Bridging the Algorithmic Divide: Refocusing Faculty Artificial Intelligence Literacy in Higher Education

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Abstract

The urgency for artificial intelligence (AI) literacy has been highlighted by the 2024 Nobel Prizes in Physics and Chemistry, awarded for groundbreaking AI research. Despite AI's transformative potential in higher education, a digital divide persists between faculty and students, with educators often lagging behind in AI adoption. This commentary addresses the critical need to enhance AI literacy among faculty, examines the barriers to AI adoption, and emphasises the evolving role of students as contributors to faculty development. The commentary outlines future research and development directions, including interdisciplinary studies, ethical frameworks, and international collaboration, to foster an inclusive and effective AI-integrated educational environment. Through these efforts, higher education can cultivate a technologically adept and ethically informed academic community, prepared to leverage AI for scientific discovery and innovation.

Keywords: AI literacy; faculty development; STEM education; higher education; educational transformation

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Introduction

Artificial intelligence (AI) technologies have rapidly become a transformative force for higher education as they offer unprecedented opportunities to enhance teaching and learning experiences. The 2024 Nobel Prizes in Physics and Chemistry highlight AI's profound impact on scientific research and innovation (Coulter 2024), underscoring the urgent need for higher education institutions to prioritise AI literacy among faculty and students. These prestigious recognitions highlight AI's potential across diverse scientific domains, emphasising the urgent need for higher education institutions to prioritise AI literacy, thereby creating an educational environment that is both technologically informed and ethically grounded (Casal-Otero et al. 2023; Ng et al. 2021). While student-focused initiatives for AI literacy are essential, an equally critical need exists to enhance AI literacy among faculty, particularly in science, technology, engineering, and mathematics (STEM) departments. As faculty serve as the primary conduits of knowledge and innovation, their proficiency in AI is crucial for fostering an educational environment that prepares students for a future shaped by technological advancements.

In examining the role of faculty as AI followers and learners, this commentary explores the various barriers that hinder the adoption of AI technologies among educators. These barriers include institutional inertia, cultural apprehensions, and individual challenges. Addressing these barriers requires a multifaceted approach that includes professional development, interdisciplinary collaboration, and institutional support. Moreover, this commentary highlights the importance of rethinking the role of students in the context of AI integration. Students, as quick adopters of AI technologies, possess valuable insights and practical knowledge that can support faculty in developing their AI literacy. The commentary also underscores the need for institutional support and policy reform to encourage faculty to pursue AI literacy and integrate AI technologies into their pedagogical practices.

Collectively, this commentary calls for a comprehensive approach to AI literacy that encompasses both faculty and students. By enhancing AI literacy among educators, fostering a collaborative learning environment, and providing institutional support, higher education institutions can bridge the digital divide and create a dynamic, inclusive educational landscape.

Nobel Prize: Significance, Controversies, and Current AI Trend

The Nobel Prize, established through the will of Alfred Nobel, stands as one of the most prestigious global accolades, celebrating significant contributions to humanity in the fields of Physics, Chemistry, Medicine, Literature, Peace, and Economics. Alfred Nobel's vision for the Nobel Prize was to honour those whose work had conferred the greatest benefit to humankind. Over the years, the Nobel Prizes have maintained their esteemed status, celebrating significant achievements while also playing a crucial role in shaping scientific discourse and public perception (Eshach 2009).

The scientific significance of the Nobel Prize highlights groundbreaking research and discoveries that often catalyse profound paradigm shifts in their respective fields. The 2024 Nobel Prizes awarded to AI pioneers John Hopfield and Geoffrey Hinton in Physics, and Demis Hassabis and John Jumper in Chemistry, underscore AI's transformative impact on modern science. Hopfield and Hinton's work in machine learning and neural networks laid the groundwork for advancements that have revolutionised numerous scientific domains, including biochemistry, as evidenced by Hassabis and Jumper's AI-driven protein structure predictions. These awards widely signal the broader scientific community's validation of AI as a revolutionary tool across disciplines.

However, the Nobel Prize's significance extends beyond its scientific contributions. It plays a crucial political and ideological role, serving as a global endorsement of scientific and humanitarian values. For instance, the Nobel Peace Prize has been awarded to individuals and organisations advocating human rights, disarmament, and conflict resolution, reflecting global political currents and the promotion of international peace. Similarly, the awards in scientific fields can influence funding priorities, public interest, and policymaking, steering the direction of future research and innovation.

