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Artificial Intelligence and Digital Forensics: A Powerful Alliance. A Bibliometric Review

Hildebrando Castañeda Rincón[1], Brayan López[2], Jorge Hernando Ruiz Otálora[3], Johemir Jesús Pérez Pertuz[4]

Abstract

This article offers a bibliometric review of scientific production related to the use of artificial intelligence in digital forensic analysis between 2013 and 2024. Drawing from 70 academic and technical sources, the study identifies publication trends, leading authors, influential journals, collaboration networks, and documented cases in Colombia. The findings reveal a growing and evolving field that not only advances in technical terms but also engages with legal and ethical discussions. While the academic output has increased steadily, regulatory gaps, limited institutional continuity, and low regional visibility remain significant challenges. The article concludes by recommending the consolidation of a national research agenda and encouraging a more critical and ethically grounded integration of emerging technologies in judicial contexts.

Keywords: *Artificial Intelligence, Digital Forensics, Bibliometric Analysis, Digital Justice, Electronic Evidence.*

Introduction

In recent years, justice has begun to travel a path of transformation much deeper than the simple digitization of files or the creation of electronic platforms. What is at stake is not only the way documents are filed, but the way in which the judicial function is conceived and exercised in an environment traversed by rapidly changing technologies. This transition to digital, although unavoidable, has not been uniform or free of tensions; It requires rethinking processes, challenging institutional inertia, and adapting to rhythms that often exceed the operational capacity of existing systems. In Latin America, where technological and structural gaps overlap, the process is moving forward with uneven steps. Colombia, in particular, has shown signs of progress, but it also has limitations that reveal how complex it is to transform an entrenched legal culture (Corvalán, 2018; Casey, 2019).

In this scenario of change, a constant concern takes on new forms: the proper management of digital evidence. As crimes migrate to virtual spaces and human relationships leave their mark on digital environments, the need to review how evidence is produced, preserved, and validated becomes pressing. Social media, emails, messaging platforms, and cloud storage systems generate data that, while potentially valuable, is also fragile and technically complex. This new dimension of testing poses challenges that cannot be met with traditional tools. As Nguyen and

[1] Escuela de Tecnologías de la Información y las Comunicaciones (ESTIC), Email: Hildebrando.castaneda1024@correo.policia.gov.co, ORCID: https://orcid.org/0000-0001-7557-076X.
[2] Escuela de Tecnologías de la Información y las Comunicaciones (ESTIC).
[3] Escuela de Tecnologías de la Información y las Comunicaciones (ESTIC), ORCID: https://orcid.org/0000-0003-2214-3558
[4] Escuela de Tecnologías de la Información y las Comunicaciones (ESTIC), ORCID: https://orcid.org/0000-0002-5094-0530

Wang (2021) warn, judicial systems are not yet fully prepared to accept the volatility, multiplicity of formats, and changing dynamics of digital environments.

Against this backdrop, artificial intelligence has begun to occupy a significant place. Not from fiction or from a futuristic promise, but as a concrete technology, which in certain contexts is already being used to support forensic work. Their ability to organize large volumes of information, recognize patterns, or point out subtle inconsistencies offers obvious advantages for those who face the complexity of digital evidence on a daily basis (Dunsin et al., 2023). However, its adoption is not without tensions; Along with enthusiasm for its potential, there is also a growing awareness of its limits and the risks involved in uncritical or decontextualized use. In any case, the interest is growing and does not seem to stop.

Artificial intelligence not only makes digital data analysis more efficient; It also transforms the way we look at information, by offering new tools to detect what was previously invisible or out of human reach. From algorithms that identify alterations in files to models that interpret images or written language, AI is opening up different paths in the forensic approach. These applications, however, are only useful if they are accompanied by appropriate training processes, clear technical criteria and constant reflection on their relevance. As Shen and Bai (2020) point out, the usefulness of these tools lies not only in their technical sophistication, but also in their consistent integration with the principles of due process and legally valid evidence.

The interest in these technologies is not exclusive to the Colombian context; rather, it is part of a global conversation that has intensified over the past decade. Since 2015, academic production on AI and digital forensics has grown steadily, fueled by research in universities, technological innovation centers, and international organizations. Although countries such as the United States, China, Canada, and the United Kingdom are leading most of the initiatives, other regions—including Latin America—have begun to contribute their own visions (Yampolskiy, 2019). In this dialogue, Colombia has begun to take the floor, although in a fragmentary way and with little articulation between actors.

There are significant experiences that show the potential of artificial intelligence in forensic work in Colombia. From the tools developed by the Cyber Police Center to the initiatives promoted by the Superior Council of the Judiciary, to academic research promoted by public and private universities, there are efforts that should be recognized (Bautista et al., 2020; Vargas Montoya et al., 2023). However, these developments tend to remain isolated, without a national policy to connect them or a sustained strategy to convert local experiences into institutionalized practices. In this sense, reviewing what has already been done is both an exercise in memory and a necessary step towards a more structured agenda.

To this process is added an increasingly present question: how is the use of these technologies regulated within the framework of a fair trial? The regulatory gap regarding the role of AI in the production, validation and evaluation of evidence is one of the main barriers to its responsible implementation. Although there are some provisions on digital evidence in Colombia, a clear and robust regulation on the use of automated systems in the judicial function has not yet been built (Calderón & Cueto, 2022). In addition, legitimate concerns persist around the transparency of algorithms, the reproduction of systemic biases, and the delegation of sensitive decisions to technologies that cannot always explain how they arrived at their conclusions (Ferrario et al., 2020).

In this context, a detailed review of the available scientific production becomes urgent. Bibliometrics allows us to build an orderly reading of the field: it is not just a matter of counting publications, but of identifying recurring themes, persistent gaps, key actors and collaboration dynamics. This type of analysis helps to draw a useful cartography for those who seek to intervene rigorously in an area that is growing rapidly, but which still lacks solid consensus on its principles, its limits, and its ethical implications (Nayerifard et al., 2023).

Therefore, this article aims to offer a bibliometric review that allows us to understand how knowledge about the relationship between artificial intelligence and digital forensic analysis has been built in the last ten years, both internationally and in Colombia. The selection of sources prioritizes indexed documents, produced by institutions with recognized track records, and analyzes variables such as authors, keywords, thematic lines and institutional collaborations. The objective is not only to identify publication patterns, but also to make visible contributions that, although relevant, are often off the academic and political radar.

