

Role of Artificial Intelligence in Sustainable Development of Education at Global Level

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ABSTRACT

Artificial Intelligence (AI) integration in education has become one of the most influential forces shaping sustainable development across the world. Education, as conceived under the United Nations Sustainable Development Goal 4 (SDG-4), focuses on inclusive and equitable quality learning for all. Nevertheless, current issues like unequal access, lack of qualified teachers, linguistic barriers, and high dropout rates continue to hinder educational advancements worldwide. Here, AI provides new solutions that can fill gaps and create sustainable educational environments globally. This paper investigates the potential of AI in ensuring sustainable education development through the examination of its applications, advantages, and disadvantages in various contexts. AI-based technologies like personalized learning platforms, adaptive tests, intelligent tutoring systems, and predictive analytics are transforming how students learn and teachers deliver knowledge. Through data-driven intelligence, AI facilitates individualized learning paths, increases accessibility for students with disabilities, and bridges geographical and language gaps. In addition, AI helps advance environmental sustainability through the reduction of physical resource dependency and encouraging digital learning platforms with minimal carbon impacts. At the international level, AI solutions exhibit differing effects between developed and developing countries. While developed countries leverage AI for advanced smart classrooms and curriculum design, developing countries utilize AI to enhance accessibility, reduce learning inequalities, and improve teacher capacity. Case studies from different regions reveal that AI can significantly contribute to reducing dropout rates, ensuring skill development, and fostering lifelong learning. Yet, their sustainability is contingent upon solving the existential issues of data privacy, the ethical utilization of AI, technological disparities, and the digital divide. The research also reveals future opportunities of AI in education such as integration with newer technologies like Blockchain, Internet of Things (IoT), and Virtual/Augmented Reality, which can further transform learning systems around the world. For achieving sustainable development, international cooperation, favorable policies, and universal access to AI infrastructure are essential. In conclusion, AI has the vast potential to revolutionize education and make it inclusive, equitable, and sustainable in the world. Despite challenges, strategic adoption and ethics can help ensure that AI becomes a driving force for long-term educational sustainability and bringing global commitments under the SDGs to fruition.

Keywords: Artificial Intelligence (AI), Sustainable Development, Global Education, SDG-4, Personalized Learning, Educational Technology, Digital Inclusion, AI Ethics; Teacher.

Introduction

Artificial Intelligence (AI) has become a force of revolution with wide-ranging implications in various domains, and education is one of the most vibrant areas impacted by its implementation.

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Education, in the modern global context, is not just viewed as a fundamental human right but also as an agent for sustainable development. The United Nations' Sustainable Development Goal 4 (SDG-4) is for inclusive and equitable quality education and lifelong learning opportunities for all. However, realizing this vision is a challenge due to disparities in access, lack of teachers, outdated pedagogy, and the digital divide between countries.

AI offers a revolutionary route to overcoming these challenges through the transformation of the manner in which education is delivered, accessed, and maintained. By means of learning tools such as adaptive learning systems, virtual classrooms, intelligent tutoring platforms, and predictive analytics, AI makes learning personalized, flexible, and data-sensitive. For example, AI can tailor curricula to fit students' learning capabilities, detect early identification of struggling learners, and offer instant feedback. Such interventions make strong contributions to minimizing dropout levels and enhancing general learning outcomes.

At the international level, AI is used for varied objectives. Developed nations are using AI to promote intelligent education systems, bringing robotics, natural language processing, and virtual reality into the classroom. Developing countries, on the other hand, are using AI to enhance accessibility, teacher training, and resource allocation in disadvantaged regions. This demonstrates the ability of AI not just to close gaps but also to promote international cooperation in education.

Moreover, AI complies with sustainability objectives by minimizing reliance on physical infrastructure, paper documents, and energy-consuming habits, hence decreasing environmental footprint. Nonetheless, the use of AI in education also has its challenges, including ethical issues, privacy invasion, algorithmic bias, and technological over-reliance. The international education community, thus, has to strike a balance between innovation and responsibility, ensuring that AI is implemented inclusively and fairly.

