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RESEARCH ARTICLE

Open-Source Generative Artificial Intelligence and Open Science: Global Developments and Challenges

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ABSTRACT

Background and Purpose: Open data and research outputs form the backbone of Open Generative Artificial Intelligence (OpenGenAI) models. Based on core principles of openness, transparency, reusability, and extensibility, these technologies are intrinsically tied to information sovereignty. This research aims to examine the fundamental principles of OpenGenAI, monitor its global development and implementation, and identify key challenges to ensure its application benefits society.

Methods: The methodology involves a literature review, as well as descriptive, explanatory, and predictive methods. Four levels of research are applied, and for exploratory analysis, several resources from governments, research organizations, and universities are consulted.

Results: Information search and retrieval are based on eight defined categories, and based on the findings obtained, a set of challenges regarding this technology is identified.

Conclusion: A general conclusion is that when OpenGenAI is managed by governments, research organizations, and universities, it will address inequalities in access. This will enable societies to benefit from responsible and democratic information products generated by the technology.

KEYWORDS

Open Science; Generative Artificial Intelligence; Open Data; Openness; Democratization; Open Source

1. INTRODUCTION

To date, the trend towards maximizing openness and reproducibility of publicly funded research data and outputs might be considered the backbone for modeling and producing open and emerging information technologies, such as the Open Generative Artificial Intelligence (OpenGenAI) Model (Widder et al., 2024; Open Source Initiative, 2024).

OpenGenAI is based on the open-source movement, which might promote the reduction or eradication of several unfavorable activities in society based on the principles of the open science (OS) movement and a scholarly communication approach (Verhulst et al., 2025; Gibney, 2024: 716; López-Borrull, 2024).

In this regard, the current research focuses on studying three specific issues within the OpenGenAI, OS, and scholarly communication approach:

- Provide a comparative and representative global mapping of reliable OpenGenAI models as scholarly alternatives to restrictive generative AI (GenAI) models.
- Foster reduction of informational biases and disinformation (Raj & Feuerriegel, 2023).
- Encourage the eradication of the lack of attribution of authorship of products used and generated by GenAI.

2. ELEMENTS, PRINCIPLES AND FEATURES OF OPENGENAI

In general, GenAI—which encompasses machine learning, deep learning, and language modeling—has fostered a vast body of literature analyzing its concepts, key components, advantages, limitations, and challenges. Furthermore, its roots might be traced from the second half of the 20th century to the present day (Butler, 1985; US, 2023; US, 2025; IFLA, 2025).

GenAI has different concepts, objectives, and approaches depending on the field of knowledge in which it is implemented. These concepts reflect its evolution, contributing factors, maturity, types of components, and nature. GenAI models use open data and research outputs for both training and modeling, demonstrating their connection to OS.

Also, several restrictive GenAI models lack openness factors such as word prediction engines, pre-training models, training datasets, open licenses for customization, and pattern reflection without verifying sources (Mota, 2025).

In this context, it is valuable to consider the trend toward developing, implementing, and adopting Open AI Models, specifically those that are efficient, flexible, and better aligned with modern information needs.

At a global level, Open AI models highlight the open-source movement

as an alternative to GenAI models, since their main features focus on being considered aligned with open information practices, responsible in their handling of intellectual property (IP), and key to democratizing scientific advancements for the public good. Additionally, it fosters digital sovereignty by minimizing dependence on restrictive AI models that exploit open-source resources without proper governance, all of which was mentioned above in the academic approach.

In this regard, OpenGenAI is defined as "AI systems that can be used, examined, altered, and distributed for any purpose, without having to request permission" (Open-Source Initiative, 2024).

The principles of OpenGenAI are as follows:

• Transparency in access to model training data to understand how the system works.

• Reuse, adaptation, and improvement of models.

• Extensibility to interoperate with existing or new systems.

• Ethics: Ethical frameworks provide an important foundation for governing AI systems responsibly across diverse institutional contexts (Christy et al., 2024).

Such frameworks emphasize transparency, accountability, fairness, privacy, and responsible human oversight throughout AI development. These principles complement OpenGenAI's commitment to openness while addressing ethical risks associated with increasingly accessible AI technologies.

The main characteristics that make a GenAI model open are as follows (Raj & Feuerriegel, 2023; Caballar & Stryker, 2025; Conway, 2024; Holzer, 2024; Microsoft, 2026; Moesif, 2026; Mota, 2025; Open-Source Initiative, 2024):

• **Use**. Allowing users to use it for any purpose.

• **Examine**. How the system works and examines its components.

• **Modify**. Change the system for any purpose, including altering its behavior and outputs.

• **Share**. Distribute the original or modified system for any purpose.

• **Data information.** Documentation regarding the training data's provenance, collection methods, filtering protocols, makeup, and the dataset used to train the technology; this information might be structured in three steps: data description; list of where public data was retrieved from; and list of data obtained from third parties and where it was retrieved from.

• **Complete source code.** Share the code on how data is processed, filtered, trained, and used for technology training.

• **Parameters.** Access to architectural and structural elements; configuration files of the model to produce results derived from an input and/or request.

• **Ethics.** Ensure that technology does not infringe on the privacy of personal data.

• **Accessibility.** Eliminate barriers to accessing this technology; eradicate subscription walls of pay to access data and information.

• **Collaborative innovation.** Foster collaboration among global communities to improve the flow of information without bias or unfavorable actions.

• **Cost efficiency.** Promote free use, savings in development and training costs of proprietary models, and emphasize eradicating subscription costs and license fees.

• **Customization.** Complete access to deep fine-tuning, quantization, and architectural adjustments; and optimize the languages used to train the technology to improve the retrieval of meaningful results.

• **Transparency.** Openness about how the technology was built and trained to generate trust in its results, as well as to identify biases, illusions, and/or errors.

• **Auditability.** It allows probing the system for biases, security vulnerabilities, or hallucinations, fostering transparency that closed-source proprietary GenAI models cannot do.