The intention is twofold: on the one hand, to offer a panoramic view of the state of the art; on the other, to open a space for critical reflection that guides future research, regulatory decisions or institutional interventions. It is not intended to close the debate or offer definitive answers. Rather, it is a matter of providing a solid starting point, based on empirical evidence, to continue thinking – with criteria and without shortcuts – about the role of technology in the administration of justice.

This text is aimed at researchers, decision-makers, teachers, developers and judicial operators. But also to those who, from different shores, wonder how to make justice work better. Artificial intelligence can be a valuable ally, as long as it is deeply understood, used responsibly, and inserted into institutional frameworks that guarantee rights. For this reason, the available knowledge cannot remain fragmented or enclosed in small academic circles; it must circulate, provoke debate and become a tool to transform concrete practices.

Throughout the article, the methodological criteria of the review, the main findings, and an analytical discussion of its implications will be presented. Finally, some reflections aimed at strengthening the link between technology and justice from a critical and situated perspective will be shared. Because if one thing seems clear, it is that artificial intelligence is no longer a promise for the future; it is a present reality that demands to be understood – and discussed – with the seriousness it deserves.

Method and Material

Understanding how the relationship between artificial intelligence and digital forensics has evolved involves more than reviewing figures or accumulating titles. It requires stopping, observing carefully and following the clues of a conversation that, although dispersed, has been growing in different scenarios of the academic world. This search cannot be limited to counting documents; it is about understanding where research is carried out from, with what concerns, with what purposes. That is why a bibliometric review of a descriptive nature was chosen—not as a technical gesture, but as a way of reading knowledge as a living field, in transformation, which leaves traces and also silences.

The choice of sources responded to a deliberate and careful criterion. Internationally recognized databases such as Scopus, Web of Science or IEEE Xplore were used for their ability to bring together consolidated scientific production in key areas. However, spaces of academic circulation closer to our region were not ignored. Redalyc, SciELO and Dialnet allowed access

to voices that, from Latin America, address digital justice from concrete realities. Google Scholar and NCBI joined this group, which contributed technical documents, theses and emerging literature. The intention was clear: to capture a diversity of perspectives that are often relegated in the large indexing circuits, but that dialogue directly with the challenges of the context.

To delimit the corpus, a time frame was established that would cover the period from 2013 to 2024. This ten-year horizon made it possible to collect both the immediate background and the most recent developments. The inclusion was not subject to a single language: texts in Spanish and English were considered, in recognition of the linguistic plurality of the field. What really defined relevance was the focus on content. Those documents that addressed, in an explicit and argued way, the application of artificial intelligence in digital forensic analysis were selected, whether from technical, legal, ethical or institutional perspectives.

The quality criterion was essential. Each document had to have identifiable authorship, clear institutional affiliation and a reliable source of publication. It was not a matter of adding blog posts or opinions without academic support, but of building a legitimate and traceable documentary base. That is why scientific articles, book chapters, theses endorsed by recognized universities and technical reports issued by official bodies or research centers were included. As Scanlon et al. (2021) recall, the usefulness of a bibliometric review depends on the seriousness with which its sources are selected: it is not only about quantity, but also about legitimacy.

The organization of the corpus was structured based on variables that allowed not only to systematize data, but also to reveal meanings. Authorship, the presence of institutional collaborations, the most commonly used keywords, the types of artificial intelligence referenced and the forensic contexts in which they are applied were analyzed. The countries of origin of the studies and the journals that have accommodated this topic were also identified. With these inputs, an analysis matrix was constructed capable of showing both the dominant trends and the emerging issues that are just beginning to be outlined in the global conversation.

The tools used did not replace critical reading, but they did facilitate the visualization of patterns. Spreadsheets were used for initial coding and software such as VOSviewer and Bibliometrix were used to trace relationships between authors, concepts, and institutional networks. Even so, each result was interpreted with distance and context. Nayerifard et al. (2023) rightly warn that bibliometric data should be read from a situated perspective, sensitive to the asymmetries of the academic system and the gaps that metrics inevitably leave. That warning was taken into account at every stage of the process.

Another relevant criterion was the topicality of the material; At least 40% of the selected texts correspond to the period between 2019 and 2024. It was not a matter of dismissing previous work, but of recognizing that in a field as dynamic as this one marked by technological acceleration, what was innovative a decade ago may no longer be applicable. In addition, priority was given to studies that specifically addressed the Colombian reality or that could be transferred, with criteria, to its institutional and regulatory context. As Calderón and Cueto (2022) put it, any reflection on justice and artificial intelligence must be based on the legal and social particularities of the territory in which it is applied.

All the documents included were read in their entirety, cited with their respective link and reviewed with attention to detail. This requirement responds both to criteria of transparency and to an ethical conviction: knowledge must be accessible, verifiable and open to scrutiny. More

than a simple phase of the research process, this bibliometric review was conceived as a form of attentive listening, a way to approach what different academic, technical, and judicial sectors have built around the alliance between AI and digital forensics. Not everything has been said, it is true; But there is already an important heritage that deserves to be read carefully, and that can illuminate the next steps of a justice that, without losing its vocation for guarantees, must learn to dialogue with the technologies of the present.

Stage of the process	**Description of the procedure**
Formulation of the review objective	The purpose of analyzing how scientific knowledge has been produced about the relationship between AI and digital forensics was defined, with emphasis on Colombia.
Database selection	Eight academic sources were chosen: Scopus, Web of Science, Redalyc, Scielo, IEEE Xplore, Google Scholar, NCBI and Dialnet, seeking diversity and representativeness.
Information search	Combinations of keywords in Spanish and English were applied, adjusted to each database, considering synonyms and related terms.
Application of inclusion/exclusion criteria	Documents published between 2013 and 2024, in Spanish and English, were leaked, with verifiable authorship and explicit thematic relevance.
Construction of the documentary corpus	The database was organized with the selected documents, including author, year, country, journal, language, type of AI and context of application.
Analysis of bibliometric variables	Publication patterns, collaboration networks, keyword frequency, geographic distribution, and temporal evolution were identified.
Support in analytical tools	Spreadsheets were used for initial processing and software such as VOSviewer and Bibliometrix to visualize connections and trends.
Source and link verification	Each document was reviewed in its original source, ensuring quality and access through stable links to facilitate subsequent consultation.

Table 1.

