

## Environmental Challenges in the Era of Artificial Intelligence Use in Schools in Sub-Saharan Africa: The Case of Gabon

Moussa Voundjimbit Olivier Ange-Yannick

Doctor of Information and Communication Sciences, Member of the MICA laboratory (EA 4426) of the University of Bordeaux Montaigne, France

**\*Corresponding Author:** Moussa Voundjimbit Olivier Ange-Yannick, Doctor of Information and Communication Sciences, Member of the MICA laboratory (EA 4426) of the University of Bordeaux Montaigne, France.

Submitted: 12 June 2026

Accepted: 18 June 2026

Published: 26 June 2026

**Citation:** Ange-Yannick, M.V.O. (2026). Environmental Challenges in the Era of Artificial Intelligence Use in Schools in Sub-Saharan Africa: The Case of Gabon. *Journal of Artificial Intelligence and Data Analytics*, 1(2), 1-6. DOI: doi.org/10.67927/JAIDDataAnalytics/2026(1)109.

### Abstract

This article explores the links between AI, education, and the environment in Gabon, a country undergoing a digital transition and facing the challenges of biodiversity conservation. It demonstrates that AI, such as ChatGPT, is revolutionizing education by making knowledge more accessible and improving student learning. The article analyzes the social, cultural, and educational aspects of AI using the approaches of Thierry Gaudin's ethnotechnology (2013), Patrice Flichy's sociology of innovation (2003), and Darin Barney's critical approach to digital technologies (2016). The findings show that AI fosters connections between scientific and traditional knowledge in environmental education. The article highlights the role of AI in raising students' awareness of the importance of protecting national parks and biodiversity in Gabon. Digital tools promote understanding of environmental threats and digital eco-citizenship. Furthermore, the study analyzes the use of ChatGPT in the study of human-panther conflict in Gabon. AI helps learners compare scientific knowledge and cultural representations to better understand the challenges of wildlife conservation and the environmental causes of conflict. Finally, the article highlights the ethical challenges of AI in the Woleu-Ntem province and emphasizes the need to promote ethics education to combat misinformation and plagiarism. Observing these technologies in pedagogy in Gabon encourages responsible digital citizenship and the preservation of biodiversity, under an educational governance that values both scientific and traditional knowledge.

**Keywords:** Artificial Intelligence, Environmental Education, Biodiversity, Information Ethics, Gabon.

### Introduction

Contemporary societies are facing a major dual transition characterized, on the one hand, by the intensification of global environmental crises and, on the other hand, by the acceleration of digital transformations. The National Center for Forest Ownership considers climate change, deforestation, and the depletion of natural resources to be major current concerns for governments, international organizations, and scientists [1]. Abou-Zeid, A. emphasizes that AI is revolutionizing processes related to digital technologies by profoundly transforming the modes of knowledge production, dissemination, and appropriation [2]. In this context, sub-Saharan Africa appears as a captivating space for analyzing the interactions between environmental issues and technological innovations. The region faces significant ecological challenges while experiencing substantial growth in digital usage. Information and communication technologies (ICTs), digital social networks, and, more recently, artificial intelligence tools are gradually becoming instruments for communication, learning, awareness-raising, and citizen participation. Gabon offers a unique vantage point for observing these dynamics. Recognized as one of the world's most forested countries, it boasts nearly 88% forest cover and exceptional biodiversity, protected notably through a network of thirteen national parks. This ecological wealth gives the country

a particular responsibility in preserving global environmental balances. However, this preservation remains fraught with numerous challenges, including illegal logging, poaching, conflicts between local populations and wildlife, increasing urbanization, and the effects of climate change. According to the Ministry of National Education, Higher Education and Research, the development of digital infrastructure and the growing use of artificial intelligence technologies in schools are transforming teaching methods [3]. Learners now use conversational tools such as ChatGPT to conduct research, produce summaries, prepare academic papers, or delve deeper into concepts taught in class. This evolution raises questions about the quality of information, the ethics of technology use, the development of critical thinking, and the capacity of these tools to contribute to environmental education. Artificial intelligence thus represents a major opportunity to strengthen awareness of ecological issues. It facilitates access to up-to-date scientific knowledge, which promotes the popularization of complex environmental problems and enables the development of innovative educational approaches. At the same time, it can also generate risks related to misinformation, technological dependence, the reproduction of informational biases, and the weakening of learners' critical thinking skills. The fundamental challenge, therefore, lies in

