Artificial Intelligence (AI) in Higher Education

In collaboration with researchers from Universidad del Rosario, this three-part special report explores the role of AI in higher education: in biology and its impact on scientific research, its transformative effects on industry and business, with an in-depth look on how innovation will be essential for the successful implementation of this technology, and its growing influence on legal decision-making.

By Juan Manuel Sarasua
Photos Freepik.es
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Adriana Maldonado Chaparro, Behavioral Ecologist and Director of the Behavioral Ecology and Conservation Research Group at the School of Science and Engineering at Universidad del Rosario.

Álvaro Ávila, Hydrologist and Researcher with the Climate-Ecosystem Interactions Research Group at Universidad del Rosario.

A New Tool for Scientific Research

The use of AI by university students and researchers extends far beyond the generative tools that have captured public attention in recent years. In Science Communication, we feature two stories from the School of Science and Engineering that demonstrate how these technologies are helping advance scientific research at Universidad del Rosario.

By Juan Manuel Sarasua
Photos Juan Diego Pineda, Álvaro Ávila, URosario
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A pair of oilbirds with their chicks.

In order to estimate populations of *oilbirds* (*Steatornis caripensis*), a species of nocturnal fruit-eating birds, biologist Juan Diego Pineda traveled nearly 12 hours by bus from Bogotá to the municipality of El Peñón, in the department of Santander, Colombia. There, he descended to the entrance of La Pandora cave and used thermal cameras to record the birds as they entered and exited during the late afternoon and evening. He repeated this fieldwork three times a year in nine caves—five in El Peñón and four in the neighboring municipality of Bolívar—selected from the 218 caves documented in the region. In addition, Pineda reviewed 108 hours of footage collected over a 42-day period and manually counted the individuals emerging from the caves. This work formed part of his undergraduate thesis at Universidad del Rosario in 2023, under the supervision of Professor Adriana Maldonado Chaparro of the School of Science and Engineering.

After spending hundreds of hours reviewing footage, Juan Diego did not lose his sight or go mad—or at least that was my impression during the interview.

Two years later, he began researching how tourism affects these birds for his master's thesis, which he also conducted with the Behavioral Ecology and Conservation (BEC) research group. The question is particularly relevant given that, according to data from the Colombian Association of Travel and Tourism Agencies (ANATO), more than 2.5 million tourists visited "ecotourism destinations" in 2025.

Pineda set out to determine whether disturbances associated with cave tourism—fueled in part by the growing visibility on social media over the past decade—increase energy expenditure in oilbirds. "This time, I don't just have to identify each bird I see, as I did before," explains Pineda. "Now I stay quiet and "disturb" them—with a light, the sound of people talking, or a combination of both—which is what would normally happen when there are tourists in the cave. "And the oilbirds start flying everywhere! There's no way to count them; it's impossible to keep track"

In November 2025, Pineda began training an artificial intelligence (AI) model using BehaveAI, software developed by the Visual Ecology Group at the University of Exeter in the United Kingdom. BehaveAI can be trained to identify and classify animals and objects appearing in video recordings. To do so, researchers must first teach the system how to recognize specific targets. "I can 'teach' the model what a flying bird is, how to identify it, and how to track it," explains Pineda. "It can do this with hundreds of birds flying at the same time while tracking the trajectory of each individual. Once the model is fully trained, any researcher will be able to replicate the experiment and adapt it to other locations at a fraction of the cost in terms of time and resources," he adds.

The results of this project have also inspired an entrepreneurial venture. WingSentry is a thermal-scanning system powered by artificial intelligence and designed to help tourism companies protect bird populations. "Our machine learning system captures thermal images, detects behavioral changes, and tracks populations, generating millions of data points beyond what humans could realistically process," he explains. "The idea behind WingSentry is to use technology to help the tourism sector design more environmentally friendly routes."

Contributing to the Study of Animal Behavior

"AI has been around for a long time without causing particular concerns . What has changed is the pace at which it has evolved and the growing number of tools that have become available to researchers," says Adriana

Maldonado Chaparro, a behavioral ecologist and Director of the Behavioral Ecology and Conservation (BEC) research group, where she supervises Juan Diego Pineda's research.