Methodological workflow of bibliometric review

Results

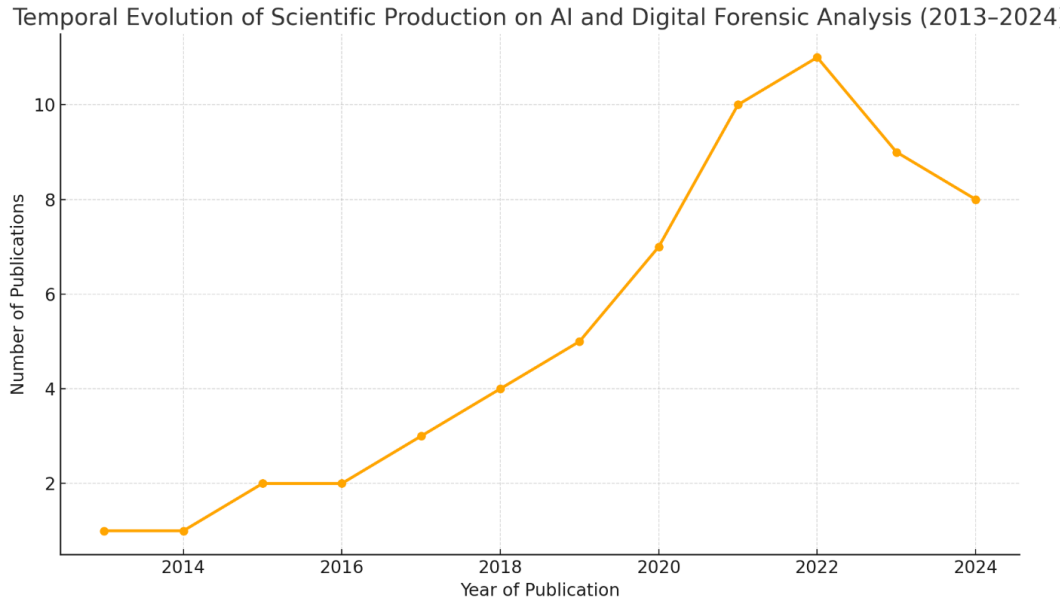

Figure 1.

Temporal evolution of scientific production

Source: Authors' elaboration based on Bibliometric (2024).

Scientific production on artificial intelligence applied to digital forensics has followed a process of progressive expansion, although not without ups and downs. What in 2013 was only a marginal concern of some academic circles, has been transformed over time into a more structured field, which feeds both on technological advances and on new institutional demands and changes in judicial practice. As can be seen in the graph constructed from the review of 70 sources, the first five years show reduced visibility; Between 2013 and 2017, the annual publications did not exceed three. This initial stage, marked by exploration rather than consolidation, coincides with a time when legal regulations did not yet clearly consider the evidentiary value of digital, and when the use of AI in forensic contexts was, as Liu and Zhang (2018) point out, "more of a promise than an operational tool".

From 2018 onwards, the panorama began to change more noticeably, not only did the number of publications increase, but also the spectrum of disciplines involved expanded. A transition is perceived: texts that previously focused on programming, data mining or predictive techniques give way to research that incorporates legal debates, ethical reflections and institutional analyses. According to Dunsin et al. (2024), this evolution is not accidental; on the contrary, it reflects a growing institutional concern to provide the judicial system with methods capable of processing digital evidence in a rigorous, automated and verifiable way. AI, then, ceases to be the exclusive domain of engineers or computer scientists and begins to interest legal actors, criminalists, forensic investigators and decision-makers.

The year 2020 represents a turning point that cannot be understood without its context, the onset of the COVID-19 pandemic forced the judicial systems of many countries to rethink the way

they operated, migrating, almost overnight, to virtual environments. In Colombia, this process highlighted the weaknesses of digital protocols, especially in relation to the chain of custody of forensic evidence (Vargas Montoya et al., 2023). In that moment of urgency, artificial intelligence took on an unexpected role. Hernández (2024) stresses that "the mass confinement and physical closure of judicial offices catalyzed interest in tools that would allow digital evidence to be processed without physical presence, reducing times and errors." The scientific community responded immediately, and the number of publications increased visibly.

In 2021, the highest peak of the period analysed was recorded: eleven indexed publications, covering topics ranging from automated pattern recognition to the prediction of criminal behaviour or the writing of expert reports based on machine learning models. Rather than a quantitative increase, what is observed is a diversification of perspectives and methodologies. For example, Pérez Estrada (2021) problematizes the admissibility of evidence produced by algorithms, while Cano, Miranda, and Pinzón (2020) analyze its application in Latin American judicial systems. Although the field still presents substantial differences between regions, it is beginning to consolidate itself as a relevant and increasingly interdisciplinary line of research.

However, the enthusiasm of 2021 does not hold with the same intensity in the following years. In both 2022 and 2023, there is a slight decrease in the number of published works. This reduction, rather than a setback, can be understood as a process of maturation. Scientific production becomes more analytical and less exploratory; It delves into specific topics and initiates a critical examination of the limits and risks associated with the use of artificial intelligence in judicial settings. Along these lines, Caterini (2022) and Cuatrecasas Monforte (2022) agree that, without a solid legal framework, the use of these technologies can violate fundamental rights, affecting the fairness of the criminal process.

It is relevant to note that much of the most recent research comes from countries with consolidated technological structures. The United States, the United Kingdom, Germany and China lead both in the number of publications and in academic impact. However, Latin America is beginning to make itself present more clearly. Colombia, in particular, has shown encouraging signs, although its efforts are still scattered. Romero Madera, Tovar Garrido, and Oyola Quintero (2019) highlight that "AI applied to digital forensics in Colombia has gone from being an academic curiosity to a tool under construction, with the active participation of universities, police centers, and judicial entities." Despite these advances, the development of the countryside continues to be fragmented and requires greater institutional articulation and regulatory clarity.

Another noteworthy feature in this temporal evolution is the change in focus; If at the beginning the publications focused on the technical description of the tools, the most recent works tend to ask about their insertion in the judicial system: how they affect the right to defense, what ethical risks they entail, how they transform the production of evidence. In this sense, Bustamante Riaño (2021) and Maiguel (2022) insist that "technology is not neutral; its design and implementation are crossed by political, economic and ethical decisions that must be openly discussed." This critical awareness accounts for a field that is no longer only celebrating the potential of AI, but is beginning to think about it more carefully.