This research centers on the contribution of AI to the sustainable development of education globally, with an emphasis on its uses, advantages, limitations, and prospects. It further emphasizes the need for global cooperation, strong policies, and ethical standards to make AI a sustainable catalyst for changing education globally.

Background of the Study

Education has consistently played a paramount role in human advancement, and it has formed societies and facilitated economic and cultural growth. But the conventional education model has long been faced with the challenge of keeping up with the needs of globalization, quick technological advancement, and increasing population. Issues such as poor infrastructure, shortages of teachers, language limitations, disparity in access to facilities, and increased dropout rates underscore the imperative of finding creative solutions. The COVID-19 pandemic further revealed the limitations of conventional educational approaches, forcing institutions worldwide to seek digital and technology-driven alternatives.

Here, Artificial Intelligence has proven to be a forceful instrument to fill systemic gaps in learning and stimulate sustainable development. AI-driven technologies—covering everything from intelligent tutoring systems and machine learning algorithms to language translation and accessibility aids—provide personalized, inclusive, and adaptive learning experiences. For instance, AI can customize educational content to match specific student requirements, help differently-abled learners with enabling technologies, and offer predictive insights into students' performances.

In addition to scholastic development, AI promotes the values of sustainability as well. It lessens the reliance on tangible resources like books and classrooms, promotes online learning systems with minimal carbon prints, and facilitates lifelong learning for a knowledge economy. The adoption of AI in international education contributes to the overall aims of the SDGs, especially SDG-4, by providing inclusive and equitable quality education.

Therefore, the context of this study is in exploring how AI has the potential to transform education worldwide, not just as a technology but as a model that is sustainable, closes gaps, empowers educators, and improves learner achievements in various contexts.

Significance of the Study

- Illustrates the contribution of AI to attaining SDG-4 (quality education for all).
- Emphasizes the ways in which AI closes education system inequalities across the world.

- Explains AI's contribution to inclusive learning for differently-abled and marginalized groups.
- Shows AI's potential to reduce dropout rates and improve retention.
- Provides insights into digital sustainability and eco-friendly educational practices.
- Bridges the technological and knowledge gap between developed and developing nations.
- Offers recommendations for policymakers and institutions on ethical AI integration.
- Encourages lifelong learning and skill development for the future workforce.

Objectives of the Study

- To discuss the part played by AI in reshaping global education systems.
- To study the role of AI in contributing to sustainable development in education.
- To research applications of AI in inclusive and personalized learning.
- To determine the ethical, social, and technical challenges of AI in education.
- To contrast the use of AI in developed and developing countries.
- To recommend strategies for successful AI integration in education policies.

Scope and Limitations of the Study

Scope

- The research addresses the role of AI in education with reference to sustainable development at the global level.
- It encompasses uses of AI in personalized learning, inclusivity, teacher empowerment, curriculum planning, and sustainable environments.
- The research develops insights through global case studies in developed and developing countries.
- It focuses on alignment with Sustainable Development Goal 4 (SDG-4) and wider UN sustainability targets.
- The research offers policy recommendations for policymakers, educators, and international agencies

Limitations

- The research does not entail primary data collection and is primarily based on secondary sources
- The fast-changing nature of AI is such that results can become obsolete with the advent of new technologies.
- Resource and infrastructure differences between nations might confine generalizability of results.
- Ethical and cultural aspects of AI in education could differ across the world, limiting applicability across the board.
- The research is educational in nature; hence, the role of AI in other areas of sustainable development is not explored.