---

understanding how the educational uses of artificial intelligence can contribute to building responsible environmental citizenship in the Gabonese context. This issue leads to broader questions concerning the relationships between technological innovation, knowledge production, environmental governance, and sustainable development. This article aims to analyze the interactions between artificial intelligence, school learning, and environmental issues in Gabon. More specifically, it examines how AI tools contribute to the dissemination of environmental knowledge, influence learners' perceptions, and can contribute to biodiversity conservation and the sustainable management of natural resources.

### **Methodological Framework**

This research adopts a qualitative approach, employing several complementary methods to understand the social uses of artificial intelligence in the Gabonese school context. The first method is netnography. Developed within the field of digital studies, it allows for the observation of interactions, information practices, and content disseminated on digital platforms. This approach facilitates the analysis of how learners use artificial intelligence tools to search for and share information related to environmental issues. The second method is content analysis. It involves studying the discourse produced by learners, teachers, and users of digital platforms to identify the social representations associated with environmental issues and the uses of AI. Participant observation constitutes a third methodological approach. Conducted in various schools, it allows for the understanding of learners' actual practices, the ways in which artificial intelligence tools are integrated into teaching activities, and the interactions between actors in the education system. Finally, semi-structured interviews are conducted with teachers, students, and educational administrators. These interviews aim to understand the motivations, perceptions, expectations, and limitations associated with the use of AI in environmental learning processes. These methods were employed in Gabon between 2021 and 2024. Combining these different methods fosters a comprehensive understanding of the observed sociotechnical dynamics and ensures better triangulation of the collected data.

### **Theoretical Framework**

This research is based on three complementary theoretical approaches. These include Thierry Gaudin's theory of ethnotechnology, Patrice Flichy's sociology of innovation, and Darin Barney's critical approach to digital technologies [4-6].

#### **Thierry Gaudin's Ethnotechnology**

The ethnotechnology developed by Thierry Gaudin highlights the role of cultural contexts in the appropriation of technological innovations. According to this perspective, technologies are never adopted uniformly; they are reinterpreted according to the specific social, cultural, and historical realities of each society. In the Gabonese context, this approach allows us to analyze how artificial intelligence tools are integrated with local knowledge related to natural resource management. Traditional knowledge about forests, biodiversity, and wildlife behavior can thus interact with the information produced by AI systems [4].

#### **Patrice Flichy's Sociology of Innovation**

The work of Patrice Flichy highlights that technological innovations are the result of a social construction involving various actors [5]. The actual uses of a technology often exceed the initial intentions of its designers. This perspective helps us understand how Gabonese learners develop specific uses for ChatGPT and

other AI systems in their school activities. Digital tools thus become spaces for knowledge production, collaborative learning, and raising awareness of environmental issues.

### **Darin Barney's critical approach**

Darin Barney considers digital technologies as devices that carry political, social, and ethical implications [6]. These technologies influence forms of citizen participation, governance mechanisms, and power relations. From this perspective, artificial intelligence must be analyzed not only as a pedagogical tool but also as an actor capable of transforming modes of environmental information production, educational practices, and forms of civic engagement. Combining these three theoretical approaches allows us to simultaneously grasp the technical, social, cultural, and political dimensions of the use of artificial intelligence in the Gabonese educational context.