Despite its esteemed status, the Nobel Prize is not without its controversies and criticisms. Critics argue that the prizes only reflect Eurocentric and male-dominated perspectives, potentially overlooking significant contributions from other regions and under-represented groups (Feldman 2000). Historically, the Nobel Prizes in scientific fields have predominantly been awarded to researchers from Western countries, raising questions about inclusivity and representation in global scientific recognition. The Nobel Prize also serves an ideological function, reinforcing certain narratives about the nature of scientific progress and the individuals who drive it. The emphasis on individual achievement, often symbolised by the solitary genius, can overshadow the collaborative and cumulative nature of scientific research. This perspective can marginalise the contributions of lesser-known researchers, technicians, and interdisciplinary teams who play crucial roles in scientific advancements (Bucchi 2018).

Despite these criticisms, the Nobel Prize remains an unparalleled symbol of excellence in the scientific community, continuing to influence future research and teaching agendas. The recent recognition of AI in the 2024 awards signals a critical turning point in how AI is perceived and valued within both the scientific world and society at large. In this regard, it is imperative that higher education institutions prioritise AI literacy, both among the faculty and students, to develop a critical understanding of AI's technological capabilities and ethical implications.

A New Digital Gap: Faculty Left Behind in AI Use

The attitudes of higher education faculty towards the integration of AI into teaching are shaped by a delicate balance of optimism, scepticism, and caution. Although there is a growing recognition of AI's transformative potential to enhance pedagogical

approaches, a significant proportion of faculty remain hesitant to embrace these tools in their instructional strategies.

A recent survey conducted by Turnitin (Bharadwaj et al. 2023), the largest internet-based educational services provider focusing on academic integrity, in March 2023 revealed that only 9% of faculty members actively used AI tools in their teaching. Those who did engage with AI primarily used it to monitor and better understand how their students were utilising these tools rather than integrating AI as a core component of their own teaching practice. This digital gap is further confirmed by findings from the UK Department of Education (The Open Innovation Team and Department for Education 2024), which revealed that nearly half of primary and secondary school teachers have never used AI in any capacity—whether in their professional duties or personal activities. Alarmingly, only 7% of educators reported incorporating AI tools into their lessons or classroom activities. This stark gap between awareness of AI's potential and its actual implementation in educational settings suggests that many educators are not yet prepared to fully leverage AI's benefits.

One of the key concerns driving faculty hesitation is the perceived threat AI poses to academic integrity. AI's ability to generate content that mimics human output has led to fears that students could misuse these technologies to bypass learning processes, undermining the value of education. According to a 2024 survey conducted by Wiley, the academic publisher, 96% of instructors believe that some students cheated over the past year—a sharp increase from 72% in 2021. Additionally, over half of students (53%) reported that cheating had increased in the past year, with nearly a quarter (23%) describing a significant rise in academic misconduct, largely attributed to the increasing use of AI tools in academic work. Both instructors and students anticipate that cheating will continue to grow, fuelled by the pervasive availability of generative AI applications such as ChatGPT, which can be used to generate essays, assignments, and other academic content.

Interestingly, the survey results also highlight a significant disparity between faculty perceptions of AI misuse and the actual integration of AI into their teaching. While many instructors express concerns about the misuse of AI, fewer than 15% report having used AI in their classrooms in the past year. By contrast, 45% of students have used AI tools to assist with tasks such as brainstorming, generating ideas for essays, or solving complex problems. This contrast suggests that the reluctance among faculty may stem not only from fears about AI's impact on academic integrity but also from a general lack of familiarity with AI tools and their educational potential.

In many cases, the gap between student and faculty AI usage highlights the growing urgency for faculty to embrace AI literacy, both to keep pace with student adoption of these technologies and to harness AI's potential for improving teaching and learning outcomes. For educators, the unfamiliarity with AI tools may lead to a missed opportunity to leverage AI as a valuable asset in the classroom. As students become

increasingly adept at using AI to facilitate their learning, it becomes critical for faculty to develop similar competencies to ensure that they can guide students in the ethical and productive use of AI technologies.

Current Barriers: Faculties as AI Learners

The role of faculty in higher education, particularly within STEM disciplines, extends beyond traditional teaching responsibilities. Faculty members must also embrace the role of learners to keep pace with technological developments that are reshaping educational landscapes. This dual role of educator and learner is essential for effectively integrating AI into curricula and preparing students for a future defined by AI-driven innovation.