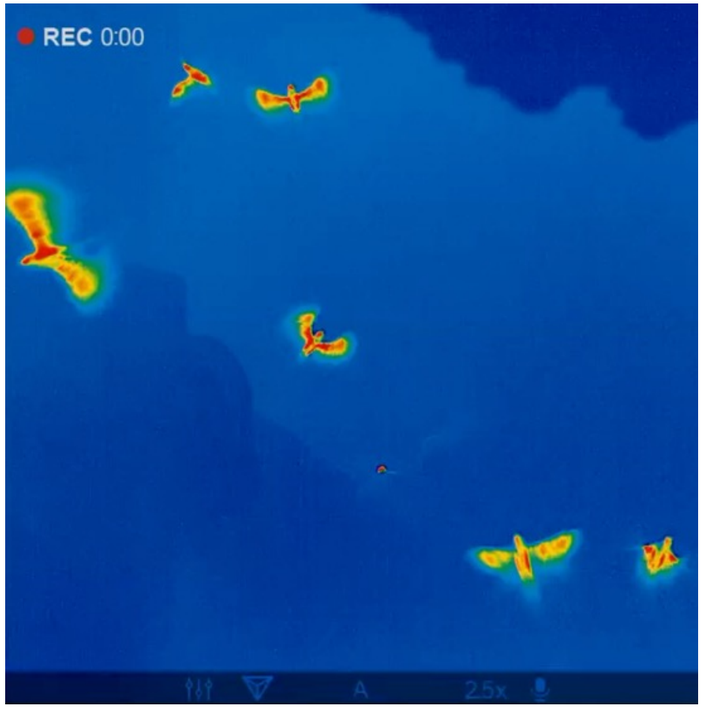
"I think I'm more open to using AI than many other people because I was fortunate to become familiar with the technology early on. And for our field—the study of animal behavior—AI has had a tangible impact, since much of our work involves spending long hours in the field and then many more analyzing and coding video recordings."

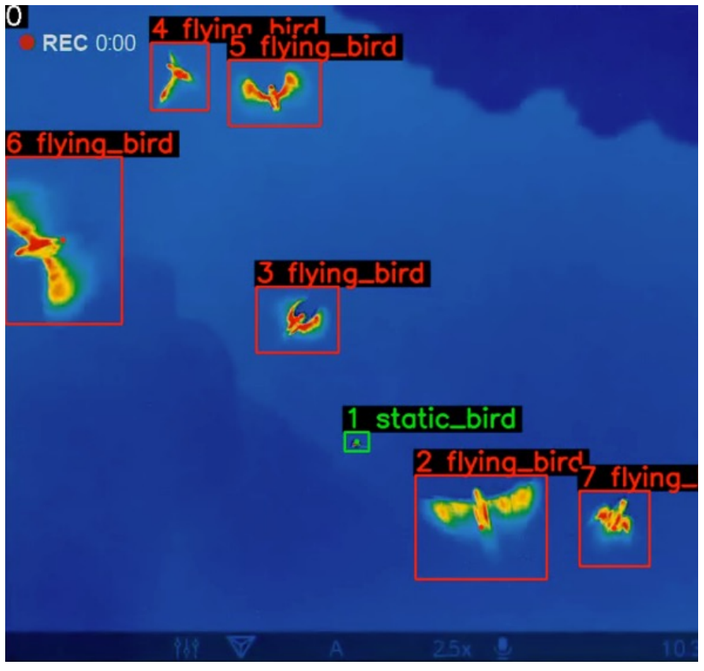
For now, however, AI remains limited by the context in which it is trained. The methods developed for studying oilbirds, for example, cannot simply be transferred as is to other research areas, such as the study of terrestrial mammals. Models trained for one set of conditions only work in that specific context.

Maldonado Chaparro's research also examines environmental disturbances and their effects on social relationships among animals. For this purpose, she uses monitoring cameras, but focused on another species; guinea pigs. Student Oriana Vargas Guerrero investigates how rising temperatures affect social interactions among individuals, including socio-negative behaviors such as aggression and fighting, and socio-positive behaviors such as affiliation. Researchers must carefully document these interactions, and because guinea pigs are kept in captivity, the volume of footage is substantially greater than in field studies, as they can be recorded continuously throughout an experiment (24/7).

"The challenge lies in using all these images to train the model to understand what is happening in each interaction," explains the professor. In this case, three separate models are involved: one that defines what a guinea pig is, another that distinguishes individual animals, and a third that classifies their interactions. "The idea is that if a human can observe and define an interaction, AI should be able to learn how to recognize it as well."