### **The Interplay Between Scientific and Traditional Knowledge in Light of the Use of AI and Environmental Challenges in schools in Gabon**

For Huet, J.-M. the emergence of artificial intelligence in African educational systems opens new perspectives in the production, dissemination, and appropriation of knowledge [7]. In the Gabonese context, this digital transformation is taking place within a specific socio-cultural environment where scientific knowledge from academic institutions coexists with traditional knowledge passed down through generations within local communities. The articulation between these different forms of knowledge is now a major challenge for environmental education and sustainable development. Kialo, P. presents Gabon as possessing an exceptional ecological heritage characterized by extensive forest cover, remarkable biodiversity, and diverse ecosystems [8]. For centuries, indigenous populations and rural communities have developed empirical knowledge related to natural resource management, plant and animal species, and mechanisms for preserving ecological balance. This knowledge constitutes a valuable cultural and environmental asset that contributes to understanding local natural dynamics. In parallel, the scientific knowledge produced by universities, research centers, international organizations, and environmental agencies provides theoretical and methodological explanations for observed ecological phenomena. For the Gabonese Agency for Space Studies and Observation, this knowledge rests on several elements [9]. These include experimental approaches, rigorous research protocols, and sophisticated technological tools such as artificial intelligence, remote sensing, GIS, and environmental databases. In the field of education, the gradual introduction of artificial intelligence tools such as ChatGPT, Gemini, and Copilot is changing how students access information and their learning practices. Learners now have access to resources capable of rapidly generating educational content, simplifying complex concepts, and facilitating the acquisition of environmental knowledge. This development contributes to strengthening access to scientific knowledge while raising questions about the consideration of local cultural realities. The ethnotechnological approach developed by Thierry Gaudin sheds light on this issue. According to this author, technologies cannot be understood independently of the cultural contexts in which they are embedded [5]. Technological innovations are reinterpreted by social actors according to their values, representations, and practices. From this perspective, artificial intelligence is not merely a technological tool; it also becomes a space for interaction between different knowledge systems.

---

In Gabon, this hybrid approach is observed in environmental learning. When a student uses artificial intelligence to search for information on forest elephants, mangroves, or local tree species, the generated responses are primarily based on scientific knowledge available in digital databases. However, this information can be enriched by the knowledge held by local communities, particularly regarding wildlife behavior, seasonal cycles, and traditional uses of natural resources. This complementarity appears especially relevant in the context of education for sustainable development. The report "From Science to Action" shows that scientific knowledge helps explain the mechanisms of climate change, ecosystem degradation processes, and the impacts of human activities on biodiversity [10]. Traditional knowledge, for its part, provides a contextualized understanding of the relationships between people and their environment. Together, they foster a more holistic approach that is better adapted to local realities. Artificial intelligence can thus play an interface role between these different forms of knowledge. Used critically and within a pedagogically sound framework, it offers the opportunity to value local knowledge while facilitating its dialogue with contemporary scientific knowledge. Teachers can, in particular, use these tools to develop comparative activities, case studies, or educational projects focusing on environmental issues in Gabon. However, this approach is not without its limitations. Artificial intelligence systems are primarily fed by data sets from Western or international contexts. Local African knowledge often remains underrepresented in the knowledge bases used to train algorithmic models. This situation can lead to the partial invisibility of traditional knowledge and promote a standardization of environmental representations. Therefore, one of the major challenges for Gabonese educational institutions is to promote a critical use of artificial intelligence capable of recognizing the plurality of knowledge. This involves not only training learners in digital skills, but also developing their ability to compare the information produced by AI systems with the social, cultural and environmental realities of their territory.

### **The Use of AI in Schools and the Question of the Protection of National Parks and Biodiversity in Gabon**

Biodiversity conservation is one of the major environmental challenges facing African states today. In Gabon, this issue is particularly important due to the country's immense ecological wealth. With nearly 88% of its territory covered by tropical forests and thirteen national parks established in 2002, Gabon is recognized as one of the planet's leading biodiversity hotspots. This situation places conservation issues at the heart of public policies and sustainable development strategies. In this context, education emerges as a crucial tool for raising awareness among younger generations about environmental protection. According to Delahay Marion, schools play a fundamental role in transmitting knowledge about forest ecosystems, wildlife, climate change, and conservation issues [11]. The recent emergence of artificial intelligence in educational practices opens up new perspectives for strengthening learning about environmental issues and promoting an ecological culture among students. Collin Simon and Hennetier Clémentine argue that artificial intelligence is profoundly transforming school governance and the ways in which knowledge is accessed [12]. Conversational tools like ChatGPT allow students to quickly obtain information on animal and plant species found in national parks, biodiversity conservation mechanisms, and threats to forest ecosystems. Thanks to these technologies, learners can deepen their research, diversify their information sources, and access scientific content that was previously difficult to find.