Nevertheless, the barriers for faculty to further develop AI literacy are multifaceted, encompassing institutional, cultural, and individual dimensions. One of the primary barriers is institutional inertia, where traditional educational structures and rigid curricula hinder the adoption of innovative teaching methodologies (Jónasson 2016). The reluctance of faculty to integrate AI into their teaching practices is compounded by the lack of formal training and clear institutional policies surrounding AI use. Many educators have expressed a desire for more structured training in AI, recognising the importance of AI literacy in modern educational environments. However, a significant portion of those who have sought training have had to rely on external organisations with substantial costs (Luckin 2017). This dependence on external resources highlights a critical gap in the professional development offerings of higher education institutions, where internal training programmes on AI are either insufficient or non-existent.

Further complicating the issue is the lack of institutional policies regulating AI use in the classroom. According to a recent global survey by the United Nations Educational, Scientific and Cultural Organization (UNESCO 2024) involving over 450 educational institutions, less than 10% have established formal policies or guidance concerning the use of generative AI applications. This statistic highlights the uncertainty and lack of preparedness among educational systems in response to the rapid advancements in AI technology. While universities are more likely to have some form of guidance compared to primary and secondary schools—13% versus 7%, respectively—most of these policies are not comprehensive. The majority of institutions that have some guidance often provide only informal or verbal instructions, with only 40% offering written policies. Moreover, the survey found that close to 20% of respondents were unsure whether their institutions had any AI policies or guidance, underscoring the pervasive uncertainty and regulatory void surrounding AI in education. Without clear policies in place, educators are left to navigate the complexities of AI integration on their own, which can lead to inconsistent practices and potentially undermine educational outcomes. Establishing comprehensive institutional guidelines and providing robust, institution-led professional development opportunities are critical steps towards empowering faculty to confidently and effectively utilise AI in their pedagogical practices.

Cultural barriers within academic institutions present significant obstacles to the integration of AI into higher education, particularly within STEM fields. Studies have demonstrated that many educators view AI as a disruptive force that could destabilise traditional teaching methods or lead to obsolescence (Bewersdorff et al. 2023; Velander et al. 2024). This fear, often based on misunderstandings of AI's capabilities and limitations, contributes to a culture of resistance among faculty members who are wary of incorporating AI technologies into their pedagogical practices (Acikgoz, Borulu, and Bölen 2024). This resistance is not merely a rejection of innovation but rather a reflection of deeper concerns about job security, relevance, and the shifting educational paradigm.

At the individual level, many faculty members also face personal barriers. A lack of confidence in their ability to master AI concepts is a pervasive issue, as some educators perceive AI as too complex or outside the scope of their disciplinary expertise (Sejnowski 2020). Such a sense of inadequacy is further compounded by the rapid pace of AI development, which can leave even technologically proficient faculty feeling overwhelmed by the constant evolution of AI tools and applications. These individual barriers are exacerbated by the absence of tailored professional development opportunities that address the diverse needs and backgrounds of faculty members.

Therefore, developing AI literacy among faculty is crucial for advancing the integration of AI into STEM education. Faculty who are proficient in AI can better navigate the complexities of these technologies and prepare students for a future driven by innovation. Furthermore, by embracing AI as learners, faculty members can contribute to a more dynamic and forward-thinking educational environment, where AI is used to enhance learning outcomes and promote critical thinking. Institutions must prioritise professional development, foster interdisciplinary collaboration, and address the cultural barriers that hinder AI adoption if they are to fully realise the potential of AI in education.

A Call to Action: Institutional Support and Policy Reform

The dynamic nature of AI technologies requires educational institutions to adopt a proactive stance, ensuring that faculty members are equipped with the necessary skills and knowledge to integrate AI effectively into their pedagogical practices. Institutional support and policy reforms are pivotal in overcoming barriers to AI literacy and fostering an environment that prioritises continuous learning and innovation.

A fundamental aspect of institutional support involves the allocation of adequate attention and resources for faculty development in AI literacy. This includes financial investments in professional development programmes, technological infrastructure, and research initiatives that focus on AI applications in education. Institutions must recognise that fostering AI literacy among faculty is not a peripheral activity but a central component of their mission to provide high-quality education in a rapidly evolving technological landscape. By committing resources to AI literacy initiatives,

institutions can signal their dedication to preparing both educators and students for the future (Fullan 2015).