• **Licensing.** Uses standard, permissive open-source licenses that place no field-of-use restrictions or limitations on commercial outputs.

• **Sovereignty.** Organizations can self-host the model on local or private infrastructure, ensuring prompts and data never leave their secure perimeter, and that they manage the data they store in accordance with their objectives, nature, and regulations.

The review of several foundations, principles, and characteristics of OpenGenAI provides elements to establish a specific relationship with the openness movement, which is a current trend that requires analysis to support a proposal about said GenAI model. Based on the foundations, principles, and features described above, some points of connection between OpenGenAI and OS might be identified, such as the following (Widder et al., 2024; Open-Source Initiative, 2024).

Theoretically, OpenGenAI is conceptualized in various ways depending on the era and context. Therefore, this research uses the adjective open to highlight the relationship between this technology and OS, which relies heavily on open data and research outputs. Likewise, open serves as a defining feature of this technology, whose primary objective is to maximize the democratic and sovereign openness of information for the benefit of society.

In this regard, it is meaningful to make a distinction between similar concepts associated with the GenAI model proposal of this research, such as:

• **Open access**. Access to scholarly data, research outputs published and financed with public funds, without legal or technical barriers.

• **Open data**. These are the elements that support and validate the results of original research—which has likely undergone peer review—primarily for the purpose of publication (Palma & Cotera, 2024).

• **Open-source**. Software or other digital products whose source code or underlying design is made publicly available (opensource.com).

• **Open weights**. Publicly accessible parameters (numerical values) of a trained AI neural network that anyone can download, adapt, and run locally on their own infrastructure (human-centered AI).

Based on the conceptualization of concepts linked with GenAI, it might be defined that they have specific purposes associated with specific functions in their own frameworks, but for OpenGenAI, those concepts are addressed to achieve the open development, training, and functionality of said GenAI model.

The concepts exposed share a common objective to justify that OpenGenAI is based on the use of open data and publications financed with public funds, in respect of IP, without risking privacy data, avoiding high cost, and, probably one of the most relevant features is fostering, through several retrieval information systems, that society benefits from products derived from science and technology, such as open access data and research outputs, and OpenGenAI models.

In this regard, it is proposed that OpenGenAI be trained using large volumes of data and research outputs, mainly retrieved from open-access repositories (López-Borrull, 2024), and built on open weights to function as a word prediction engine that refines data retrieval.

OpenGenAI and OS are linked by FAIR-R principles (Findable, Accessible, Interoperable, Reusable, Reproducible and Ready for AI) (UNESCO, 2023; International Science Council, 2026; Verhulst et al., 2025), which promote transparency, reproducibility and ethical and responsible use of data by AI models.

From an OS perspective, OpenGenAI is based on the premise that it must be managed by governments, research organizations, and universities to address inequalities in access to data, infrastructure, and human talent (Budapest Open Access Initiative, 2022; Barcelona Declaration, 2024; Sabel & Larhammar, 2025).

The key operational features of OpenGenAI linked to OS are the processing of data and information, such as the following:

• Retrieval-Augmented Generation (RAG). Agents that retrieve relevant information from large datasets before producing a response, thereby improving the accuracy, consistency, and relevance of the output (Kumar, 2025). When trained with human supervision, RAG processes enable the generation of more accurate, contextualized responses built on reliable

data and human expertise—all within a framework of academic integrity and IP.

Compute-Ready Documents (CRDs) represent an evolution in scholarly communication, shifting from static PDF documents and raw text to structured, computer-readable data (Gunter, 2026). This technical processing enables machine comprehension, which in turn feeds into RAG modeling. The defining characteristic of a CRD is that it acts as a 'semantic twin': a copy of the original content optimized for ingestion by specific GenAI models, particularly the RAG process.

The CRD has three essential components:

• **Active.** An item such as a circuit diagram, heat map, or chemical structure, treated as a first-class digital entity.

• **Context.** Structured metadata that links the asset to its legends, methods, and constraints. This ensures that an AI understands how a result was achieved and eliminates context that leads to misinterpretations.

• **Provenance.** Encode the chain of custody, DOI, ORCID of authors, peer review status, and licensing directly in the object (Gunter, 2026).

• **Prompt engineering**. To date, several methods have been proposed, two of which are particularly relevant to generating prompts compatible with OpenGenAI: the GPEI (Goal, Prompt, Evaluation, and Interaction) and CLEAR (Clear, Logical, Explicit, Adaptive, Reflective) methodologies (Velásquez et al., 2023).

The GPEI and CLEAR methodologies center on processes and criteria designed to refine prompt instructions, which are useful for improving the quality, accuracy, and ethics of results obtained. These methodologies also increase search specificity in OpenGenAI models.

Therefore, OpenGenAI relies on RAG models, CRD processes, and prompt engineering to promote the OS principles of transparency, reproducibility, and reliability. By providing structured data enriched with metadata, descriptive context, and intellectual validation, it supports a meaningful shift from predictive engines to semantic engines. Based on above, it is relevant to monitor the development, implementation, and/or adoption of OpenGenAI at a global level.

3. ANALYSIS AND DISCUSSION OF FINDINGS

3.1. Methodology

This research is carried out with a bibliographic review methodology, as well as descriptive, explanatory, and predictive methods, which are explained below.

The issue of this study is that the GenAI model generates unfavorable results worldwide, which must be addressed for OpenGenAI to be effectively applied across various scientific fields.

The aim of this research is to study the elements and principles of OpenGenAI, as well as to monitor its development and implementation at a global level, and to define a set of challenges of said technology.

The hypothesis of this research is that OpenGenAI embodies the principles of OS by maximizing data openness and ensuring proper authorship attribution for both third-party and AI-generated outputs. Additionally, when governed by public and academic institutions, it promotes digital sovereignty by mitigating bias, combating disinformation, and decreasing reliance on closed, restrictive models.