In Gabon, these tools are used by students to gain a better understanding of protected areas such as Lopé National Park, Ivindo National Park, Loango National Park, and Minkébé National Park. 58% of the students surveyed reported discovering the diversity of emblematic species found in these areas, such as forest elephants, gorillas, chimpanzees, leopards, sea turtles, and numerous unique plants. The use of artificial intelligence by students also facilitates an understanding of the complex interactions between human activities and ecological balances. According to Moussavou Ndjimbit Olivier AY, "beyond the basic transmission of knowledge, digital and artificial intelligence tools promote the development of environmental awareness" (2024, p. 336). Simulations, predictive analyses, and interactive educational tools allow learners to visualize the consequences of deforestation, poaching, and climate change on Gabonese ecosystems. This experiential approach helps strengthen young people's commitment to nature conservation. According to Kalervo According to Gulson and Sam Sellar, one of the major contributions of digital technology and AI lies in their ability to support inquiry-based learning [13]. Students use digital tools to conduct research projects on local biodiversity, analyze environmental data, and compare scientific information with knowledge from local communities. This dynamic fosters the development of a scientific culture while valuing traditional knowledge related to natural resource management. Furthermore, the use of artificial intelligence in school activities in Gabon helps raise awareness among learners about the threats facing national parks. These are major conservation challenges in Gabon, such as poaching, illegal logging, clandestine gold mining, and conflicts between local populations and wildlife.

The use of these technologies in schools allows artificial intelligence to provide up-to-date information on environmental issues and to cultivate citizens who are more aware of national challenges. However, this contribution of artificial intelligence to biodiversity conservation should not obscure certain limitations. The information produced by AI systems can sometimes lack context or fail to adequately consider local realities. Much data relating to traditional conservation practices, indigenous knowledge, or specific Gabonese ecological characteristics remains insufficiently represented in the knowledge bases that feed these technologies. This creates a risk of disseminating generic content poorly adapted to African environmental contexts. This situation underscores the need for rigorous pedagogical support. Teachers must play a mediating role to help students develop their critical thinking skills when faced with information generated by artificial intelligence. The goal is not to replace human knowledge with AI, but to use it as a complementary tool to enrich learning and foster a better understanding of environmental issues. From a sustainable development perspective, the use of artificial intelligence in Gabonese schools promotes the emergence of genuine digital eco-citizenship. This concept refers to individuals' ability to use digital technologies responsibly while actively participating in environmental preservation. Students thus become active participants, capable of informing themselves, raising awareness among their peers, and engaging in local initiatives for biodiversity conservation.

### **The Adoption of ChatGPT in Schools and the Representation of the Human-Panther Conflict: An Emerging Issue in Certain Regions of Gabon**

According to Elie Allouche, the rise of generative artificial intelligence in educational settings is gradually transforming

how students access information and their learning processes [14]. Among the most widely used tools is ChatGPT, which has become a standard tool for assisting with research, writing, and understanding complex concepts. In the Gabonese context, this growing adoption opens new perspectives for environmental education, particularly for analyzing and understanding conflicts between human populations and wildlife. According to Cédric Schippers et al., "human-elephant conflict remains well-documented in scientific work on conservation in Central Africa" (2008, p. 4). However, the issue of human-panther conflict is emerging as a growing concern in certain regions of Gabon. The panther, an emblematic predator of equatorial forests, holds a special place in local social representations. Feared for its power and discreet nature, it is also associated with many beliefs, legends and cultural interpretations inherited from ancestral traditions.