Literature Review

- **Aggarwal (2023)** stressed Green Education using AI by pointing out that smart systems can maximize resources, minimize energy, and facilitate e-learning platforms with sustainability for long-run educational sustainability.
- **Aggarwal, Sharma & Saxena (2023)** discussed AI adoption in Indian Smart Education Systems. Based on their discussion, it was concluded that AI makes education sustainable as well as accessible by augmenting personalized learning, virtual mentoring, and automated tests.
- **Kapoor & Bakhshi (2025)** examined AI and the Future of Education in the Indian Journal of Educational Technology. The research emphasized how AI-driven intelligent grading, adaptive content delivery, and digital learning ecosystems promote sustainability in global learning.

- **Kumari, Kumari & Wao (2024)** presented an extensive overview of AI innovations for sustainable development, and education was treated as one of the most important drivers in attaining SDG-4 (Quality Education). They believed AI promotes inclusive and equitable lifelong learning.
- **Gupta, Gupta & Gupta (2024)** emphasized India's journey towards SDGs and stated that AI can enhance quality education through inclusive platforms, data-driven education, and better monitoring systems.
- **Srivastava & Upadhyay (2024)** emphasized how Generative AI facilitates empowerment of indigenous people by enhancing digital literacy, maintaining knowledge, and achieving access to international education, thus fostering sustainability.
- **A systematic review in International Journal of Environmental Research (2024)** charted AI approaches for SDGs, and its conclusion was that adaptive learning platforms based on AI are the key to realizing sustainability in education.
- **Choudhary (2025)** critically examined the role of AI in realizing SDG-4 and observed that AI aids inclusive access, pedagogy tailored to the learner, and effective education governance but hampering issues such as digital divide remain.
- **Preprints.org Review (2025)** evaluated systematically higher education reforms implemented by AI and posited that intelligent tutoring systems, plagiarism check, and predictive analytics can secure sustainable and equitable access globally.
- **Discover Sustainability Journal (2024)** analyzed AI within quality education. The research demonstrated that smart classrooms and learning analytics through AI open the door to long-term sustainable education policies.
- **Pathak & Waghmare (2024)** researched AI in secondary education in India and reached a conclusion that AI tools assist with classroom management, content personalization, and decreasing teacher workload, thus making the education system sustainable.
- **Ghori (2024)** examined AI interventions in India's education sector, observing that AI-powered digital classrooms and adaptive e-learning platforms can close rural-urban disparities and ensure sustainability in higher and technical education.
- **Shrivastava (2023)** explored AI in education's future, with a focus on integration with IoT and cyber-physical systems. It contended that AI facilitates scalability and sustainability in education worldwide.
- **Mallik & Gangopadhyay (2023)** examined proactive and reactive utilization of AI techniques in education. They realized that AI facilitates proactive admission planning, customized instruction, and reactive feedback, all of which reinforce sustainable education.
- **Gosselink et al. (2024)** in AI in Action: Accelerating SDGs presented international case studies where AI sped up SDG action. For education, AI lowered access barriers, improved teacher-pupil engagement, and facilitated long-term sustainable development.

Research Methodology

Research Design

The research follows a descriptive cross-sectional design with a survey approach. The aim is to examine perceptions, access, advantages, and limitations of Artificial Intelligence (AI) in ensuring sustainable development of education on a global scale. The design focuses on descriptive analysis through percentages rather than sophisticated statistical techniques.

Population & Sample Size

- **Population:** Students, instructors, and educational administrators within schools, colleges, and universities.
- **Sample size:** 300 respondents.
- **Students:** 180 (60%)
- **Teachers:** 90 (30%)
- **Administrators:** 30 (10%)

- **Sampling Technique:** Purposive sampling in order to have representation of various stakeholders of education.