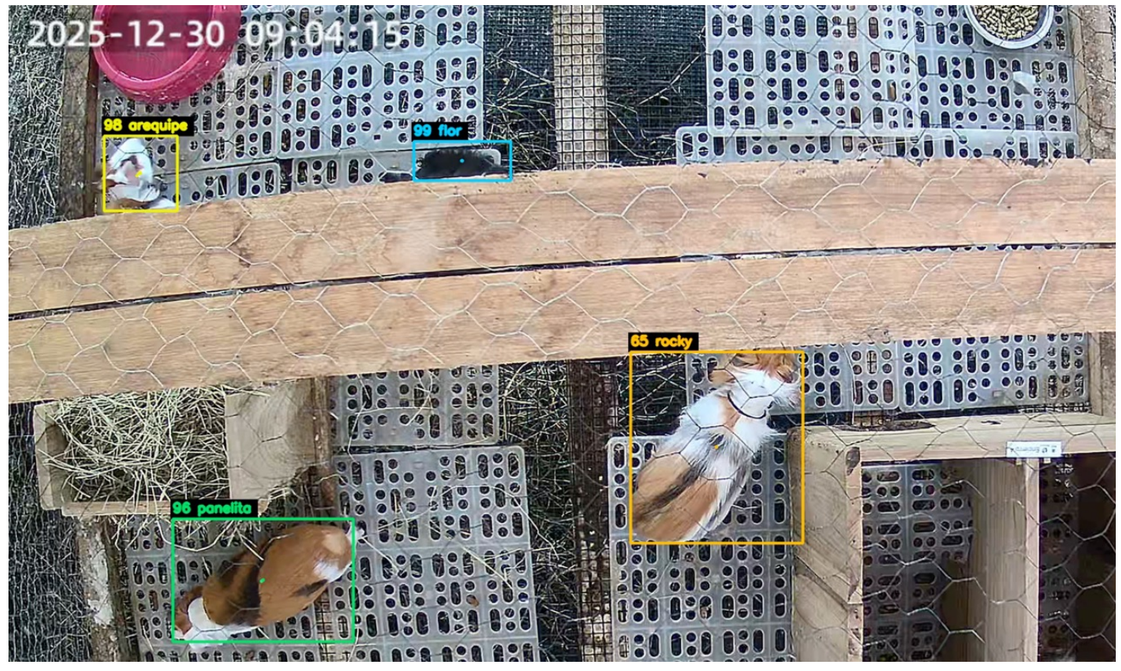
This example illustrates how AI systems depend entirely on the data used to train them, and, on a broader level, it also demonstrates how work is shifting toward other areas. "It makes your life easier in some ways, but it changes the challenges and the questions," says Maldonado Chaparro. "In the guinea pig study, we recorded at 30 frames per second, 24 hours a day for 15 days. With that volume of data, our research operates at a Big-data scale, and even with AI, it took us about 174 days to analyze the videos. But once the model is trained, future studies can be analyzed more quickly and accurately."





← Thermal imaging of oilbirds in flight (top) and their automatic detection in flight using machine learning (bottom)

→ Pandora Cave, in Santander. "To take that photograph, we had to descend 60 meters to reach the oilbird colony," says Pineda.



→ A training model for identifying guinea pigs by name in the undergraduate thesis experiment by student Oriana Vargas Guerrero.

AI Applications in Climatology

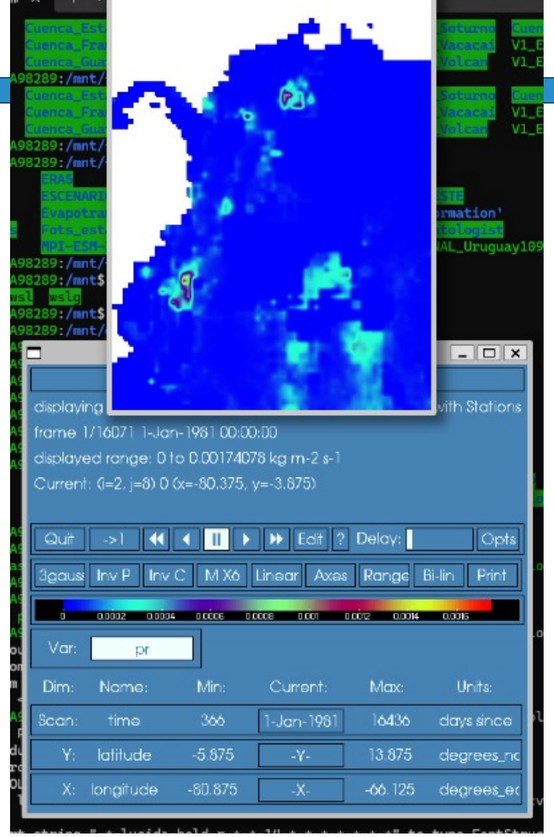
AI tools are also being used to better understand and predict Colombia's climate. Current weather patterns, characterized by periods of both extreme rainfall and severe drought, are of concern to researchers, policymakers, and the public alike. Understanding the trends and variability associated with these events is essential, particularly for short- and medium-term forecasting.