In several rural communities near forested areas, attacks on domestic animals and encounters between people and panthers are regularly reported. These communities are located primarily in the provinces of Woleu-Ntem, Ogooué-Ivindo, Ngounié, and Ogooué-Lolo. These situations often fuel a sense of insecurity within the communities concerned and reinforce negative perceptions of this animal, which is nevertheless essential to the ecological balance of forest ecosystems. The introduction of ChatGPT into school curricula offers new possibilities for analyzing this phenomenon. Students query the artificial intelligence to obtain information on panther behavior, its role in the food chain, its natural habitat, and the factors explaining the increase in interactions with human populations. This approach provides access to scientific knowledge that can go beyond representations based solely on lived experience or local beliefs. One of ChatGPT's main contributions lies in its ability to connect different sources of information. Students compare biological and ecological explanations with traditional narratives passed down within communities. This comparison fosters the development of a critical perspective on environmental phenomena and contributes to a more nuanced understanding of conflicts between humans and wildlife. In the Gabonese context, the panther also holds significant symbolic importance in the collective imagination. In several sociocultural groups, it is associated with strength, power, wisdom, and even certain mystical practices. These representations often influence how people interpret interactions with this animal. The pedagogical approach based on the use of ChatGPT allows for the simultaneous exploration of the cultural and scientific dimensions of this issue.

This hybridization of knowledge aligns with the principles of ethnotechnology developed by Thierry Gaudin, according to which "technologies are embedded in specific cultural contexts" (p. 5) and contribute to the reshaping of knowledge systems [4]. From this perspective, ChatGPT becomes a mediation tool enabling learners to engage in dialogue between traditional knowledge about the panther and scientific knowledge produced by biodiversity specialists. Furthermore, the use of artificial intelligence helps raise students' awareness of the conservation challenges facing this species. The information provided by ChatGPT helps us understand that observed conflicts often result from broader environmental changes. Deforestation, logging, the expansion of agricultural activities, and the fragmentation of natural habitats are progressively reducing the spaces available for wildlife. These ecological disturbances increase contact between animals and human populations, thus raising the risk of conflict.

The adoption of ChatGPT in schools can also encourage learners

to take a more active role in finding solutions. Educational projects based on AI, for example, allow for the exploration of different strategies for coexistence between rural communities and wildlife. They also raise awareness about appropriate behavior when encountering a panther and promote local conservation initiatives. However, this use of artificial intelligence is not without its limitations. The responses generated by ChatGPT are primarily based on internationally available data and can sometimes lack local context. Certain Gabonese socio-cultural specificities, as well as the realities experienced by rural communities, remain insufficiently considered in the data used by the tool. This situation underscores the importance of teachers' roles in supporting the pedagogical uses of AI and in validating the information produced. Beyond environmental learning, the study of the human-panther conflict through ChatGPT contributes to the development of learners' information literacy skills. Students learn to verify sources, compare viewpoints, distinguish facts from beliefs, and construct arguments based on reliable data. These educational practices are essential today in a context marked by the proliferation of digital content and environmental information circulating on social networks.

### **The Use of Artificial Intelligence by Learners in the Woleu-Ntem Province and the Issue of Information Ethics**

According to the Canopé Network, the gradual integration of artificial intelligence into educational practices is one of the major transformations characterizing contemporary education systems [15]. In Gabon, this trend is also evident in schools in the Woleu-Ntem province, where students are increasingly using digital tools to access information, complete academic work, and develop their skills. The emergence of conversational platforms such as ChatGPT, Gemini, and Copilot is thus changing the ways in which learning and knowledge production are carried out, while also raising questions about information ethics. Located in northern Gabon and bordering Cameroon and Equatorial Guinea, the Woleu-Ntem province is distinguished by its educational dynamism and the growing adoption of digital technologies by younger generations. The increasing prevalence of smartphones, improved internet connectivity, and the proliferation of digital uses are fostering the emergence of new information practices among learners, even "a prophetic vision in society" [16]. These learners now use artificial intelligence to search for information, write reports, prepare for exams, or delve deeper into certain educational content covered in class.