Policy reforms are equally critical in facilitating the integration of AI literacy. Currently, many institutions emphasise traditional metrics such as publication records and teaching evaluations. However, integrating AI literacy into these evaluation processes can incentivise faculty to engage with AI technologies and incorporate them into their teaching and research (Nazaretsky et al. 2022; Ng et al. 2021). This policy shift not only acknowledges the importance of AI literacy but also aligns faculty incentives with institutional goals of technological advancement.

Another critical aspect of institutional support involves fostering interdisciplinary collaboration. AI is inherently interdisciplinary, drawing from fields such as computer science, data science, ethics, and domain-specific knowledge. Institutions must create opportunities for faculty from different disciplines to collaborate on AI-related projects, research, and teaching initiatives. This can be achieved through interdisciplinary grants, collaborative research programmes, and cross-departmental workshops. By encouraging interdisciplinary collaboration, institutions can enhance the depth and breadth of AI literacy among faculty, enabling them to approach AI from multiple perspectives and apply it effectively in their teaching (Kim 2024; Lattuca, Bergom, and Knight 2014).

Moreover, institutions must address the cultural apprehensions surrounding AI by promoting a culture of openness and transparency. Institutions should facilitate open dialogues and discussions on these issues, providing faculty with a platform to voice their concerns and explore the ethical dimensions of AI. Incorporating ethics and social responsibility into AI literacy programmes can help faculty navigate these complexities and ensure that AI applications in education are used in an ethical and equitable manner (Acikgoz, Borulu, and Bölen 2024).

In addition to internal support, institutions should seek external partnerships to enhance their AI literacy initiatives. Collaborations with industry, government agencies, and other educational institutions can provide valuable resources, expertise, and insights into the latest AI developments. These partnerships can facilitate the exchange of best practices, access to advanced AI tools, and opportunities for faculty to engage in real-world AI applications. By leveraging external partnerships, institutions can enrich their AI literacy programmes and provide faculty with a broader perspective on AI and its implications (Dubljević 2024).

Rethink the Role of the Student

Students today are increasingly exposed to AI tools that can assist with a myriad academic tasks, from generating ideas and drafting essays to solving complex problems and providing personalised feedback. Given this trend, it is essential to shift the educational paradigm from a teacher-centred model to a more student-centred approach.

This reimagining involves fostering a culture of collaboration, critical thinking, and ethical considerations, thereby preparing students to navigate and shape the future of AI-driven innovation.

In this redefined role, students are not mere recipients of knowledge but active co-creators of their learning journeys. This shift necessitates a re-evaluation of traditional teaching methods and assessment strategies, encouraging a more participatory and enquiry-based learning environment (Barab et al. 2000; Wu and Hsieh 2006). By empowering students to take ownership of their learning, educators can foster a sense of agency and responsibility, which are crucial for the ethical and effective use of AI technologies (Luckin 2017).

To facilitate this transformation, educational institutions must prioritise AI literacy as a fundamental component of the curriculum. Besides, fostering a culture of collaboration is vital in rethinking the role of students in an AI-integrated educational landscape. Interdisciplinary collaboration, both among students and between students and faculty, can enrich the learning experience by exposing students to diverse perspectives and expertise. Collaborative projects that involve AI applications can provide students with hands-on experience in solving real-world problems, thereby enhancing their critical thinking and problem-solving skills. Such projects also encourage students to work together, share knowledge, and learn from one another, promoting a sense of community and collective responsibility (Nowell and Boyd 2010).

Ethical considerations must also play a central role in this redefined educational paradigm. As students become more adept at using AI tools, it is crucial to instil a strong ethical foundation that guides their use of these technologies. This involves teaching students about the potential biases and limitations of AI, the importance of data privacy, and the broader societal implications of AI applications. By incorporating ethics into AI education, institutions can ensure that students are not only technically proficient but also morally and ethically aware, capable of making informed decisions that benefit society as a whole (Dubljević 2024).

In sum, rethinking the role of students in the context of AI integration in higher education is crucial for preparing both students and faculty to navigate and shape the future. By recognising students as quick AI learners and leveraging their familiarity with AI tools, educational institutions can create a collaborative learning environment that benefits all parties involved. This redefined role not only enhances their academic experiences but also prepares them to contribute meaningfully to a rapidly evolving technological landscape. Through these efforts, higher education can cultivate a generation of informed, responsible, and innovative individuals capable of harnessing AI's potential for the greater good.