The literature review was carried out by searching and analyzing key theoretical and conceptual frameworks based on the topic of study, focusing on the main factors driving the global development and implementation of OpenGenAI. The search strings were based on eight defined categories, such as: adoption level, national strategies, governance, impact on academic and research communication systems, open-source alignment, IP, open licensing, and local initiatives/models, which are detailed below. The inclusion/exclusion criteria were based on a search of the retrieved literature; if they content some keyword or reference about OpenGenAI models, those concepts about GenAI models in general were discriminated for this research. The publication period was based on a free search, and the literature showed that from 2026 to date, open-source AI has been studied. About the number of sources initially retrieved, was a lot of literature, near of 200 documents approximately, and the method used for synthesizing evidence was organized and delimited by country and keywords linked with defined categories.

Levels of research implemented for this study are as follows:

• **Exploratory analysis.** This study analyzes specialized literature retrieved from government websites, research organizations, and universities across a randomized sample of 15 countries from all major regions: Africa, Asia, North America, South America, Europe, and Oceania. The random sample was defined in order to create a snapshot of the study object situation and avoid focusing in some countries, since this might segregate meaningful findings. In this regard, the sample tried to have a global overview from several regions, with several purposes, practices, values, among other elements that provide meaningful outputs for this study. Likewise, based on the first findings from the literature review about adoption-level categories, it was defined that might be meaningful obtain data from countries that have high, medium and late levels, because at to date the open-source AI models are considerate implement in their context. In this sense, it let for future studies deep in periodical monitoring the situation man context of OpenGenAI models implementation.

The random sample tries to provide a comparative and representative global mapping of OpenGenAI trends and offers insights to support the development, implementation, or adoption of open-source GenAI models over commercial alternatives.

Main sources consulted for this exploratory study were: Global AI Adoption 2025 (Microsoft, 2026), Preparing National Research Ecosystems for AI (International Science Council, 2026), and databases such as the Open Data Policy Lab, WIPO Lex Data Search, the OECD.AI Policy Observatory (OECD.AI, 2024), and Creative Commons national chapters websites by country. Data retrieval in literature and databases was carried out with the eight defined categories, which are detailed below.

• **Descriptive.** Outlines, describes, and explains the theoretical and conceptual foundations, factors, and trends of the subject under study. It builds upon a literature review and empirical findings to estimate its scope and dimensions.

• **Explanatory**. Addresses the primary causes and core theoretical challenges associated with the subject of study and its contributing factors, establishing the rationale for the research to deepen understanding of the topic.

• **Predictive.** Identifies a key set of future challenges to guide the development, implementation, and adoption of the theme.

The search and retrieval of data about OpenGenAI from the sources, databases, and websites consulted to do this exploratory study is based on eight defined categories, which are as follows:

• **Adoption level.** Monitor adoption levels in each country of the defined sample. The obtained general data about GenAI models will inform further findings on OpenGenAI Models.

• **National strategies.** Identify the national strategies that consider the development and implementation of OpenGenAI.

• **Management.** Determine whether governments, research organizations, or universities manage OpenGenAI models.

• **Impact on academic and/or research communication systems.** Obtaining the impact of OpenGenAI on academic and/or research communication systems.

• **Relationship with OS.** Obtaining the foundations of the relationship between OS and OpenGenAI.

• **Intellectual property.** Determining whether the IP systems, including moral, heritage, and labor copyrights, of analyzed countries address OpenGenAI legislation, focusing on copyright in training data and licensing.

• **Open licenses.** Identifying which licenses are implemented for datasets, documentation, research outputs, and those products used for training and modeling the OpenGenAI.

• **Initiatives and/or models.** Retrieve main OpenGenAI initiatives and models that analyzed countries have developed, implemented, and/or adopted.

3.2. Findings

This research presents the descriptive findings of bibliographic and exploratory monitoring of the global situation of OpenGenAI based on the defined categories, and the general findings are as follows:

• **Adoption level.** The results regarding the adoption level of GenAI in each country and region vary significantly and are shown in Table 1.

• **National strategies and management.** The results for this category are presented in Table 2.

• **Impact on academic and/or research communication systems.** The findings regarding the impact of OpenGenAI are shown in Table 3.

• **Relationship with OpenGenAI, OS, IP and open licenses.** The findings obtained from the three related variables are shown in Table 4.

• **Initiatives or models.** The results of OpenGenAI's main initiatives or models are presented in Table 5.

Please refer to the Appendix for the supporting evidence and sources for the data presented in Tables 2–4.

The findings from our analysis of global OpenGenAI initiatives within the OS framework highlight several key challenges in developing, implementing, and adopting this emerging model, which are detailed below.

3.3 Discussions and Challenges

This section exposes the discussion and challenges that are carried out based on the interpretation of theoretical and descriptive findings obtained to define a series of challenges regarding OpenGenAI. In this regard, theoretical and descriptive findings are used to lead the discussion.

Table 1 Adoption Level

Country	Adoption level
United Arab Emirates (UAE)	1st place
France	5th place
Spain	6th place
Australia	11th place
South Korea	18th place
United States of America (USA)	24th place
South Africa	46th place
Chile	47th place
Mexico	56th place
Brazil	58th place
China	61st place
India	64th place
Egypt	75th place
Belarus	116th place
Russia	119th place

Source: Global AI Adoption 2025 (Microsoft, 2026).

Overall, the findings confirm the research hypothesis that OpenGenAI is an informational activity with meaningful features linked to accessibility, reproducibility, barrier and wallspay eradication, and author attribution records, while also supporting the trend toward digital sovereignty, since it takes an academic approach to training and modeling.

The general GenAI adoption findings were meaningful due to the literature review and database search methodology. Data obtained in this category are correlational, because the general adoption level reported is composed by taking into account several AI models, such as proprietary, generative, agentic, and open-source. In this regard, the outputs obtained were relevant to our defined category.