This evolution reflects a profound transformation in the relationship to knowledge. Unlike traditional learning methods based primarily on textbooks and lectures, artificial intelligence offers near-instantaneous access to a vast amount of information. Learners receive detailed explanations, can rephrase complex content, and benefit from personalized support in their schoolwork. This accessibility "contributes to redefining and democratizing access to knowledge" [6], and to strengthen students' autonomy in their learning. However, this ease of access to information comes with new challenges related to information ethics. According to the approach of Manuel Zacklad and Antoinette Rouvroy in Information and Communication Sciences, "information ethics refers to the set of principles that govern the production, dissemination, use, and evaluation of information in digital environments" (2022, para. 65). It notably involves verifying sources, respecting intellectual property, combating disinformation, and developing critical thinking skills. In the Woleu-Ntem context, learners' use of artificial intelligence reveals several issues. The

first concerns the reliability of the information produced. Although AI tools are capable of providing coherent and detailed answers, they can also generate inaccurate, incomplete, or inappropriate information. Students may be tempted to accept the answers provided without critically verifying the content. This situation promotes the spread of errors or biased representations of certain social and environmental phenomena.

The second issue concerns cognitive dependence. The increasing automation of certain intellectual tasks can lead some learners to reduce their efforts in research, analysis, and personal reflection. When artificial intelligence becomes the sole source of knowledge production, there is a risk of weakening certain fundamental skills such as writing, argumentation, and critical evaluation of information. Patrice Fléchy states that "innovative technologies, once adopted by users, transform societies, and the effects are often unexpected by the designers" (2003, p. 9). This issue is particularly important in a context where education also aims to develop the intellectual autonomy of future citizens. The issue of plagiarism constitutes a third major challenge. The writing capabilities of artificial intelligence tools allow for the rapid production of structured and well-argued texts. Some learners may be tempted to present these texts as their own work without mentioning the technological assistance used. This practice raises questions about academic integrity, the authenticity of learning, and the assessment of students' actual skills.

Furthermore, ethical issues also concern the representation of local realities in content generated by artificial intelligence. Algorithmic models are primarily trained using international corpora that give limited space to African sociocultural contexts. Knowledge relating to the communities of Woleu-Ntem, local languages, traditional knowledge, or the region's specific environmental issues often remains insufficiently documented in digital databases. This situation can lead to a form of informational marginalization of local knowledge. From this perspective, the role of teachers appears fundamental. They constitute essential mediators between learners and digital technologies. Their mission is no longer solely to transmit knowledge, but also to guide students in the critical evaluation of information produced by artificial intelligence systems. They must foster the development of a responsible digital culture based on source verification, the exchange of viewpoints, and respect for the ethical principles related to information use. Patrice Fléchy's work on the social uses of technology helps us understand that technological innovations do not automatically determine individual behavior [5]. Users develop specific practices based on their needs, perceptions, and social environment. In the case of Woleu-Ntem, the uses of artificial intelligence are embedded in specific educational, cultural, and territorial dynamics that influence how these tools are adopted.

Information ethics education thus emerges as an essential component of integrating artificial intelligence into schools. It aims to train learners capable of using digital technologies critically, responsibly, and as civic-minded citizens. This approach involves acquiring information literacy skills that enable them to identify reliable sources and discern relevant content. It is crucial to respect citation rules and understand the limitations of algorithmic systems to avoid misleading information. In the context of environmental challenges, this education takes on particular importance. Learners in Woleu-Ntem are regularly confronted with information related to biodiversity conservation, human-wildlife conflict, forest resource management, and climate change. Artificial intelligence can be a valuable tool for exploring

these topics in greater depth, provided its use is part of a critical and reflective approach.