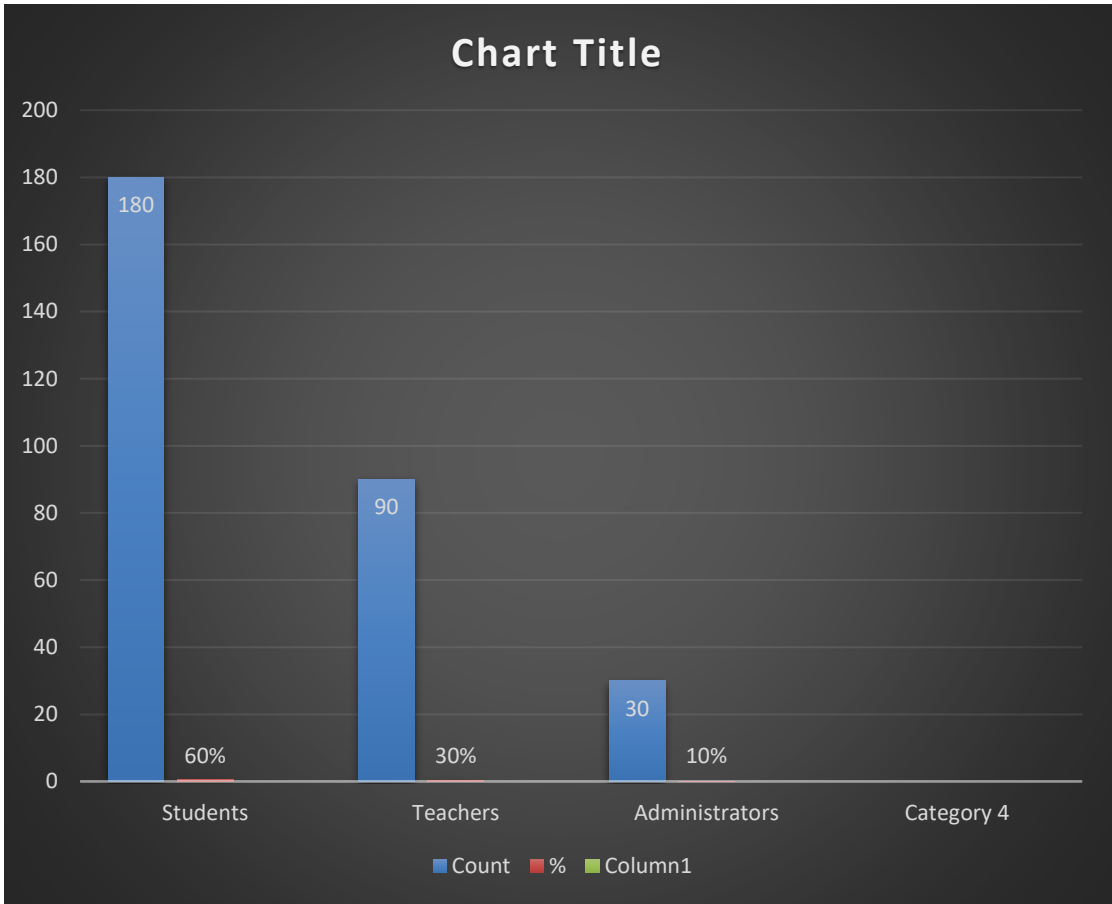
Data Collection Method

- **Primary Data:** Closed-ended questions + Likert scale items in a structured questionnaire distributed online and offline.
- **Secondary Data:** Published articles, reports, and policy documents concerning AI and sustainable education.