Conclusion and Future Directions

As we have explored throughout this commentary, the integration of AI in higher education presents a complex interplay of opportunities and challenges. The current landscape reveals a significant digital gap between faculty and students in terms of AI adoption, with students being far more proactive in leveraging AI tools to enhance their learning experiences. This disparity underscores the urgent need for institutions to prioritise AI literacy among faculty, ensuring that educators are not left behind in this technological revolution.

Looking ahead, several future directions can be pursued to ensure a more inclusive and effective AI-integrated educational environment. First, one crucial area of future directions involves examining the role of AI in fostering interdisciplinary collaboration between STEM and non-STEM fields. As demonstrated by the Nobel-winning work in chemistry and physics, AI has become an indispensable tool for cross-disciplinary research, driving innovation in fields that traditionally had minimal computational focus. Educational institutions must explore how AI can be used to bridge disciplinary silos, fostering a culture of interdisciplinary learning that prepares students for complex, real-world challenges. Future studies should investigate how AI can be integrated into interdisciplinary projects, exploring its potential to facilitate communication and collaboration between diverse academic disciplines.

Moreover, the dual recognition of AI in the Nobel Prizes highlights the ethical and societal dimensions of this technology. Geoffrey Hinton's decision to leave Google to voice his concerns about the potential dangers of AI emphasises the critical need for future research to focus on ethical frameworks for AI use (Metz 2024). Research should explore how educational institutions can cultivate a culture of ethical AI literacy among students and faculty, ensuring that all stakeholders are aware of the risks and ethical considerations associated with AI. Developing robust frameworks for teaching the ethical use of AI in scientific research and education will be essential in promoting responsible innovation and safeguarding against misuse.

Finally, given the global implications of AI, future research should focus on developing international frameworks for AI literacy and governance in education. With the advance of AI literacy, the breakthroughs celebrated by future Nobel Prizes should not be confined to a specific region but represent a collaborative global effort. Therefore, research should explore how different educational systems around the world are integrating AI into their curricula, comparing approaches and outcomes. Such comparative studies can inform the development of best practices for AI integration in diverse educational contexts, promoting a shared understanding of AI literacy that transcends national boundaries.

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References

Acikgoz, F., B. Borulu, and M. C. Bölen. 2024. "How Does Obsolescence Risk Influence Consumer Resistance to Smartwatches?" *Information Technology and People*. https://doi.org/10.1108/ITP-08-2023-0843.

Barab, S. A., K. E. Hay, K. Squire, M. Barnett, R. Schmidt, K. Karrigan, L. Yamagata-Lynch, and C. Johnson. 2000. "Virtual Solar System Project: Learning through a Technology-Rich, Inquiry-Based, Participatory Learning Environment". *Journal of Science Education and Technology* 9: 7–25. https://doi.org/10.1023/A:1009416822783.

Bewersdorff, A., X. Zhai, J. Roberts, and C. Nerdel. 2023. "Myths, Mis- and Preconceptions of Artificial Intelligence: A Review of the Literature". *Computers and Education: Artificial Intelligence* 4: 100143. https://doi.org/10.1016/j.caeai.2023.100143.

Bharadwaj, P., C. Shaw, L. NeJame, S. Martin, N. Janson, and K. Fox. 2023. *Time for Class 2023: Bridging Student and Faculty Perspectives on Digital Learning*. Tyton Partners. Accessed December 7, 2024. https://www.turnitin.com/whitepapers/tyton-partners-time-for-class-study.

Bucchi, M. 2018. "'The Winner Takes It All?' Nobel Laureates and the Public Image of Science". *Public Understanding of Science* 27 (4): 390–396. https://doi.org/10.1177/0963662518764948.

Casal-Otero, L., A. Catala, C. Fernández-Morante, M. Taboada, B. Cebreiro, and S. Barro. 2023. "AI Literacy in K-12: A Systematic Literature Review". *International Journal of STEM Education* 10 (1): 29. https://doi.org/10.1186/s40594-023-00418-7.

Coulter, M. 2024. "Google's Nobel Prize Winners Stir Debate over AI Research". Reuters, October 10, 2024. Accessed December 7, 2024. https://www.reuters.com/technology/artificial-intelligence/googles-nobel-prize-winners-stir-debate-over-ai-research-2024-10-10/.

Dubljević, V. 2024. "Colleges and Universities Are Important Stakeholders for Regulating Large Language Models and Other Emerging AI". *Technology in Society* 76: 102480. https://doi.org/10.1016/j.techsoc.2024.102480.