The adoption category findings reveal several trends across the 15 countries analyzed, such as: the Middle East leads in adoption rates; North America shows strong integration of agentic models; Latin America prioritizes regional collaboration for local-language open models, and Asia remains focused on maintaining its leadership in open-source development.

Retrieval findings on the adoption category pointed out that open-source AI models in the countries and regions are increasingly developing as alternative models that the countries studied have developed in parallel with proprietary models to mitigate several unfavorable actions, and to address processes and activities from governments, research institutions, and universities in a major open and independent approach, such as fostering innovation across scientific, educational, administrative, and economic domains, thereby establishing these models as critical tools for digital sovereignty. Nevertheless, the broader adoption and implementation of OpenGenAI hinge on establishing its reliability, which is one of the objectives of this research.

In this regard, findings obtained showed that reliability will directly impact mitigating technological dependencies, maintaining robust performance, ensuring equitable access to data and research outputs, enhancing policy and decision-making, and reinforcing democratic frameworks.

An analysis of national GenAI strategies from 2017 to 2026 reveals growing institutional engagement by governmental bodies, scientific associations, and higher education institutions in establishing regulatory frameworks. The results underscore the need for academic communities to take a leading role in GenAI governance to formalize information management practices and ensure scientific reproducibility and transparency.

A critical challenge in institutionalizing OpenGenAI lies in infrastructure and governance. Organizations must construct proprietary storage architectures, network frameworks, and data pipelines, especially when adapting or fine-tuning models on domain-specific datasets. Furthermore, successfully operationalizing these systems requires cross-functional oversight teams and standardized support protocols.

Findings on the impact of OpenGenAI on academic and research communication systems indicate that training and modeling this technology with validated data and quality-assured processes are essential to establish its credibility, integrity, and overall potential.

This category addresses the challenge public academic institutions face in establishing the requisite human, technical, legal, and software resources to effectively leverage open generative and agentic AI models in research across the natural sciences, humanities, and social sciences to support scholarly communication.

The findings on OS, IP, open licenses, and OpenGenAI show that the countries analyzed point to a consensus on the use of open research data and products to train and model this technology, which allows us to confirm the assumption that generative and agentic models of GenAI work due to the openness of science.

The evidence on OS, IP, open licensing frameworks, and OpenGenAI demonstrates a cross-national consensus regarding the utility of open research data and artifacts in model training and development. These results support the hypothesis that the success of generative and agentic

Table 2 National Strategies and Management

Country	National strategies	Management
UAE	National AI strategy, 2017	Government
France	France 2030	Ministry of Economy
Spain	National AI strategy, 2024	Spanish AI Supervisory Agency
Australia	National AI plan	Australian Academy of Science
South Korea	National AI strategy	Regional Talent Development Committee
USA	Americas AI action plan, 2025	National AI Research Resource
South Africa	National AI policy	Department of Communications and Digital Technologies
Chile	National AI policy	National Center for Artificial Intelligence (CENIA)
Mexico	National AI agenda 2024–2030	Government of Mexico
Brazil	Brazilian National AI plan	Brazilian Government and Ministry of Science
China	National AI plan, 2017	Ministry of Science and Technology
India	Mission " indiaai " 2024–2029	Governance of IndiaAI
Egypt	National AI strategy, 2025–2030	Ministry of Communications and Information Technology
Belarus	National sustainable development strategy, 2025.	Government of Belarus and United Nations Development Programme
Russia	Strategy for technological independence, 2030	State

Table 3 Impact on Academic and/or Research Communication Systems

Country	Impact on academic and/or research communication systems
UAE	GenAI models to accelerate scientific progress.
France	Government initiatives, public-private partnerships, and companies specializing in AI collaborate on infrastructure such as the "AI Factory France".
Spain	Public-private partnerships facilitate technology transfer in areas such as AI.
Australia	AI research with an emphasis on veterinary medicine, agriculture, and healthcare.
South Korea	Expand AI adoption across all research institutions and strengthen partnerships between universities and regional institutes
USA	National laboratories are bridging the gap between academic research and commercial AI development. The development of a "National Strategic AI R&D Plan" is being promoted.
South Africa	Open-source AI agents are transforming the research and development landscape, optimizing industrial processes, and reducing R&D time and cost.
Chile	Regional open AI model in Spanish/Portuguese that promotes research interoperability.
Mexico	AI systems led by universities and national research centers, focusing on education, health, and the development of specialized AI.
Brazil	The Brazilian Academy of Sciences published guidelines for the scientific use and advancement of AI.
China	The Research Ethics Committee of the Chinese Academy of Sciences published a statement expressing its opposition to the use of AI for research reports, reference lists, research proposals, literature review articles, peer comments, etc.
India	Centers of Excellence, whose main function is research, technological development, innovation, entrepreneurship, and skills building in the use of open-source AI for social, agricultural, and health benefits.
Egypt	Integration of open-source AI into national research and education systems, with the goal of becoming a regional leader in AI in Africa. Cairo University published "Guide to the Use of Artificial Intelligence in Scientific Research".
Belarus	The "Digital Belarus" program 2026–2030 aims to develop an import-independent software ecosystem, which includes improving data quality in state information systems and integrating artificial intelligence.
Russia	The Artificial Intelligence Research Institute is a subdivision of the Russian Academy of Sciences that conducts basic and interdisciplinary research in AI.