Data Analysis

Table 1: Respondent Composition

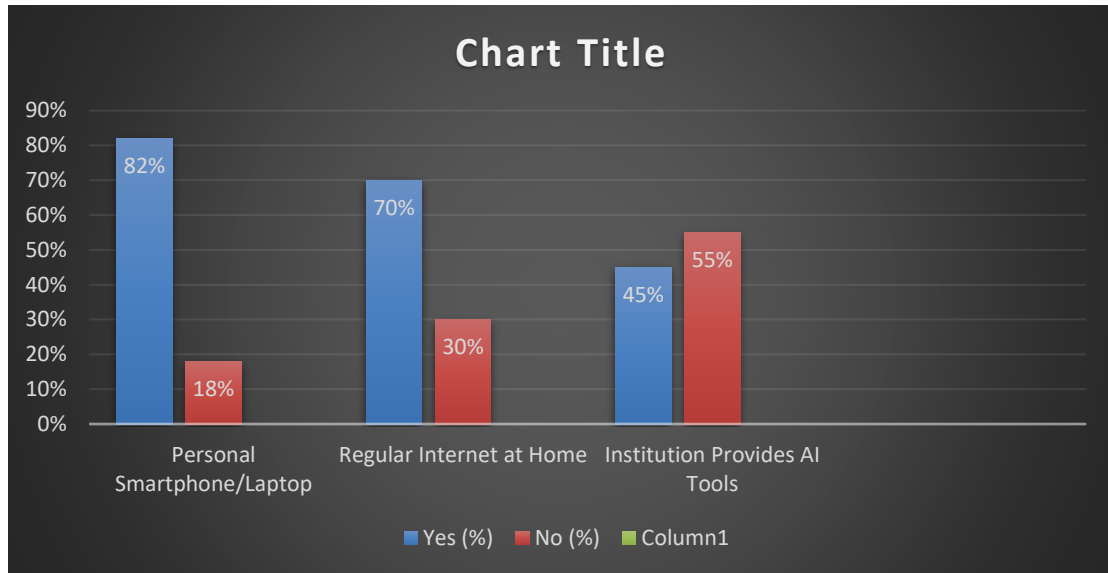
Category	Count	%
Students	180	60%
Teachers	90	30%
Administrators	30	10%



Interpretation: Majority of respondents were students (60%), ensuring learner perspectives are strongly represented, followed by teachers (30%) and administrators (10%).

Table 2: Access to AI-Enabled Educational Tools

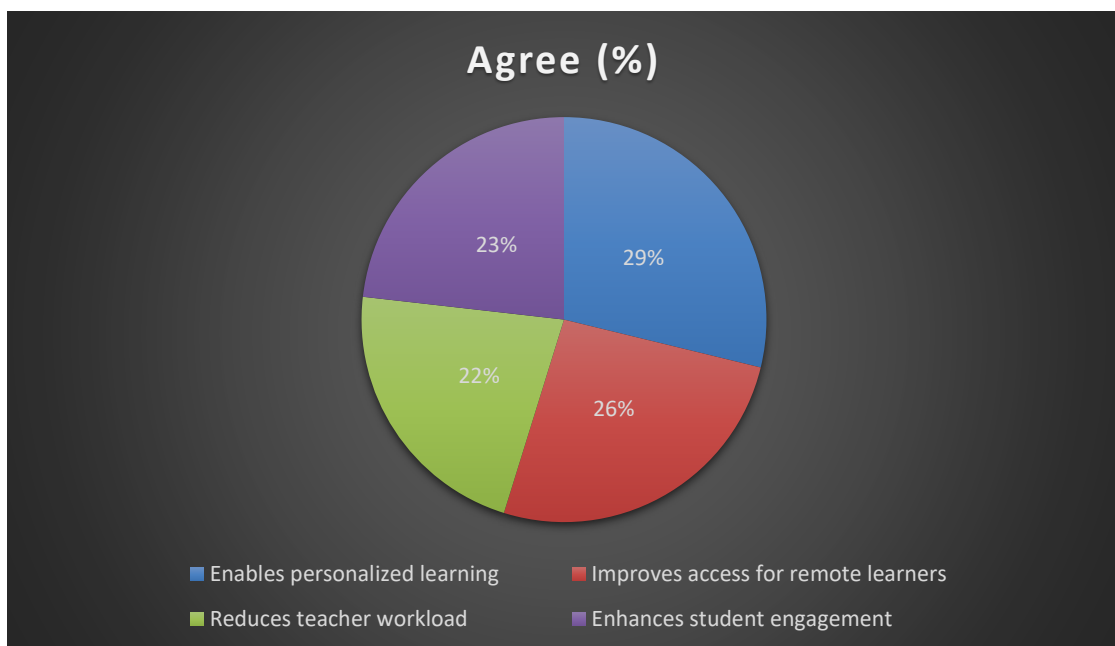
Access Indicator	Yes (%)	No (%)
Personal Smartphone/Laptop	82%	18%
Regular Internet at Home	70%	30%
Institution Provides AI Tools	45%	55%



Interpretation: While 82% of respondents had devices, only 45% reported institutional access to AI-based educational tools, highlighting a gap between personal access and institutional adoption.