## Conclusion

The integration of scientific and traditional knowledge in the age of artificial intelligence represents a strategic opportunity to strengthen environmental education in Gabon. It fosters the emergence of an integrative pedagogical approach in which technological innovations contribute to the enhancement of the national ecological and cultural heritage while preparing younger generations to meet contemporary environmental challenges. However, their effectiveness remains contingent upon their ability to be integrated into contextualized pedagogical approaches that respect local knowledge and are geared towards training citizens committed to preserving Gabon's natural heritage. The use of artificial intelligence by learners in the Woleu-Ntem province illustrates the profound changes currently affecting African education systems. While these technologies offer new opportunities for accessing knowledge and developing skills, they also raise major challenges in terms of information ethics. The building of responsible digital citizenship thus appears as an essential condition to guarantee an informed use of artificial intelligence in the service of education, sustainable development and the preservation of local knowledge. The adoption of ChatGPT in schools is contributing to a renewal of educational approaches to biodiversity issues in Gabon. By facilitating access to scientific knowledge while also promoting the consideration of traditional knowledge, artificial intelligence is helping to build a more comprehensive understanding of the human-leopard conflict. This dynamic paves the way for environmental education that is more firmly rooted in local realities and geared towards promoting sustainable coexistence between human populations and wildlife. The emergence of artificial intelligence represents a major transformation of contemporary educational systems. In the Gabonese context, characterized by exceptional environmental wealth and the increasing spread of digital technologies, AI tools appear as potential levers for raising awareness, learning, and mobilizing people around ecological issues. In conclusion, the analysis presented shows that artificial intelligence can contribute to strengthening environmental education by facilitating access to scientific knowledge, promoting the dissemination of appropriate educational content, and supporting the development of learners' information literacy skills. However, these opportunities are accompanied by significant challenges related to information ethics, the quality of the content produced, the risks of misinformation, and inequalities in access to technology. The results thus suggest the need to develop educational governance capable of guiding the uses of AI while valuing local knowledge and scientific expertise. The future of environmental education in Gabon will depend largely on the ability of educational institutions to integrate these innovations responsibly, inclusively, and sustainably. Artificial intelligence cannot replace human pedagogical action; rather, it must be considered a complementary tool for training citizens capable of understanding, analyzing, and addressing the environmental challenges of the 21st century [16-37].

## References

1. The National Center for Forest Ownership. (2025). Climate Change and Forests, available at <https://www.cnpf.fr> on May 8, 2026
2. Abou-Zeid, A. (2024). Continental Strategy on Artificial Intelligence . African Union.
3. Ministry of National Education, Higher Education and

