creative thinking, and help students develop more efficient and accurate work habits.*

De Simone, M. E., Barron, M., Mosuro, W., Dikoru, E., & Manolio, F. (2024, September 18). From chalkboards to chatbots in Nigeria: Seven lessons to pioneer generative AI for education. *World Bank Blogs.*

Positive ▾ | *A pioneering pilot program in Edo State, Nigeria, demonstrated the potential of using free generative AI tools like Microsoft Copilot to provide personalized learning for 800 secondary students, showing high student engagement and inspiring teachers to view AI as an assistant. For successful scaling, the pilot's "PIONEER" lessons emphasize the need for crucial support elements, including strengthening necessary infrastructure (such as electrification and connectivity), providing relevant toolkits for prompt engineering, and carefully mitigating AI risks, such as hallucination and overreliance.*

Henderson, M., Bearman, M., Chung, J., Fawns, T., Buckingham Shum, S., Matthews, K. E., & de Mello Heredia, J. (2025). Comparing Generative AI and teacher feedback: student perceptions of usefulness and trustworthiness. *Assessment & Evaluation in Higher Education*, 1–16. https://doi.org/10.1080/02602938.2025.2502582

Neutral ▾ | *Educators must understand that while students highly value Generative AI for providing immediate, objective, and easily accessible feedback, they overwhelmingly perceive human teacher feedback as significantly more trustworthy, relevant, and expert. Therefore, GenAI should be viewed as a complementary tool for preliminary review, but it cannot replace the essential pedagogical role of the teacher in delivering high-quality, contextualized, and relationally significant guidance that supports deep learning.*

Heung, Y. M.E., & Chiu, T. K.F. (2025). How ChatGPT impacts student engagement from a systemic review and meta-analysis study. *Computers and Education: Artificial Intelligence*, 8. https://doi.org/10.1016/j.caeai.2025.100361

Positive ▾ | *Integrating ChatGPT into learning activities significantly boosts overall student engagement across behavioral, cognitive, and emotional dimensions, suggesting educators can effectively leverage it for personalized tutoring, technical assistance, and content collaboration. However, leaders and teachers must develop clear instructional strategies that capitalize on these*

strengths while proactively mitigating the potential risks of student disengagement and overreliance on technology.

Kestin, G., Miller, K., Klales, A., Milbourne, T., & Ponti, G. (2024). *AI tutoring outperforms active learning*. Research Square. https://doi.org/10.21203/rs.3.rs-4243877/v1

> Positive ▾ | *A randomized controlled trial demonstrated that a carefully designed AI tutor significantly outperformed in-class active learning in a college physics course, leading to greater student learning in less time, along with increased engagement and motivation. These findings provide a compelling case for educational leaders and educators to adopt structured, research-based, AI-powered pedagogy to enhance learning outcomes and potentially free up class time for higher-order skills, such as problem-solving and critical thinking.*

Wang, J. & Fan, W. (2025). The effect of ChatGPT on students' learning performance, learning perception, and higher-order thinking: Insights from a meta-analysis. *Humanities and Social Sciences Communications* 12. https://doi.org/10.1057/s41599-025-04787-y

> Positive ▾ | *The overall findings of this research show that integrating ChatGPT has a large positive impact on student learning performance and a moderate positive effect on both higher-order thinking and overall learning perception. To maximize student growth, educators should strategically incorporate ChatGPT over a sustained period of 4–8 weeks, particularly by utilizing it in problem-based learning or as an intelligent tutor, while providing scaffolds to ensure the robust development of complex thinking skills.*

AI Literacy, Ethics, and Institutional Policy

Buyserie, B., & Thurston, T. N. (Eds.). (2024). *Teaching and generative AI: Pedagogical possibilities and productive tensions*. Utah State University.

> Neutral ▾ | *This collection offers practical and thoughtful pedagogical resources for teachers, librarians, and instructional designers to navigate the possibilities and challenges of generative AI in education. By emphasizing critical digital pedagogy and the importance of iterative thinking, the book encourages educators and students to critically reflect on the impact of AI on learning, ethics, and traditional educational practices.*

Dangol, A., Wolf, R., Zhao, R., Kim, J., Ramanan, T., Davis, K., & Kientz, J. A. (2025). *Children's mental models of AI reasoning: Implications for AI literacy education*. arXiv. https://arxiv.org/pdf/2505.16031v1

> Neutral ▾ | *Younger students (grades 3-5) typically view AI reasoning as an inherent, almost magical intelligence, while older students (grades 6-8) demonstrate an emerging and more accurate understanding of AI as a data-driven "pattern recognizer". To correct misconceptions and build robust AI literacy, educators must explicitly design curricula that bridge computational and data literacies, helping students understand AI as a learning system that processes data, not just a system of predefined human rules or an omniscient database.*

Elon University & American Association of Colleges and Universities. (2025). *Student Guide to Artificial Intelligence* (2nd ed.). Imagining the Digital Future Center. https://studentguidetoai.org/wp-content/uploads/2025/03/Student-Guide-to-AI-2025.pdf

> Neutral ▾ | *Educators and leaders must urgently adapt their teaching models and assignments, as the AI revolution requires institutions to both teach students essential AI literacy skills for their future careers and actively cultivate human capabilities such as critical thinking, ethical judgment, and creative problem-solving. The central mandate is to create clear, assignment-specific policies that ensure students use AI to augment their work—not replace their intellectual effort—by remaining the primary author, being fully transparent, and properly attributing any AI assistance.*

MLA-CCCC Joint Task Force on Writing and AI. (2024). *Building a culture for generative AI literacy in college language, literature, and writing.* Modern Language Association.