Table 3: Perceived Benefits of AI in Education

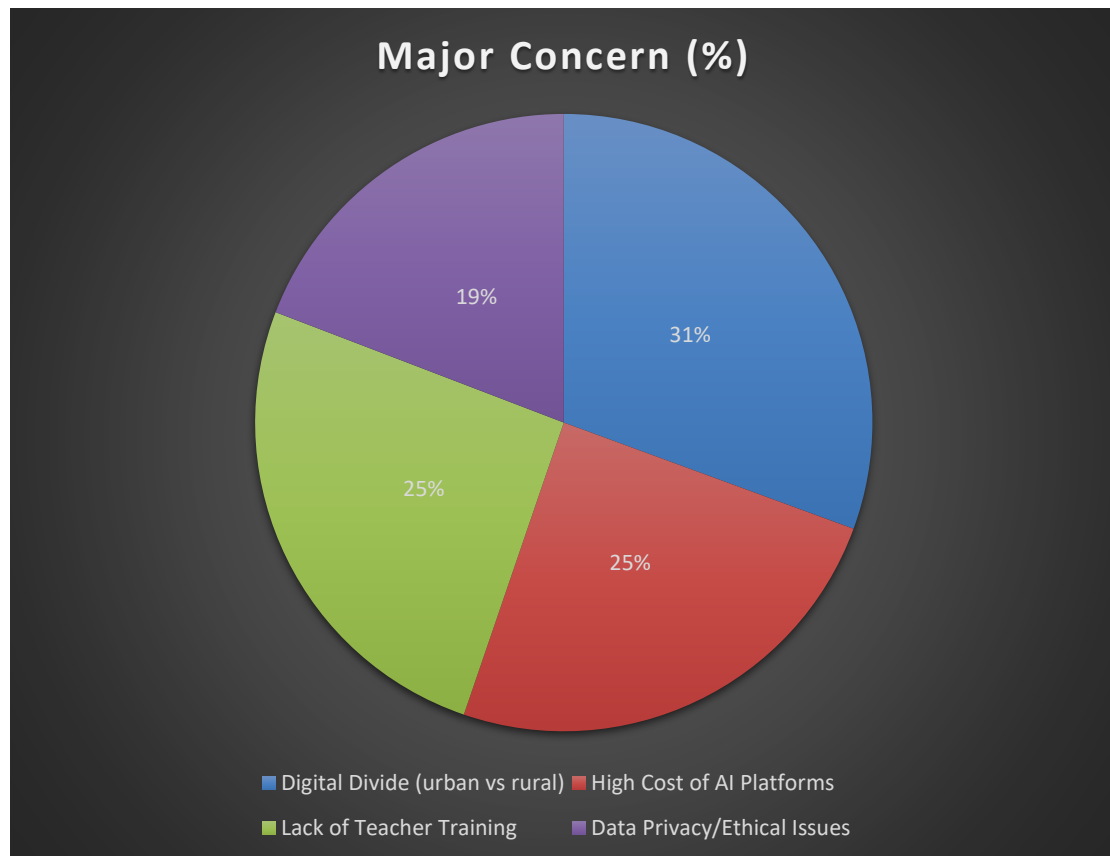
Benefit Statement	Agree (%)
Enables personalized learning	72%
Improves access for remote learners	65%
Reduces teacher workload	55%
Enhances student engagement	58%



Interpretation: Personalized learning (72%) and remote access (65%) are the top perceived benefits. Teacher workload reduction (55%) is also significant but less universally acknowledged.