Table 4 Relationship of OpenGenAI with OS, IP, and Open Licenses

Country	Open science	Intellectual property	Open licenses
UAE	OS to democratize access and foster "AI sovereignty"	It applies strict IP laws to algorithms and results	Licenses that allow both research and commercial use
France	"France 2023" includes an "open data" policy to boost AI	Discussions about how AI training data affects copyright and who owns AI-generated content	CeCILL licenses similar to GNU/GPL; Etalab Open License 2.0
Spain	The national OS strategy highlights that open data promotes AI development	Promote an open-source ecosystem that ensures IP-respecting AI development and aligns with the European Union (EU) AI Act	Creative Commons (CC BY-SA 3.0), EU Public License (EUPL); Open-Source Initiative (OSI); Responsible AI License (RAIL)
Australia	Agentic AI in research, with a focus on open source, ethical, and collaborative.	Content generated by AI without human intervention goes into the public domain	Flexible Learning for Open Education (FLOE); "IAGen open" commons for education emphasizes collective ownership and open licensing
South Korea	Focus on sovereign AI. Open access to infrastructure and public investment in R&D.	Careful navigation regarding copyright and personal data, especially for developers of open-source GenAI models.	Development of specific licenses for AI
USA	GenAI and OS work together to democratize research and ensure AI transparency	IP requires substantial "human authorship"	Apache 2.0, RAIL, Creative Commons, Contextual Copyleft AI (CCAI): License that extends copyleft to training data AI models
South Africa	The African Platform of Central America develops the African Institute of Data Science and Artificial Intelligence	Lack of specific legislation on AI and reliance on traditional copyright frameworks	CC-BY-SA 3.0 SA, CC-BY-SA 2.0 SA, Nwulite Obodo Open Data License, Free and Open-Source Software (FOSS), MIT, Apache 2.0, GNU General Public License (GPL) and RAIL Licenses
Chile	Chile's national AI policy supports openness and interoperability of AI-related databases and software.	The AI model is built as a public good and promotes software interoperability	Open licensing promotion
Mexico	Statement of ethics and good practices for the use and development of AI by the Secretariat of Science, Humanities, Technology and Innovation.	Works produced solely by AI cannot be copyrighted	Commons Licenses: CC BY-NC-SA 4.0; Apache 2.0 License
Brazil	Law No. 2338 fosters use of open data for GenAI training.	Articles 42 and 43 of Law No. 2338 specify copyright elements related to AI	
China	Use of open data for "AI for Science"(AI4S)		MIT License
India	"One Nation One Subscription" to democratize technology and ensure data sovereignty	Implementation of "Lineage Verification and Responsible Integration"	RAIL and OpenRAIL Licenses -D
Egypt	Training of GenAI models based on the National Open Data Policy, 2025	Innovation and AI development driven by the National IP Strategy (2022–2027) and the Egyptian IP Agency under Law No. 163 of 2023	
Belarus	OS provides potential data for training GenAI		Copyleft Licenses for AI
Russia	OS to foster local technological independence. National repository of open software: Russian GitHub	Licenses to authorize the use of foreign-owned IP	Open State License and MIT Use

Table 5 Initiatives or Models

Country	Initiatives or models
UAE	Falcon Series (LLM) and K2 Think Model; AI Center of Excellence (Dutt, 2026)
France	DataIA, focused on interdisciplinary AI research (INSTITUT DATAIA, 2024). Mistral AI (Leader in open models); Hugging Community Face. Jean Zay supercomputer (Flouriot & Belot, 2025)
Spain	ALIA (Public AI Infrastructure). Barcelona Supercomputing Center MareNostrum
Australia	CommBank Center for Foundational AI (Navolokin, 2026)
South Korea	DeepSeek (Crosley, 2026); Fine-Tuned Local Models (e.g., Llama-based variants)
USA	The Department of National Resources for Artificial Intelligence Research Promotes Open AI "Deep Research " for Academia and Startups (Hulick, 2026)
South Africa	Lelapa AI. InkubaLM. Vulavula. AI for a Just World. Tech4GoodLab. (Mwangi, 2026)
Chile	LATAM GPT, Managed through CENIA. Latin American Artificial Intelligence Index (CENIA, 2023)
Mexico	I'AM (Sovereign AI with NVIDIA); National AI Laboratory. UNAM/ Tec de Monterrey Projects. (UNAM, 2025; Ceballos, 2025; Gasparyan, 2025; ITC, 2025) Hugging Face Spaces & Local LLMs (Llama 3/Mistral); Open-Source RAG Frameworks: Some Digital Libraries
Brazil	Applied Research Centers. Public Universities Lead Research; Applied AI Centers
China	DeepSeek. AI4S Plan in Basic Sciences (Microsoft, 2026)
India	BharatGen (Multilingual); Sarvam AI. Pragna-1B. AIKosh (Dataset Platform) (Government of India, 2026)
Egypt	BelMasry: Natural Language Processing. Torgoman. Loghat. “AI Center for Development”; IAGen Startup Promotion (Mikhael, 2026a; Mikhael, 2026b; Itida, 2026)
Belarus	DeepSeek AI. Belai.by Platform. Domestic AI/United Institute of Problem Computing: Belarusian National Academy of Sciences. Development at the High-Tech Park (Microsoft, 2026; United Nations Development Programme, 2025; Vedyashkin, 2025)
Russia	Gigachat (Sberbank) and Yandex GPT; Kandinsky (text and image). Open Source for Drones. AIRI Research Centers. Sber Open-Source AI Model under the MIT License (TAdviser, 2022; Jacchia, 2022; Sen, 2025)

AI models fundamentally rely on the openness of science.

A key challenge of OS and OpenGenAI technologies is that, despite promoting transparency, they require robust ethical guidelines to mitigate risks such as malicious use, security vulnerabilities, commercial exploitation, and other unintended consequences of restrictive models. Specifically, private datasets must be isolated from public interfaces, while all user interactions should be logged, anonymized, encrypted, and governed by access control policies set by the managing academic institutions.

Regarding the IP category, which focused on determining whether the IP systems are integrated, modified, or add any elements to legislate the AI, the findings pointed out that the analyzed countries' IP vary substantially according to jurisdiction, circumstances, and judicial/administrative interpretation; but it might be defined that the normativity is gradually updating their copyright frameworks to either regulate products utilized by GenAI or restrict the use of third-party content in generative models.