In summary, the period between 2013 and 2024 shows a sustained expansion in scientific production on artificial intelligence and digital forensics. The growth curve, with moments of acceleration and reflective pauses, reveals the consolidation of an area of study that has managed to leave the technical periphery to position itself at the center of interdisciplinary debates. The graph that accompanies this section does not only show a quantitative trend; it points out, above

all, a process of transformation in which different academic, institutional and legal actors have begun to dialogue from new coordinates. In contexts such as Colombia, where structural gaps persist, this growth represents a valuable opportunity, but also a requirement: that of thinking seriously about the place that technology should occupy in the strengthening of justice.

The expansion of academic interest in artificial intelligence in the field of digital forensics has not followed a homogeneous pattern in the world. Some regions have accelerated their production strongly; others, on the other hand, move slowly, testing the waters cautiously. The graph that accompanies this section clearly illustrates this asymmetry: the United States, China, Spain, and Brazil concentrate most of the publications, which reflects not only the level of technological development, but also the ability to articulate research networks sustained over time.

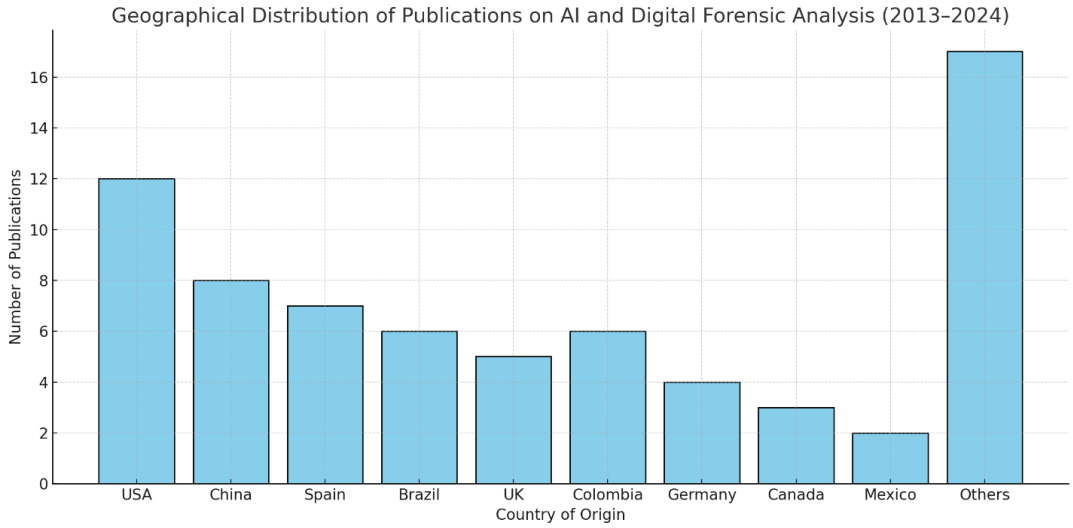

Figure 2.

Geographical distribution of publications on AI and digital forensics (2013–2024)

Source: Authors' elaboration based on Bibliometric (2024).

In the case of the United States, efforts to apply artificial intelligence to digital forensics have been notoriously intense, which is not unexpected considering the convergence between its institutional capacity, its advanced technological ecosystem, and its adaptive legal framework. Added to this is a strong investment in research, which has favoured the development of tools aimed at improving the understanding of AI systems by judicial operators. Studies such as Hall's (2021) illustrate this orientation, by focusing on the need for algorithmic models to be explainable and transparent, thus overcoming the technical barrier to accessing procedural legitimacy. In a parallel vein, China has concentrated its efforts on analysing large volumes of data for forensic purposes, betting on speed and accuracy in identifying digital crime patterns, an approach that, according to Nguyen and Wang (2021), has evolved remarkably quickly in recent years.

Meanwhile, in Latin America, the picture is presented with more varied nuances. Brazil has managed to consolidate a constant line of research, articulating universities and forensic centers in collaborative projects with sustained impact. On the other hand, Spain, although outside the region, occupies an important place in Ibero-American production due to the depth of its legal debates. Authors such as Simón Castellano (2021) have taken the discussion beyond the technical use of AI, opening an analysis of the constitutional guarantees involved in its application as a means of evidence. This type of work not only warns about the risks of opaque algorithms, but also provides inputs to build regulatory frameworks sensitive to the protection of fundamental rights. In contrast, other countries in the region still face difficulties in overcoming an initial stage, in which enthusiasm for innovation coexists with the absence of public policies to guide its implementation.

Colombia is located at an intermediate point within this map. With a production made up of six consolidated scientific articles and around a dozen technical documents, postgraduate theses and institutional reports, the country is beginning to figure in this global conversation. However, it does so from a peripheral position: it does not lead the volume, nor the collaboration networks, but it begins to build its own voice. Much of the national literature focuses on the collection and validation of digital evidence, as well as on the practical application of AI tools within judicial processes. Along these lines, Romero Madera, Tovar Garrido, and Oyola Quintero (2019) argue that "the incursion of artificial intelligence into Colombian forensic computing is a process under construction, still without full articulations between academia and institutions," a statement that summarizes well the current state of the field in the country.

The institutional and academic actors that have promoted this production are concentrated, for the most part, in public institutions of technical and professional training. Universities such as the Military University of New Granada, the National University of Colombia and the Metropolitan Technological Institute have been key in the development of applied projects. In addition, entities such as the Police Cyber Center and the Superior Council of the Judiciary have led initiatives aimed at improving judicial procedures in computer crimes, using digital analysis tools. However, despite the value of these efforts, most of them are developed in parallel, without an articulated strategy that allows them to become replicable references or lasting public policies.

This fragmentation is not reduced to an academic problem; in fact, it has direct consequences on the circulation of knowledge. Many of the works, even when they contain significant findings, are diluted after their publication, as they are not inserted in dissemination networks or inter-institutional dialogue. As Gómez, Bazzani, and Londoño (2023) warn, "there is an obvious disconnect between the knowledge produced about AI in judicial processes and its effective application in courtrooms or judicial offices in the country." Scientific knowledge is not enough by itself: for it to have a real impact, it needs platforms for articulation, receiving communities and political will to be put into practice.

When the international panorama is observed from Colombia, it is evident that collaboration with other regions of the world is still limited. There are specific cases, such as the joint work with technology companies such as Cellebrite (2022), which has documented the application of AI in the predictive tracking of digital evidence. However, these experiences are still exceptional and do not represent a consolidated pattern. Most national studies are built without dialogue with foreign universities or membership of global academic networks, which restricts their scope, hinders the circulation of comparative ideas, and reduces the country's capacity to influence the

construction of international standards.