Table 4: Barriers to Sustainable AI Adoption

Barrier	Major Concern (%)
Digital Divide (urban vs rural)	67%
High Cost of AI Platforms	54%
Lack of Teacher Training	56%
Data Privacy/Ethical Issues	42%



Interpretation: Digital divide (67%) emerged as the most critical barrier, followed by lack of teacher training (56%) and cost of platforms (54%).

Conclusion

The research focused on the contribution of Artificial Intelligence (AI) in fostering sustainable development of education globally through a descriptive survey of 300 respondents. Results indicate that AI has vast potential to revolutionize education into a more inclusive, accessible, and efficient system, but there are issues that need to be addressed.

A large majority of the respondents (82%) said that they had access to personal digital devices and 70% had frequent internet, reflecting the technical foundation for AI adoption already being in place. Institutional backing for AI tools was lower at 45%, which implies a gap between individual preparedness and organizational capability. Important advantages mentioned were personalized learning (72%), increased access for remote students (65%), and student participation (58%). These results support international literature that places AI as a force behind SDG-4 (Quality Education).

While its potential is vast, there are some challenges to sustainable uptake. The digital divide, for example, continues to produce disparities, particularly between urban and rural students, as 67% point to it as a significant obstacle. Cost of AI platforms (54%) and teacher training (56%) are also a

cause for concern, while privacy and bias (42%) are issues of ethics. In-depth interviews with administrators and teachers validated that insufficiency of training, along with constraints of resources, keep AI from being efficiently utilized in classrooms.

In summary, with AI being a deciding factor in the progress of global sustainable education, only sustainability will be achieved when infrastructural, financial, and human resource issues are addressed. Closing the digital divide, building capacity for teachers, and providing ethical, low-cost solutions are significant stepping stones to making AI a real catalyst of inclusive and equitable education globally.

Discussion

The descriptive findings offer some key observations on how AI can facilitate as well as undermine sustainable education. To begin with, the findings affirm that IT infrastructure is now more widely available at the individual level, with 82% of respondents possessing a smartphone or a laptop. Institutional adoption, however, remains behind, with fewer than half of the institutions offering AI-facilitated tools. This is a wider global trend in which readiness at the individual level is outpacing systemic readiness, and where policy and institutional investments need to be more robust.

Second, the view of AI as an agent of personalization and inclusiveness is uniform among respondents. Seventy-two percent concurred that AI facilitates personalized learning, showing great confidence in its capacity to customize teaching for various learners. Likewise, 65% appreciated its ability to break geographical distances by enhancing distant access. These findings confirm international data that AI can level learning chances if used efficiently.

Third, the obstacles listed here reflect fundamental structural and moral concerns. The digital divide, stressed by 67% of those polled, demonstrates that even with device penetration, there remains a critical issue of equal access to the internet and AI tools, especially in rural or economically disadvantaged areas. Teacher preparation is also a serious gap: more than half the respondents indicated that the absence of training hinders effective use of AI. Without training, the danger is that AI amplifies inequalities instead of alleviating them.

Last but not least, cost and ethics are transversal challenges. The repeated subscription fees of AI platforms and issues regarding privacy and bias were emphasized by participants. Such findings highlight that AI uptake needs to be placed within wider sustainable development agendas incorporating ethics, affordability, and inclusivity.

Therefore, the research reiterates that AI is not a sole solution but an enabler whose sustainable effect lies on supportive infrastructure, capacity building, and ethical governance.

Suggestions

- Fill the digital divide by increasing low-cost internet access and community digital centers.
- Professional development of teachers with ongoing AI-oriented training programs.
- Institutional take-up of AI tools with government or NGO facilitation in order to lower costs.
- Integration of local languages in order to make it accessible to different learners.
- Ethical governance with robust data privacy, transparency, and equity policies.
- Public-private partnerships to subsidize AI platforms in education institutions such as schools and universities.
- Open-source AI solutions to minimize reliance on expensive proprietary solutions.
- Monitoring & evaluation frameworks with straightforward percentage indicators to monitor the effect of AI on learning achievement.