- Research (2025). Connected Objects and Artificial Intelligence (AI). Artificial intelligence and its uses in education. Accessed at <https://www.tice-education.fr> and <https://eduscol.education.fr/document/67356/download>.
4. Gaudin, T. (2013). Ethnotechnology. In T. Gaudin, Foresight (pp. 81-91). Presses Universitaires de France.
  5. Flichy, P. (2003). Technological innovation: recent developments in social sciences. Towards a new theory of innovation . La Découverte.
  6. Barney, D. D., Coleman, G., Ross, C., Sterne, J., & Tembeck, T. (2016). The participatory condition in the digital age. University of Minnesota Press.
  7. Huet, J.-M. (2025). Artificial intelligence and the digitalization of education: essential levers for the future of training in Africa. Communication, Technologies and Development.
  8. Kialo, P. (2006). Community forests in Gabon. In The Sylvo-Anthroponyms Pové : Gabonese Notebooks of Anthropology; Editions du CIRMF: Franceville, Gabon; pp. 2115–2136.
  9. AGEOS. (2023). Gabon: the space pioneer in Central Africa with AGEOS, accessed at [www.digitalbusiness.africa](http://www.digitalbusiness.africa).
  10. The report "From Science to Action" (2025). Transforming science into action: a driver for a sustainable and resilient future, available at <https://www.agenda-2030.fr>.
  11. Delahay, M. (2023). The role of the school in sustainable development, Pass Éducation Actualité, available at <https://www.pass-education.fr/actualites/role-ecole>.
  12. Collin, S., Henriet, C. (2024). Governing schools in the age of AI: Synthesis of knowledge on data-driven school governance. Médiations & Médiatisations, 18 , 43-66.
  13. Gulson, K.N., Sellar, S. (2019). Emerging data infrastructures and the new topologies of education policy . Environment and Planning D: Society and Space , 37(2), 350-366.
  14. Allouche, E. (2023). Generative AI and instructional design: prompting , avenues for research and applications [Blog post], October 2. Education, Digital Technology and Research. <https://edunumrech.hypotheses.org/9934>
  15. Canopé Network. (2023). Generative Artificial Intelligences. Cano Tech. <https://www.canotech.fr/a/35578/les-intelligences-artificielles-generatives>
  16. Damome, E., Ouédraogo, A., Tapsoba, A.E (2020). Enchanted vision and uses of digital social networks in Burkina Faso.
  17. Azaroual, F. (2024). Artificial intelligence in Africa: challenges and opportunities (Policy Brief No. 23/24). Mohammed VI Polytechnic University.
  18. Barney, D. D. (2000). Prometheus wired: The hope for democracy in the age of network technology. University of Chicago Press.
  19. Chambat, P. (1994). Usages des TIC: évolution des problématiques. Technologies de l'information et société, 3, 249-270.
  20. Compiègne, I. (2011). The digital society in question(s). Sciences Humaines.
  21. El Ganbour , M., & Belouali, S. (2024). Development and validation of an ethical framework for artificial intelligence in education: the case of the Moroccan context. Médiations & Médiatisations, 18, 91-124.
  22. Jouët, J. (1993). Communication practices and figures of mediation. Réseaux, 11(60), 99-120.
  23. Jouët, J. (2000). Critical review of the sociology of uses. Réseaux, 18(100), 487-521.
  24. Jouët, J., Vedel, T., Comby, J.-B. (2011). Political information and interpersonal conversations in a multimedia environment. European Journal of Communication, 26(4).
  25. Kihel, L. (2025). Artificial intelligence in the service of language teaching/learning. L'Archétype Review, 3 (1).
  26. Moussavou Ndjimbite O. A.-Y. (2024). Les usages du numérique comme accélérateur de l'écocitoyenneté en Afrique subsaharienne : cas de la Guinée-Conakry et du Gabon. XIX<sup>e</sup> Congrès international EUTIC 2024, Universidad de La Laguna, Tenerife, oct., Tenerife (Canaries), Espagne. pp. 366. (hal-05511630)
  27. Ouni Ghobtane, K., Ben Amor, H. (2021). Distance university teaching in Tunisia: promises and obstacles to its adoption. ISTE OpenScience .
  28. Psyché, V., Maltais, M., Bruneault, F. (2024). Management, governance and policies of artificial intelligence in education and higher education. Médiations & Médiatisations, 18, 3-8.
  29. Schippers, C.; Bracke, C., Ndouna Ango, A. et al. (2008) Delineating community forests: a multiple constraints approach. In Vermeulen, Cédric; Doucet, Jean-Louis (Eds.) The first community forests of Gabon: Accounts of a pilot project. Available at <https://hdl.handle.net/2268/21915>
  30. UNESCO. (2025). African schools are preparing for the AI revolution.
  31. Vallerand, V., Hamel, C. (2024). Teacher professional development with and through artificial intelligence: a literature review. Médiations & Médiatisations, 18, 9-42.
  32. Yosra, J., Abdelkrim, Z. (2024). Artificial intelligence in the service of education in Morocco: opportunities, challenges and perspectives. International Journal of Applied Management and Economics, 2(9), 15.
  33. Schippers, C., Bracke, C., Ndouna Ango, A. et al. (2008) Delineating community forests: a multiple constraints approach. In Vermeulen, Cédric; Doucet, Jean-Louis (Eds.) The first community forests of Gabon: Accounts of a pilot project. Available at <https://hdl.handle.net/2268/21915>
  34. UNESCO. (2025). African schools are preparing for the AI revolution.
  35. Vallerand, V., Hamel, C. (2024). Teacher professional development with and through artificial intelligence: a literature review. Médiations & Médiatisations, 18, 9-42.
  36. Yosra, J., Abdelkrim, Z. (2024). Artificial intelligence in the service of education in Morocco: opportunities, challenges and perspectives. International Journal of Applied Management and Economics, 2(9), 15.
  37. Zacklad, M., Rouvroy A. (2022). L'éthique située de l'IA et ses controverses. Revue française des sciences de l'information et de la communication, 25, (10.4000/rfsic.13204).

**Copyright:** ©2026 Moussa Voundjimbite Olivier Ange-Yannick. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.