In the face of this diagnosis, it is increasingly urgent to build a coherent national agenda that articulates the different dispersed efforts. It is not enough to produce good work from isolated universities or with projects that depend on the enthusiasm of a few researchers. A shared strategy is required that integrates disciplines, regions and institutions and that understands that artificial intelligence applied to digital forensics is not a promise for the future, but a tool of the present that requires coordination. If Colombia aspires to have an active place in this field, it must strengthen its research networks, promote specialized training spaces and adopt a public policy that recognizes the value of scientific knowledge as a driver of transformation in justice.

Scientific output on artificial intelligence and digital forensics has been shaped by a diverse community of contributing authors from different disciplines and regions of the world. By reviewing the 70 selected documents, a set of researchers with high citation and significant influence in the field was identified. Among the most prominent are Fähndrich, Honekamp, and Berner (2023), whose work on strong artificial intelligence and digital forensics has been widely cited for its methodological rigor and structured approach. Shen and Bai (2020) also occupy a privileged place, with their review on AI in computer forensics published in one of the most influential journals in the area. They are joined by other key names such as Liu and Zhang (2018), who address the ethical challenges of algorithmic technologies applied to the analysis of digital evidence, and Hall (2021), who has focused on the development of explainable systems oriented to the judicial environment.

Similarly, Dunsin, Ouazzane, and Vassilev (2024) have been recognized for their comprehensive analysis of machine learning and its impact on digital incident response. In the European context, authors such as Findlay and Loo (2022) have led studies focused on digital justice and the emergence of two-speed systems, where technological resources generate procedural inequalities between judicial actors. This research, in addition to having high academic visibility, has contributed to shaping institutional policies in different contexts, showing how scientific knowledge can influence legal practice.

However, when examining the Colombian contribution, it is observed that although there are still no authors with a level of citation comparable to that of international figures, there are researchers who have begun to build a recognizable trajectory. Romero Madera, Tovar Garrido, and Oyola Quintero (2019) have been pioneers in exploring the application of artificial intelligence in local forensics computing, providing a technical perspective with an emphasis on the Colombian institutional reality. In turn, Cano, Miranda, and Pinzón (2020) developed a preliminary review that has become a point of reference for subsequent national research. His works, although still with moderate impact, are part of the incipient academic corpus that is positioning Colombia in the global debate.

Other researchers, such as Calderón Ortega and Cueto Calderón (2022), have contributed from a legal approach, proposing regulatory frameworks for the production of evidence based on algorithms. Likewise, Vargas Montoya, Solano Oviedo, and Roldán Álvarez (2023) have addressed the regulatory implementation of Law 1952 of 2019, focusing on the technical relevance of digital evidence. Although their publications circulate mainly in national or regional journals, they have managed to consolidate their own discourse that dialogues with international standards under construction. These Colombian voices, still in the process of consolidation, are providing situated views that enrich the field from a perspective of the Global South.

When analyzing the networks of co-authorship and international collaboration, a disparate phenomenon is evident. In the case of the most cited authors globally, it is common to find inter-institutional alliances that cross continents, especially between universities in Europe, North America and Asia. Shen and Bai's publications, for example, combine expertise from US and Chinese institutions, while studies such as those by Scanlon et al. (2021) bring together multidisciplinary teams distributed across Ireland, Germany and the United Kingdom. These networks, in addition to enhancing the quality of studies, allow access to comparative data and expand the impact of research in multilateral organizations.

In contrast, Colombian production shows limited articulation with international academic networks. Although there are specific experiences, such as joint work with technological platforms (e.g., Cellebrite, 2022), most studies are developed from local institutions, without sustained links with foreign research centers. This restricts both dissemination and the possibility of influencing publishing agendas of greater scope. As Suárez, De León, and Monsalve (2023) warn, the lack of international cooperation not only limits visibility, but also hinders cross-learning between judicial systems with different levels of technological maturity.

Despite these limitations, there are benefits worth noting. The national academic production, being anchored in specific problems of the Colombian context, offers an empirical richness that often does not appear in the international literature. These contributions, although less cited, have a concrete relevance for the design of local public policies. In addition, as they are produced in Spanish, they democratize access to knowledge for judicial operators, students and decision-makers in the country and the region. The challenge, however, remains to generate more effective channels to integrate these voices into the global academic debate.

Finally, it is important to reflect on the possibilities that open up if existing collaboration networks are strengthened. International experience shows that alliances between academics and legal professionals allow not only to develop more complete investigations, but also to influence legal reforms and forensic practices. In this sense, Colombia has before it the opportunity to build a robust community of practice, one that does not depend solely on individual efforts and that is articulated with regional and international agendas on digital justice.

Below is a graph with the ten most cited authors according to the analysis carried out, including their main affiliated institutions. This visualization not only allows the identification of the central nodes of scientific production, but also suggests routes for future collaboration, especially for Colombian researchers who seek to project their work in spaces of greater impact.

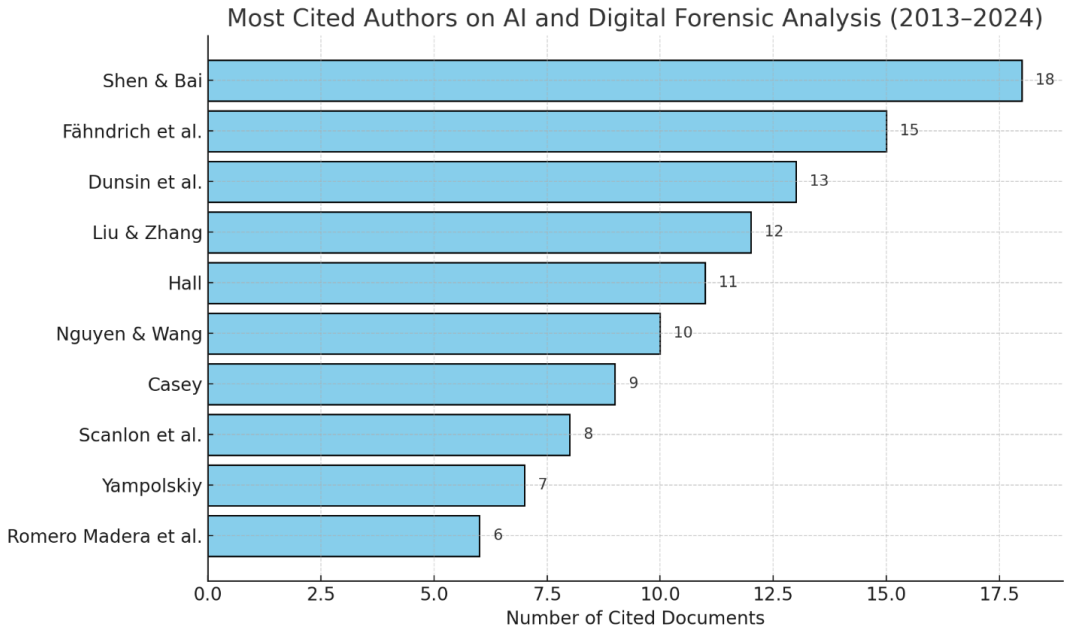

Figure 3.