References

1. Asia-Europe Foundation (ASEF). (2025, February 20). *AI for Sustainable Development: White Paper*. ASEF. Retrieved from <https://www.asiaeurope4ai.org/> [Asia-Europe Foundation \(ASEF\)](#)
2. Bardia, A., & Agrawal, A. (2025). *MindCraft: Revolutionizing Education through AI-Powered Personalized Learning and Mentorship for Rural India*. arXiv. <https://arxiv.org/abs/2502.05826arXiv>
3. Gohr, C. (2025). Artificial intelligence in sustainable development research. *Nature Sustainability*. <https://www.nature.com/articles/s41893-025-01598-6Nature>

4. Leal Filho, W., et al. (2025). Using artificial intelligence in sustainability teaching and learning: A review of case studies in higher education institutions. *Environmental Sciences Europe*, 37(1). <https://enveurope.springeropen.com/articles/10.1186/s12302-025-01159-wSpringerOpen>
5. Strielkowski, W. (2025). AI-driven adaptive learning for sustainable educational transformation. *Sustainable Development*. <https://onlinelibrary.wiley.com/doi/full/10.1002/sd.3221Wiley Online Library>
6. Tiwari, E. S. (2024). *Harnessing the Power of Artificial Intelligence in Education*. SSRN. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4747352SSRN
7. Kim, J. (2024). Artificial Intelligence in Achieving Sustainable Development. Old Dominion University. Retrieved from https://digitalcommons.odu.edu/cgi/viewcontent.cgi?article=1365&context=stemp_fac_pubsODU Digital Commons
8. "Integration of artificial intelligence by the Central Board ..." (2024). B. Karan. *Curriculum Initiatives in K-12 Education with Reference to CBSE*. *Journal of Education Policy & Practice*. doi:10.1080/1475939X.2024.2337924 [Taylor & Francis Online](https://www.tandfonline.com/doi/full/10.1080/1475939X.2024.2337924Taylor & Francis Online)
9. *Artificial Intelligence for Sustainable Education in India*. (2024, October 19). BPAS Journals. <https://bpasjournals.com/library-science/index.php/journal/article/view/2492BPAS Journals>
10. *Designing a model of sustainable education based on artificial intelligence*. (2025). *Higher Education Journal*. <https://www.sciencedirect.com/science/article/pii/S2666920X25000797ScienceDirect>
11. *Artificial Intelligence in Indian Education: Transforming Teaching and Learning for the Digital Age*. (2024). *Indian Research Journal of Innovative Engineering & Technology*. Volume 8, Issue 11. Retrieved from <https://irjiet.com/Volume-8/Issue-11-November-2024/Artificial-Intelligence-in-Indian-Education-Transforming-Teaching-and-Learning-for-the-Digital-Age/2455irjiet.com>
12. *Transforming and Reforming the Indian Education System ...* (2024). P. Sihag. *Education & Technology Review*. <https://dialnet.unirioja.es/descarga/articulo/9624304.pdfDialnet>
13. "Impact of Artificial Intelligence in Education: Effects in the Indian Higher Education System." (2024). *IJNRD*, 9(5). Retrieved from <https://www.ijnrd.org/papers/IJNRD2405255.pdfIJNRD>
14. UNESCO. (2022). *State of the Education Report for India, 2022: Artificial Intelligence in Education; Here, There and Everywhere*. UNESCO. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000382661.locale=enICRIER>
15. UNESCO. (2025, September 4). *AI and the Future of Education: Disruptions, Dilemmas and Directions*. UNESCO. Retrieved from <https://www.unesco.org/en/articles/ai-and-future-education-disruptions-dilemmas-and-directionsUNESCO>.