Eshach, H. 2009. "The Nobel Prize in the Physics Class: Science, History, and Glamour". *Science and Education* 18: 1377–1393. https://doi.org/10.1007/s11191-008-9172-4.

Feldman, B. 2000. *The Nobel Prize: A History of Genius, Controversy, and Prestige*. New York: Arcade Publishing.

Fullan, M. 2015. *The New Meaning of Educational Change*. New York: Teachers College Press.

Jónasson, J. T. 2016. "Educational Change, Inertia and Potential Futures: Why Is It Difficult to Change the Content of Education?" *European Journal of Futures Research* 4: 1–14. https://doi.org/10.1007/s40309-016-0087-z.

Kim, J. 2024. "Leading Teachers' Perspective on Teacher-AI Collaboration in Education". *Education and Information Technologies* 29 (7): 8693–8724. https://doi.org/10.1007/s10639-023-12109-5.

Lattuca, L. R., I. Bergom, and D. B. Knight. 2014. "Professional Development, Departmental Contexts, and Use of Instructional Strategies". *Journal of Engineering Education* 103 (4): 549–572. https://doi.org/10.1002/jee.20055.

Luckin, R. 2017. "Towards Artificial Intelligence-Based Assessment Systems". *Nature Human Behaviour* 1 (3): 0028. https://doi.org/10.1038/s41562-016-0028.

Metz, C. 2023. "'The Godfather of A.I.' Leaves Google and Warns of Danger Ahead". *The New York Times*, May 1, 2023. Accessed December 7, 2024. https://www.nytimes.com/2023/05/01/technology/ai-google-chatbot-engineer-quits-hinton.html.

Nazaretsky, T., M. Ariely, M. Cukurova, and G. Alexandron. 2022. "Teachers' Trust in AI-Powered Educational Technology and a Professional Development Program to Improve It". *British Journal of Educational Technology* 53 (4): 914–931. https://doi.org/10.1111/bjet.13232.

Ng, D. T. K., J. K. L. Leung, S. K. W. Chu, and M. S. Qiao. 2021. "Conceptualizing AI Literacy: An Exploratory Review". *Computers and Education: Artificial Intelligence* 2: 100041. https://doi.org/10.1016/j.caeai.2021.100041.

Nowell, B., and N. Boyd. 2010. "Viewing Community as Responsibility as well as Resource: Deconstructing the Theoretical Roots of Psychological Sense of Community". *Journal of Community Psychology* 38 (7): 828–841. https://doi.org/10.1002/jcop.20398.

Open Innovation Team and Department for Education. 2024. "Generative AI in Education Educator and Expert Views". Accessed December 7, 2024. https://assets.publishing.service.gov.uk/media/65b8cd41b5cb6e000d8bb74e/DfE_GenAI_in_education_-_Educator_and_expert_views_report.pdf.

Sejnowski, T. J. 2020. "The Unreasonable Effectiveness of Deep Learning in Artificial Intelligence". *Proceedings of the National Academy of Sciences* 117 (48): 30033–30038. https://doi.org/10.1073/pnas.1907373117.

UNESCO (United Nations Educational, Scientific and Cultural Organization). 2024. "UNESCO Survey: Less Than 10% of Schools and Universities Have Formal Guidance on AI". UNESCO, June 1, 2023, last updated September 18, 2024. Accessed December 7, 2024. https://www.unesco.org/en/articles/unesco-survey-less-10-schools-and-universities-have-formal-guidance-ai.

Velander, J., M. A. Taiye, N. Otero, and M. Milrad. 2024. "Artificial Intelligence in K-12 Education: Eliciting and Reflecting on Swedish Teachers' Understanding of AI and Its Implications for Teaching and Learning". *Education and Information Technologies* 29 (4): 4085–4105. https://doi.org/10.1007/s10639-023-11990-4.

Wiley. 2024. "The Latest Insights into Academic Integrity: Instructor and Student Experiences, Attitudes, and the Impact of AI 2024 Update". Wiley, July 26, 2024. Accessed December 7, 2024. https://www.wiley.com/en-us/network/education/instructors/teaching-strategies/the-latest-insights-into-academic-integrity-instructor-and-student-experiences-attitudes-and-the-impact-of-ai-2024-update.

Wu, H.-K., and C.-E. Hsieh. 2006. "Developing Sixth Graders' Inquiry Skills to Construct Explanations in Inquiry-Based Learning Environments". *International Journal of Science Education* 28 (11): 1289–1313. https://doi.org/10.1080/09500690600621035.