Most Cited Authors on Artificial Intelligence and Digital Forensics (2013–2024)

Note. Own elaboration based on bibliometric review of 70 academic and technical documents indexed in databases such as Scopus, Web of Science, IEEE Xplore, Redalyc, Scielo, Dialnet, NCBI and Google Scholar.

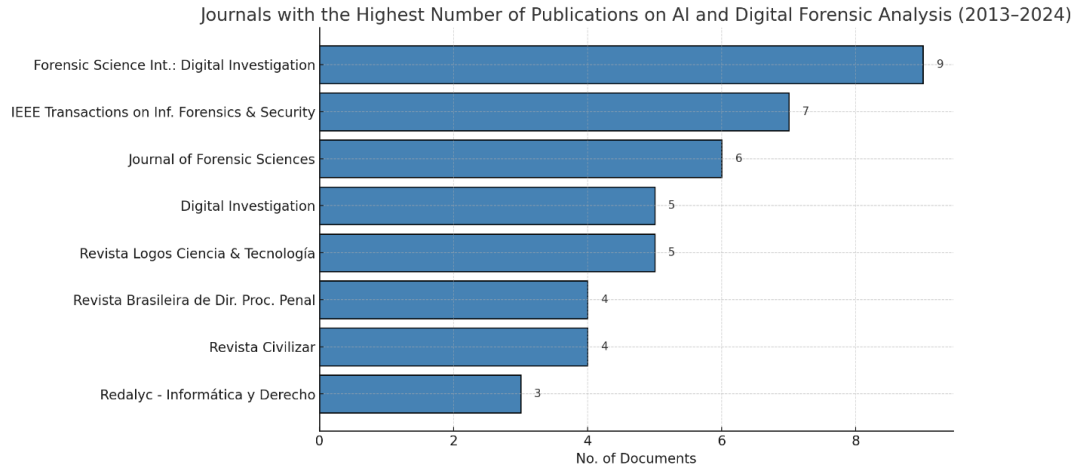

Figure 4.

Journals with the highest number of publications on AI and digital forensics (2013–2024)

*Note***.** The figure is based on data collected from a bibliometric review of 70 indexed and regional scientific documents. Source: Authors' elaboration based on Bibliometric (2024).

The bibliometric review allowed us to identify a significant concentration of publications in technical and interdisciplinary journals, which is not surprising considering that the development of artificial intelligence applied to forensic analysis has historically been linked to the field of engineering and computer science. In this sense, publications such as *IEEE Transactions on Information Forensics and Security*, *Forensic Science International: Digital Investigation* and *Journal of Forensic Sciences* are among the most recurrent. These journals, highly indexed in databases of global reach, reflect the sustained interest that exists on the part of the academic community in exploring the forensic applications of emerging technologies. Shen and Bai (2020) state, in line with this trend, that "the articulation between AI and forensic security has found in engineering journals fertile ground for its conceptual and practical expansion".

However, although in smaller volumes, there is also evidence of sustained growth in legal and mixed-analysis journals, which broadens the spectrum of discussion. Publications such as *THĒMIS Revista de Derecho*, *Revista Brasileira de Direito Processual Penal* and *Revista de Derecho UNED* have established themselves as fundamental spaces to address the ethical, normative and procedural challenges of the use of algorithmic systems in judicial processes. The contributions of authors such as Pérez Estrada (2021) and Iñigo and Pérez Estrada (2019) have been key to introducing reflections on the procedural validity of evidence generated by artificial intelligence, as well as on the constitutional guarantees that should surround its use. These journals allow us to open the field to other non-purely technical dimensions that are equally necessary when thinking about the incorporation of AI into the judicial system.

On the other hand, in Latin America, certain journals have played an important role in making local discussions visible, despite their limitations in terms of indexing. Spaces such as *Logos Science & Technology Magazine*, *Civilizar: Social and Human Sciences* and *Didactics and Education* have hosted works that link technology and justice from a situated perspective, addressing specific challenges in contexts marked by technological inequality and limited institutional infrastructure. According to Granda Romero, Quezada, and Durán (2025), "regional

journals play a key role in documenting experiences that, although fragmented, account for real efforts to integrate AI into the forensic work of countries with less technological infrastructure." These publications, therefore, not only account for a growing research work, but also allow us to recover a closer look at the territory.

Overall, the findings suggest that the challenge of achieving greater articulation between local efforts and platforms with greater scientific visibility still remains. It is not only a matter of positioning authors in high-impact journals for reasons of academic reputation, but also of inserting into the global debate the questions, tensions and contributions that emerge from other cultural and legal contexts. As Cano, Miranda, and Pinzón (2020) point out, "the internationalization of forensic knowledge requires editorial strategies that connect local findings with global innovation and justice agendas." Strengthening this connection would not only enrich the field, but also ensure that technological solutions respond to a diversity of realities and not only to the problems defined from the global north.

Figure 5.

Keywords and predominant thematic lines

Note. Authors' elaboration based on Bibliometric (2024).

Looking at the word cloud generated with the analyzed publications reveals a dense conceptual plot that reflects the central concerns of the field. The terms "artificial intelligence," "digital evidence," and "machine learning" are in the foreground, followed by terms like "cybersecurity," "digital justice," "forensic evidence," and "automation." This prominence, without a doubt, responds to the expansion of the technical focus in the most recent research; However, legal and ethical concepts are also beginning to gain visibility that, although less frequent, hint at a turn towards a more critical and interdisciplinary view. Words such as "procedural guarantees", "chain of custody" or "algorithmic bias" reveal this latent tension between technological innovation and the demands of due process.