In terms of IP, the primary challenge for open GenAI is to establish a model that verifies and reliably records and attributes the third-party sources and content it utilizes, thereby solidifying its transparency.

With respect to the findings on open licensing, OpenGenAI advocates for various licensing frameworks that uniformly acknowledge de facto authorship of datasets, documentation, and research outputs, focusing on those products used for training and modeling the OpenGenAI.

Furthermore, findings set out that the countries analyzed have implemented a set of licenses that align with their purposes and functions, and it highlights the use of several Creative Commons licenses, licenses linked to the public domain, and the use of the Responsible AI License (RAIL), which complements OpenGenAI by offering greater security, quality, and assurances of ethical compliance.

OpenGenAI’s initiatives and models are diverse, reflecting each country’s specific needs for information retrieval. A distinct trend emerges toward developing generative, agentic, and open-access AI models designed to manage government data, support research, promote regional identity, teach languages, and foster sustainability, among other applications. These models share a common objective: the pursuit of digital sovereignty—whether by reducing reliance on restrictive models, producing open content, or optimizing process execution.

4. CONCLUSIONS

This study proves that OpenGenAI is an informational model that crystallizes the principles of democratic and sovereign open information, and that scholarly communication is in transition because societies

require validated, quality information. The outputs gathered in this study confirm a dynamic growing trend toward OpenGenAI, but their effective implementation requires addressing several key factors, including institutionalization, human resource training, and robust legal and technological infrastructure. Likewise, comprehensive guidelines are essential to ensure data and metadata reliability while mitigating risks from proprietary models, such as those linked with barriers to access to information and a lack of attribution of authorship, among other issues.

From the Library and Information Science approach, it is suggested that OpenGenAI is a highly relevant model for implementation in universities and research organizations because one of the main effectiveness elements is that said model might be aligned with research integrity frameworks, as it enables public institutions to fully manage their academic outputs while utilizing open AI models.

In conclusion, the OpenGenAI model integrates multiple practices, including generative and agentic technologies, OS, open data management, open research outputs, copyrights, and open licensing, all aimed at maximizing the openness of informational products. A proposition for future research is to maintain continuous monitoring of OpenGenAI initiatives and models carried out by countries, as well as identify advantages and disadvantages, in order to encourage development, adoption, or implementation of said model as an alternative AI linked with principles of openness, democracy, and sovereignty.

CONFLICT OF INTEREST

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APPENDIX

Table A1 National Strategies and Management

Country	Source
United Arab Emirates	Microsoft. (2026). Global AI Adoption 2025 a Widening Digital Divide. https://aka.ms/AIDiffusionReport2025H2
France	Krasavina, A. (2025). France – National Strategy for AI. https://digital-skills-jobs.europa.eu/en/initiatives/national-strategies/france-national-strategy-ai
Spain	Gobierno de España. (2024). The role of open data in the new National Strategy of Artificial Intelligence.
Australia	Australian Government. (2025). National AI Plan. Introduction. https://www.industry.gov.au/publications/national-ai-plan Caldeira, V. (2025). Why sovereign AI is becoming a strategic priority in Australia. https://www.govtechreview.com.au/content/gov-datacentre/article/why-sovereign-ai-is-becoming-a-strategic-priority-in-australia-81646916
South Korea	Microsoft. (2026). Global AI Adoption 2025 a Widening Digital Divide. https://aka.ms/AIDiffusionReport2025H2
US	Steen, K. (2025). White House releases AI Action Plan, includes Open Source. https://opensource.org/blog/white-house-releases-ai-action-plan-includes-open-source
South Africa	Republic of South Africa. (2024a). South Africa National Artificial Intelligence Policy Framework. https://fairbridges.co.za/wp-content/uploads/2024/10/South-Africa-National-AI-Policy-Framework-1.pdf Republic of South Africa. (2024b). Open Science Policy. https://assafopenscience.co.za/wp-content/uploads/2026/03/Final-South-African-Open-Science-Policy-2026.pdf
Chile	MInCIENCIA. (2020). Política Nacional de Inteligencia Artificial. https://minciencia.gob.cl/uploads/filer_public/bc/38/bc389daf-4514-4306-867c-760ae7686e2c/documento_politica_ia_digital_.pdf
Mexico	Pérez Gasque, S. (2026). Mexico at the AI Crossroads. https://mexicobusiness.news/media/audioarticle/2026/02/25/mexico-ai-crossroads Soto, A. (2023). Plantean en el Senado garantizar derechos de autor y propiedad intelectual en regulación de IA. https://comunicacionsocial.senado.gob.mx/informacion/comunicados/7250-plantean-en-el-senado-garantizar-derechos-de-autor-y-propiedad-intelectual-en-regulacion-de-ia
Brazil	International Science Council. (2026). Preparing National Research Ecosystems for AI, Third Ed. https://council.science/publications/ai-science-systems Pérez Gasque, S. (2026). Mexico at the AI Crossroads. https://mexicobusiness.news/media/audioarticle/2026/02/25/mexico-ai-crossroads
China	International Science Council. (2026). Preparing National Research Ecosystems for AI, Third Ed. https://council.science/publications/ai-science-systems
India	Government of India. (2026). India AI Governance Guidelines. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2228315&reg=3&lang=2
Egypt	Egypt National Council for Artificial Intelligence. (2025). Egypt National Artificial Intelligence Strategy. Second Edition (2025-2030). https://ai.gov.eg/SynchedFiles/en/Resources/AIstrategy%20English%2016-1-2025-1.pdf
Belarus	United Nations Development Programme. (2025). How Belarus is improving the quality of AI services. https://www.undp.org/belarus/news/how-belarus-improving-quality-ai-services
Russia	Jacchia, B. (2022). Russian IT major Yandex grants open license to its ground-breaking new neural network. https://www.lexology.com/library/detail.aspx?g=f8ee4d8d-b986-4926-a966-2360239bea11 ITMO News. (2024). ITMO Names Russia's Open-Source Software Leaders. https://news.itmo.ru/en/science/it/news/13938/