> Neutral ▾ | *Educators should proactively build a comprehensive culture of Generative AI (GAI) literacy across the entire academic enterprise, requiring that programs integrate GAI skills into existing curriculum rather than treating it as an add-on. This approach emphasizes that faculty must seek professional development and model transparency to teach students how to critically evaluate GAI output for accuracy and bias while making informed, ethical decisions about its role in their learning.*

Nash, B. L., Garcia, M., Young, C. A., Turner, K. H., Rice, M., Piotrowski, A., O'Bryne, W. I., McBride, C., McGrail, E., Moran, C., Hicks, T., Fassbender, W., Boutelier, S., & Alvermann, D. (2024, November 21). ELATE position statement: Exploring, incorporating, and questioning generative artificial intelligence in English teacher education. *NCTE Position Statements.*

> Neutral ▾ | *English Language Arts (ELA) teacher educators must actively explore, incorporate, and critically question Generative Artificial Intelligence (GenAI) in their practice, as ignoring its impact would be a disservice to students. Educators should focus on developing students' GenAI literacy, maintaining a human-centered approach that emphasizes creativity and critical thinking, and modeling ethical practices while avoiding the elimination of the productive struggle inherent in writing.*

Pu, I., Ravi, P., Dinh, L. D., Joe, C., Ogoe, C., Li, Z., Breazeal, C., & Ostrowski, A. (2025). *"How can we learn and use AI at the same time?": Participatory design of GenAI with high school students.* arXiv. https://arxiv.org/pdf/2506.15525v2

> Neutral ▾ | *Educators and leaders must formally incorporate high school students' perspectives into school AI policy development, as students advocate for system-level solutions like built-in source citations and transparent design to address concerns about cheating, bias, and over-reliance. To support this integration, schools should prioritize ongoing, adaptive professional development for teachers using AI, potentially by establishing peer-to-peer learning models where digitally savvy students act as "AI Ambassadors."*

Utah State Board of Education. (2024). *Artificial Intelligence for Utah P-12 Education: Guidance on the Use of AI in Our Schools.*

Neutral ˅ | *This guidance from the Utah State Board of Education seeks a balanced approach to using artificial intelligence, maximizing learning opportunities while responsibly managing risks related to security, privacy, and academic integrity. Educators and administrators are advised to utilize AI to advance student educational goals and improve operations, clarify its permitted use in classrooms, and commit to providing ongoing staff and student AI literacy education.*

Curriculum Reform & Future Skills

Friis, S., & Riley, J. W. (2025). Performance or principle: Resistance to artificial intelligence in the U.S. labor market. *Harvard Business School Working Paper*, No. 26-017, https://ssrn.com/abstract=5560401.

Neutral ˅ | *Education leaders should recognize that for most future occupations, public resistance to artificial intelligence (AI) is only temporary and will likely dissolve as the technology improves, strongly suggesting a priority shift toward integrating AI for augmentation and collaboration across the curriculum. However, a small but critical set of roles centered on caregiving, emotional labor, and spiritual authority remains categorically off-limits due to a fixed moral boundary, requiring educators to emphasize these intrinsically human skills for the most AI-resistant careers.*

OECD (2025). *Introducing the OECD AI Capability Indicators*, OECD Publishing, Paris, https://doi.org/10.1787/be745f04-en.

Neutral ˅ | *This report introduces a framework of five-level scales across nine human-like capabilities, such as Language and Creativity, which educators can use to anticipate AI's advancements and proactively reform curricula and instructional systems. By mapping the required human abilities for teaching tasks against AI's capabilities, this tool helps leaders clarify which teacher roles may be reshaped and what essential skills students must learn to thrive alongside increasingly powerful AI systems.*

OECD (2025). What should teachers teach and students learn in a future of powerful AI? *OECD Education Spotlights*, 20.

Positive ˅ | *A 2024 expert workshop explored how the rapid evolution of powerful AI should prompt educators and leaders to rethink the goals, content, and organization of school curricula, shifting emphasis away from solely preparing students for STEM jobs toward fostering scientific literacy for all, civic engagement, and joyful, meaningful learning. This rebalancing means focusing on students becoming "competent outsiders" who can critically evaluate science and engage with real-world issues through inquiry, rather than merely replicating professional scientific practices.*

World Economic Forum (2025). The Future of Jobs Reports 2025. *World Economic Forum*.

Neutral ˅ | *The future workforce requires educators to immediately pivot their focus, deeply integrating AI, cybersecurity, and technological literacy alongside core human-centric competencies like creative thinking and resilience. To meet the critical mandate of upskilling*

nearly 60% of the global workforce by 2030 and to fill growing roles, such as teachers, education leaders must prioritize the creation of diverse, accessible training pathways, including apprenticeships and vocational programs.

Yan, L., Greiff, S., Teuber, Z., & Gašević, D. (2024). Promises and challenges of generative artificial intelligence for human learning. *Nature Human Behavior* 8, 1839–1850. https://doi.org/10.1038/s41562-024-02004-5

Neutral ⌄ | *Generative AI offers powerful new capabilities for educators, including scaling personalized tutoring, diversifying teaching materials, and providing more immediate, in-depth feedback to students. To harness these benefits, education leaders must prioritize the immediate development of AI literacy across their institutions and redesign traditional assessments to measure human-AI hybrid skills while managing critical issues like algorithmic bias, data privacy, and model inaccuracies ("hallucinations").*