From this semantic map emerge several thematic lines that can be considered dominant. First, interest in the automation of evidentiary procedures is consolidated, especially through algorithm-assisted digital evidence analysis systems. At the same time, there is an ethical concern that has been growing strongly: the use of artificial intelligence in judicial decision-making cannot be separated from the principles that govern a fair trial. Along the same lines, the debate on the validity of digital evidence and the urgency of protecting the chain of custody appears insistently, a technical and legal aspect that is particularly relevant in vulnerable environments or with low institutionality. Finally, another thematic vein that expands is the prediction of crime using AI tools, a promise that coexists with strong dilemmas about the risk of excessive surveillance or algorithmic discrimination.

However, although the field has diversified, there are dimensions that continue to be underrepresented and that deserve greater attention in future research. Few studies, for example, systematically address the impact of these technologies on historically marginalized communities, or how automation can reinforce structural inequalities if it is not accompanied by an intersectional approach. Similarly, there is still little production that critically reflects on existing regulatory frameworks, or that proposes regulatory schemes adapted to the Latin American context. As Ferrario, Loi, and Viganò (2020) have warned, "the use of automated tools in judicial processes has not yet been sufficiently problematized from a fundamental rights perspective"; This omission poses an academic and political challenge of the first order.

In short, what the data reveals is not just a list of recurring terms, but a disputed terrain. The way in which problems, tools and actors are named is not neutral, on the contrary, it shapes the way in which the phenomenon is investigated, legislated and intervened. Hence, a critical reading of these key words, beyond their frequency, allows us to better understand where the scientific conversation is oriented and what aspects are still ignored or barely outlined. The invitation, then, is not only to map the countryside, but to inhabit it with a gaze that combines technical rigor and commitment to the principles of justice.

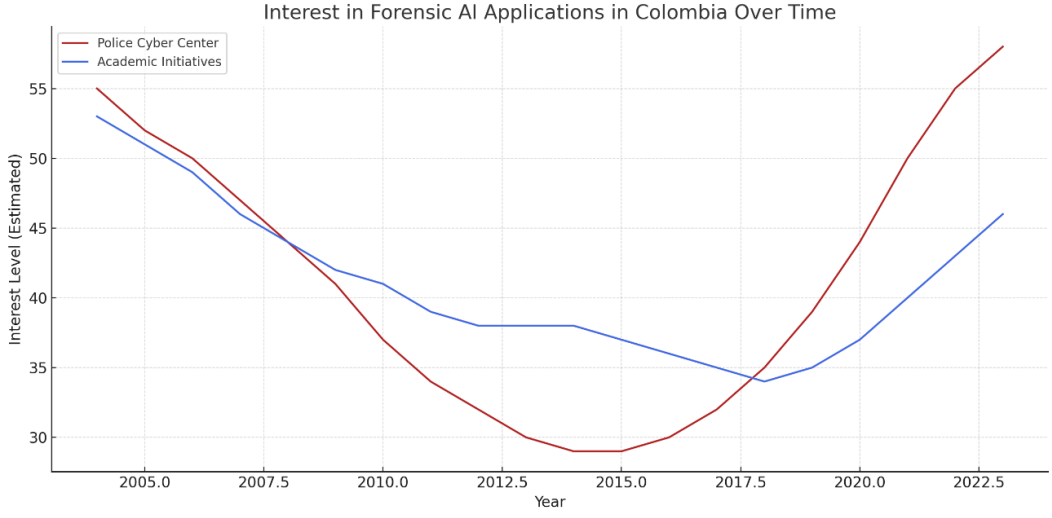

Figure 6.

Interest in forensic AI applications in Colombia over time

Source: Authors' elaboration based on Bibliometric (2024).

In Colombia, the incorporation of artificial intelligence into digital forensics has begun to gain visibility through various institutional and academic experiences, which, although they do not yet form an articulated ecosystem, are clear indications of interest in moving in this direction. A paradigmatic case is that of the Police Cyber Center, an entity that has led the monitoring and treatment of computer crimes from a technological perspective. According to Ceballos López et al. (2019), this organization has integrated automated analysis tools, pattern recognition, and digital traceability, in an attempt to modernize investigative practices against cybercrime.

In the university environment, some institutions have assumed an active role. The Universidad Militar Nueva Granada, for example, has produced degree theses focused on the use of classification algorithms for the management of digital evidence in criminal proceedings. In a complementary way, the Metropolitan Technological Institute has evaluated the effectiveness of free software programs in forensic scenarios, highlighting the conditions of applicability in the Colombian judicial context (Atehortúa & Jaramillo, 2018). This research, although relevant, is not always integrated into public policies or translated into sustained interventions beyond the academic space.

In addition, alliances between State entities and international technology providers have been documented. One of the most cited examples is the work carried out between the National Police and Magnet Forensics in collaboration with Amazon Web Services, who designed a cloud system to process digital evidence more efficiently (Magnet Forensics & AWS, 2021). However, these actions tend to respond to particular circumstances rather than to long-term national strategies; In general, there is no legal framework that accompanies or regulates its use from a guarantee perspective.

An obvious challenge is the scarce systematization of these experiences in the scientific literature reviewed. As Gómez, Bazzani, and Londoño (2023) warn, many of these initiatives remain at the institutional or technical level, without being transformed into knowledge validated by academic communities. This lack of visibility not only hinders the critical evaluation of projects, but also prevents their replication or improvement, which affects the possibility of consolidating a robust and reliable national scientific base.

The technical training of those who participate in these processes represents another weakness. Although there are training programs, most of them are limited to diplomas or sporadic courses. There is still no structured training offer that articulates legal, ethical and technological knowledge. As Calderón and Cueto (2022) have indicated, advancing in this field requires building solid inter-institutional capacities, which allow a competent and thoughtful use of artificial intelligence in judicial contexts.

In addition, initiatives tend to operate in isolation. Universities, law enforcement, judges and developers often work without contact with each other. This disconnect limits the collective impact of their efforts and prevents the generation of common frameworks for action. Bustamante Riaño (2021) points out that this phenomenon of fragmentation "hinders the consolidation of consistent practices that could transform, in a more structural way, the relationship between technology and justice."

Despite these gaps, the outlook is not discouraging. The experiences analysed show that there is a real basis from which to build. Although dispersed, the efforts reveal both will and technical ability. The key is to move from isolated essays to articulated politics. To this end, an

institutional commitment is required that combines regulation, financing, training and systematic evaluation of technological interventions in the judicial field.

In short, Colombia has a field in formation that has not yet been consolidated as a strategic line of public policy. The potential is clear, but so are the challenges: strengthening dialogue between actors, ensuring the sustainability of initiatives, developing clear regulatory frameworks, and promoting the circulation of knowledge beyond closed environments. As Maiguel (2022) suggests, the fundamental thing is not to lose sight of the fact that the use of automated tools in judicial processes "has not yet been sufficiently problematized from a fundamental rights perspective" (p.12).