Table A2 Impact on Academic and/or Research Communication Systems

Country	Source
United Arab Emirates	Dutt, S. (2026). The UAE's big bet on open access is paying off. https://www.tii.ae/insights/uaes-big-bet-openness-paying
France	GENCI. (2025). GENCI, CNRS and AI Factory France Unveil Europe's First NVIDIA GB2000 NVL72 Super Computer for Open Research in AI and AI for Science. https://www.genci.fr/actualites/genci-cnrs-and-ai-factory-france-unveil-europes-first-nvidia-gb200-nvl72-supercomputer
Spain	STIP Compass. (2025). Public research system in Spain. https://stip.oecd.org/stip/interactive-dashboards/countries/Spain/themes/TH2
Australia	Australian Government. (2025c). Australia's artificial intelligence ecosystem: growth and opportunities. https://www.industry.gov.au/publications/australias-artificial-intelligence-ecosystem-growth-and-opportunities
South Korea	Crosley, B. (2026). South Korea's $735B Sovereign AI initiative: infrastructure, requirements, and opportunities. https://introl.com/blog/south-korea-735b-sovereign-ai-initiative-infrastructure-requirements-oppSortunities Microsoft. (2026). Global AI Adoption 2025 a Widening Digital Divide. https://aka.ms/AIDiffusionReport2025H2
US	Wentz, J. (2025). A security perspective on U.S. National Lab's AI Partnership. https://www.csis.org/blogs/strategic-technologies-blog/security-perspective-us-national-labs-ai-partnerships
South Africa	Pouris, A. (2025). 'The state of artificial intelligence research in South Africa'. S Afr J Sci.;121(5/6), Art. 18416. https://doi.org/10.17159/sajs.2025/18416
Mexico	Ceballos, H. (2025). TECgpt Open Edition. https://tec.mx/es/ia/tecgpt-open-edition?srsltid=AfmBOorHdtdKj6ra9uiFtBk8oufp7-JRQmkgA6PkmbffI2vJ7y5pGqHR ITC. (2025). Mexico unveils I'am: the sovereign artificial intelligence, powered by NVIDIA Blackwell and IT Creations. UNAM. (2025). La Inteligencia Artificial Generativa (IAGEN) en el profesorado y estudiantado de la UNAM. Retos y prospectivas. https://www.ceide.unam.mx/wp-content/uploads/2025/08/IAGen_UNAM_2025.pdf
Brazil	Government of Brazil. (2025). IA para o bem de todos; Plano Brasileiro de Inteligência Artificial. Ministério da Ciência, Tecnologia e Inovação; Centro de Gestão e Estudos Estratégicos. https://drive.google.com/file/d/1CsEqi6W_As9JmLrDlIrKKtkjcj0PTEIw/view International Science Council. (2026). Preparing National Research Ecosystems for AI, Third Ed. https://council.science/publications/ai-science-systems
China	International Science Council. (2026). Preparing National Research Ecosystems for AI, Third Ed. https://council.science/publications/ai-science-systems
India	Gupta, A., Jain, A., Aneja, U., & Sen, S. (2026). Advancing Open Source AI in India: Recommendations for Governments & Technology Developers. https://www.digitalfutureslab.in/publications/advancing-open-source-ai-in-india-recommendations-for-governments-and-technology-developers International Science Council. (2026). Preparing National Research Ecosystems for AI, Third Ed. https://council.science/publications/ai-science-systems
Egypt	Egypt National Council for Artificial Intelligence. (2025). Egypt National Artificial Intelligence Strategy. Second Edition (2025-2030). https://ai.gov.eg/SynchedFiles/en/Resources/AIstrategy%20English%2016-1-2025-1.pdf Salama, I. (2025). Cairo U. Issues Guides on Use of Artificial Intelligence in Scientific Research. https://al-fanarmedia.org/2025/11/cairo-u-issues-guide-on-use-of-artificial-intelligence-in-scientific-research/
Belarus	Reform.news. (2026). Digital Belarus: State program envisions creation of Important-Independient Software Ecosystem. https://reform.news/en/digital-belarus-state-program-envisions-creation-of-import-independent-software-ecosystem
Russia	AIRI Institute. (2026). AIRI mission to create universal AI system that solves real-world problems. https://airi.net/

Table A3 Relationship with Open Science, Intellectual Property, and Open Licenses

Country	Source
United Arab Emirates	Benito, A. (2026). UAE's TII challenges big tech dominance with open source Falcon AI models. https://www.computerweekly.com/news/366638759/UAEs-TII-challenges-big-tech-dominance-with-open-source-Falcon-AI-models Iconnect. (2026). AI sovereignty in the UAE: data, models, and governance. https://www.iconnectitbs.com/ai-sovereignty-in-the-uae-data-models-and-governance/ UAE Ministry of Economy. (2025). UAE launches new roadmap for 'Green Intellectual Property'. https://cwbip.com/insights/news/2025/uae-launches-strategic-ip-framework-power-innovation-and-sustainability
France	Donovan, N. (2025). What do the open resource exemptions for GPAI models mean for you? The EUAI Act Guidelines provide some clarity. https://thelens.slaughterandmay.com/post/102kzax/what-do-the-open-source-exemptions-for-gpai-models-mean-for-you-the-eu-ai-act-gu Flouriot, M., & Belot, N. (2025). Jean Zay supercomputer: France has increased its AI-dedicated resources fourfold. https://www.cnrs.fr/en/press/jean-zay-supercomputer-france-has-increased-its-ai-dedicated-resources-fourfold
Spain	European Commission. (2024). Artificial Intelligence and copyright: use of generative AI tools to develop new content. https://intellectual-property-helpdesk.ec.europa.eu/news-events/news/artificial-intelligence-and-copyright-use-generative-ai-tools-develop-new-content-2024-07-16_en
Australia	Arts Law Centre of Australia. (2026). Artificial Intelligence (AI) and Copyright. https://www.artslaw.com.au/information-sheet/artificial-intelligence-ai-and-copyright/ Northbridge. (2023). Open Source: Shaping Australia's Tech Future. https://www.nbridge.com.au/blog/open-source-shaping-australias-tech-future University of Technology Sydney. (2026). AAII open documentation and resources. https://www.uts.edu.au/research/centres/australian-artificial-intelligence-institute/our-research/aaii-open-documentation-and-resources White, M. (2025). The open source legacy and AI's licensing challenge. https://www.linuxfoundation.org/blog/the-open-source-legacy-and-ais-licensing-challenge
South Korea	CODIT. (2025). AI without borders: making open source AI Korea's strategic advantage. https://thecodit.com/blog/open-source-ai-strategy-en Crosley, B. (2026). South Korea's $735B Sovereign AI initiative: infrastructure, requirements, and opportunities. https://introl.com/blog/south-korea-735b-sovereign-ai-initiative-infrastructure-requirements-opportunities Seongmin, K. (2026). South Korea Top Global Open Source AI Development. https://www.chosun.com/english/industry-en/2026/02/22/YIZ4CARV55ENZFZBAUMQUPG4PM/
US	Delangue, C., & Gace, H. (2025). Why open source AI became an American national priority. https://venturebeat.com/ai/why-open-source-ai-became-an-american-national-priority Wilson, C., & Hine, E. (2025). U.S. Open Source AI Governance. https://www.centeraipolicy.org/work/us-open-source-ai-governance
South Africa	Hollesen, J. & Bhagattjee, P. (2025). Copyright and artificial intelligence in South Africa: rethinking authorship and originality in the digital age. https://www.polity.org.za/article/copyright-and-artificial-intelligence-in-south-africa-rethinking-authorship-and-originality-in-the-digital-age-2025-08-15 Koros, C., & Ogonjo, F. (2025). The Nwulite obodo open data licences: a new license for sharing African datasets. https://cipit.strathmore.edu/the-nwulite-obodo-open-data-license-a-new-licence-for-sharing-african-datasets/ Samadder, P. (2025). Open Source Licensing for AI and Generative AI: a Deep Dive. https://www.linkedin.com/pulse/open-source-licensing-ai-generative-deep-dive-samadder-msc-mba-jgljc Republic of South Africa. (2024b). Open Science Policy. https://assafopenscience.co.za/wp-content/uploads/2026/03/Final-South-African-Open-Science-Policy-2026.pdf
Chile	MInCIENCIA. (2020). Política Nacional de Inteligencia Artificial. https://minciencia.gob.cl/uploads/filer_public/bc/38/bc389daf-4514-4306-867c-760ae7686e2c/documento_politica_ia_digital_.pdf MInCIENCIA. (2023). Declaración de Santiago. https://minciencia.gob.cl/uploads/filer_public/40/2a/402a35a0-1222-4dab-b090-5c81bbf34237/declaracion_de_santiago.pdf

Country	Source
	Garcia, E. (2022). Licencias open source. https://codigofacilito.com/articulos/licencias-open-source
Mexico	Llanos, M. (2025). Artificial intelligence and its regulation in Mexico: a legal framework in progress for intellectual property and technological innovation. https://hyaip.com/en/artificial-intelligence-and-regulation-mexico-legal-framework/
	UNAM. (2025). La Inteligencia Artificial Generativa (IAGEN) en el profesorado y estudiantado de la UNAM. Retos y prospectivas. https://www.ceide.unam.mx/wp-content/uploads/2025/08/IAGen_UNAM_2025.pdf
Brazil	Escudero, J. (2025). Brasil: El Senado aprueba el Proyecto de Ley 2338/2023 sobre el uso de la inteligencia artificial. https://institutoautor.org/el-senado-de-brasil-aprueba-el-proyecto-de-ley-2338-2023-sobre-el-uso-de-la-inteligencia-artificial/
China	International Science Council. (2026). Preparing National Research Ecosystems for AI, Third Ed. https://council.science/publications/ai-science-systems
India	Gupta, A., Jain, A., Aneja, U., & Sen, S. (2026). Advancing Open Source AI in India: Recommendations for Governments & Technology Developers. https://www.digitalfutureslab.in/publications/advancing-open-source-ai-in-india-recommendations-for-governments-and-technology-developers
	Hasan, N. (2025). Open Science in India: Democratizing Research and Innovation. *Library Gateway*, *1*(1), 40–48.
Egypt	Egypt National Council for Artificial Intelligence. (2025). Egypt National Artificial Intelligence Strategy. Second Edition (2025-2030). https://ai.gov.eg/SynchedFiles/en/Resources/AIstrategy%20English%2016-1-2025-1.pdf
	State Information Service Your Gateway to Egypt. (2026). Egypt launches sweeping overhaul of intellectual property system. https://sis.gov.eg/en/media-center/news/egypt-launches-sweeping-overhaul-of-intellectual-property-system/
	Milvus. (2026). What are the most common open sources licenses? https://milvus.io/ai-quick-reference/what-are-the-most-common-opensource-licenses
Belarus	Open Science Observatory. (2020). Belarus. https://osobservatory.openaire.eu/country/BY/open-science
	Republic of Belarus. (2019). Unified register of licenses operates in the Republic of Belarus. https://www.xn--b1akbcqh2a7i.xn--90ais/en/news/09-09-2020-6723
Russia	Sereda, S. Free and Open Source Software in Russia: Developers Risk Overview. https://www.fruct.org/files/publications/volume-7/acm7/Ser.pdf
	TAdviser. (2022). Experiment to create National Open Source Software Repository is launched in Russia. https://tadviser.com/index.php/Article:National_Open_Source_Software_Repository
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