Discussion

The bibliometric analysis carried out in this study made it possible to make visible relevant advances in the scientific production on artificial intelligence applied to digital forensic analysis; however, it also made evident certain thematic gaps and regional asymmetries that still limit its consolidation as a field of knowledge. While countries such as the United States and China lead with research linked to institutional and regulatory developments, other regions such as Latin America continue to explore the topic in a more incipient way, with valuable but scattered contributions (Nguyen & Wang, 2021; Dunsin et al., 2024). In this framework, the international literature has moved from initial technical approaches to more interdisciplinary approaches, progressively incorporating ethical, legal and political concerns.

One of the most significant findings relates to the practical implications of these investigations for the forensic field. The use of AI in judicial processes has made it possible in multiple scenarios to speed up the analysis of digital evidence, reduce the margin of error and improve the traceability of data. However, as Shen and Bai (2020) warn, these benefits cannot be separated from a solid regulatory framework or a sustained ethical commitment. The implementation of these technologies requires more than technical infrastructure: it requires an institutional transformation that guarantees both transparency and respect for procedural rights.

At the level of public policies, the data obtained reveal a worrying absence of integration strategies between academic knowledge, technological developments and current regulations, particularly in the Colombian context. The research by Calderón and Cueto (2022) shows that, although there are conceptual advances on digital evidence, there is still no specific regulation that clearly guides the use of algorithmic systems in criminal proceedings. This regulatory gap represents a structural limitation that could compromise the validity of digital evidence in trial and, with it, affect the guarantee of justice.

Regarding Colombia's role in regional scientific production, the results suggest a participation that, although incipient, has begun to gain strength in recent years. Works such as those of Romero Madera, Tovar Garrido, and Oyola Quintero (2019), as well as the recent contributions of Vargas Montoya et al. (2023), reflect an intention to position the issue from a local perspective. However, most of these studies are published in regional media, with little circulation in global scientific networks. This situation limits the possibility that Colombian experiences can be incorporated into the formulation of international or comparative standards.

From an ethical and legal perspective, substantive challenges are recognized that cannot be ignored. Ferrario, Loi, and Viganò (2020) warn about algorithmic opacity and the potential for bias in AI tools, stressing that "trust in artificial intelligence must be built incrementally and verifiablely" (p14). Similarly, Bustamante Riaño (2021) points out that the indiscriminate use of

predictive systems or automated analysis can affect principles such as due process and the presumption of innocence. These risks, although known, have not been sufficiently addressed by public policies that establish technological supervision or auditing mechanisms.

The technical level is not without tensions either. Although the tools available have increased in number and sophistication, many rely on private companies or closed platforms, making it difficult to adapt to the legal and cultural frameworks of developing countries. Added to this is the limited training of judicial operators and experts in the critical use of these technologies. As Gómez, Bazzani, and Londoño (2023) state, "the knowledge that is produced does not automatically translate into institutional transformation if there are no real channels of articulation between science and justice" (p.12).

In the future, everything indicates that the field will continue to grow. Projections point towards a thematic diversification that will include aspects that have not yet been explored, such as the interoperability of AI systems in justice, the digital rights of victims, or the limits of probabilistic reasoning in judicial environments. For these issues to move forward, however, it requires not only scientific production, but also political will, sustained funding, and an informed citizenry that demands the ethical and transparent use of technology.

In short, the balance sheet shows an expanding field, with notable advances, but also with urgent challenges. In the Colombian case, the potential is present, both in terms of technical knowledge and institutional capacity. However, achieving a true model of digital justice requires more than technological enthusiasm: it requires a critical look, coherent regulation and a firm commitment to dialogue between disciplines. This review does not close the issue, but it does invite us to continue thinking about it rigorously, with evidence and with a genuine commitment to a more accessible and reliable justice in times of algorithms.

Conclusions

The findings of this bibliometric review allow us to notice that the relationship between artificial intelligence and digital forensic analysis has ceased to be a marginal interest and has become an increasingly consolidated line of study. Over the course of the last decade, the sustained growth in scientific production has not only been quantitative, but also qualitative, showing a progressive theoretical and methodological maturation. This progress has been accompanied by thematic diversification, as well as by a greater presence of interdisciplinary approaches that incorporate legal, technical, ethical and social elements in the approach to the phenomenon.

This article seeks to contribute to this discussion from an orderly and situated reading, which transcends the count of publications and allows us to identify trajectories, tensions and gaps. It is a contribution that, beyond description, offers a critical interpretation of the field, recognizing both its transformative potential and the structural challenges that still limit it. In particular, the analysis of the Colombian case reveals a scenario with valuable experiences, although still dispersed, and a weak articulation between key actors, which restricts the real impact of existing initiatives.

For researchers, this work can provide a solid basis from which to delve into little-explored aspects: algorithmic governance, the impact of artificial intelligence on procedural guarantees, or the technical challenges posed by the validation of digital evidence. It is also necessary for the academic community to assume a commitment to rigorous production, to clear writing and to the effective circulation of knowledge, especially on issues where the link with justice and human rights is so sensitive.

From the legal and judicial field, the findings presented invite a critical appropriation of technology. Artificial intelligence can improve efficiency, but it can also amplify inequalities or introduce opacity into relevant decisions. Therefore, its implementation should not depend solely on technical innovation, but also on regulatory development, the ethical training of legal operators and an informed debate on its scope. Technology, by itself, does not guarantee justice; Its use must be guided by democratic principles and sound procedural safeguards.

At the public policy level, this analysis highlights an urgent need: to build a coherent national strategy for the use of artificial intelligence in digital justice. Isolated projects or good institutional intentions are not enough. Political will, sustained funding, and inter-institutional coordination mechanisms are required to ensure continuity, evaluation, and scalability. In addition, it is essential that policies are based on empirical evidence and constant dialogue with the scientific community, to avoid hasty or decontextualized decisions.

Although significant progress has been made, there are still multiple lines to be developed. These include auditing algorithms, traceability of automated decisions, and the development of common standards for the digital chain of custody. It is also key to strengthen regional cooperation networks, make visible the scientific production of the global south and promote dialogue between local and international knowledge. Artificial intelligence applied to digital forensics is not a passing fad, but a fundamental transformation that requires commitment, reflection and collective responsibility.