Developing reliable climate indices requires extensive data collected from a wide range of locations across the country. Most of these data are obtained through the monitoring network operated by the Colombian Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM), spread across the country. According to 2025 data, IDEAM operates approximately 2854 active stations, of which only 310 (11 %) are automated and equipped with satellite or cellular transmission capabilities.

For various reasons, those historical records do not contain complete measurements over extended periods. Many stations require maintenance or modernization, while others are located in remote areas that are difficult to access. Keeping them in good condition has not been carried out rigorously, particularly due to a lack of financial resources.

Juan Felipe T. Bateman is an undergraduate student in the Earth System Sciences program at Universidad del Rosario. Recently, the research group to which he belongs published a scientific article presenting an integrated analysis of the Guatiquía River basin, including the Chuza Reservoir in the Chingaza páramo. Using environmental variables such as precipitation, slope, land cover, and the topographic wetness index (TWI), the study identified areas with a high susceptibility to flooding. "The study involved large datasets crossing both spatial and temporal dimensions, and AI helped us automate much of the analytical process," he explains. "However, developing climate projections requires examining observations from the past 30 years or more, and in Colombia, long-term observational records are often limited in certain regions."

To address this limitation, Bateman used satellite observations that were subsequently calibrated using machine-learning algorithms. Bateman also used the MapBiomas database, which provides land-cover and land-use information from 1985 to 2024 at a spatial resolution of up to 30 meters. "AI assisted us with the computational aspects of the project, helping streamline data processing and achieve results" he concludes. The study's findings provide valuable information for updating watershed planning and management plans (POMCA).



Example of precipitation distribution in Colombia on January 1, 1981.

Álvaro Ávila is a hydrologist and tenured professor in the Climate–Ecosystem Interactions Research Group (ICE). According to Ávila, climate studies are particularly important in Colombia because meteorological stations are concentrated in the Andean region— primarily around Medellín, Bogotá, and Cali, often referred to as the "Golden Triangle." In many other regions, there are few weather stations, observational records are sparse, incomplete, or fragmented, making satellite-based estimates essential. However, these estimates often contain substantial biases that can be reduced through AI-based correction methods.

In a study published in Data in Brief in 2021, titled Missing Data Estimation in Extreme Rainfall Indices for the Metropolitan Area of Cali, Colombia: An Approach Based on Artificial Neural Networks, Ávila collaborated with researchers from Universidad del Valle, the Federal University of Itajubá, and the Brazilian Institute for Space Research. The study proposed a methodology for estimating missing precipitation data from 12 meteorological stations in Cali over the period 1969–2019. Researchers employed an artificial neural-network approach based on Nonlinear Principal Component Analysis (NPCA) to reconstruct missing observations and reduce systematic biases, thereby supporting the development of a model for predicting extreme events.

In another application, researchers estimated precipitation data for a station in Lloró, located in the department of Chocó, using open-access satellite data, including ERA5. Developed under the European Union's Copernicus Programme, ERA5 is the fifth generation of atmospheric reanalysis data software and combines historical in situ observations with numerical weather models to reconstruct atmospheric conditions from 1940 to the present.

Researchers from the Climate–Ecosystem Interactions Research Group (ICE) during a field expedition to Nevado Santa Isabel in Los Nevados National Natural Park, where glacier conditions were assessed in March 2025.

Climate-Ecosystem Interactions (ICE) Research Group

AI therefore enables researchers to identify patterns, fill in missing data using information from neighboring stations, and thus gain a better understanding of atmospheric phenomena. Tabares conducted most of his analyses using a personal laptop. For studies requiring greater computational capacity, however, the University provides access to a Linux-based High-Performance Computing (HPC) cluster managed by the Advanced Computing Laboratory and available to the research community.

The range of AI applications continues to expand. "We use AI tools, for example, to support scientific programming, streamline scripts, accelerate code development, and improve the use of computational resources," explains Ávila. "The greater challenge, however, lies in understanding and critically evaluating the results they produce."

“AI doesn’t replace innovation; it puts it to the test”

The impact of artificial intelligence on business and production has become increasingly evident across sectors. However, the effective adoption of these technologies remains one of the most significant challenges facing organizations of all sizes. Researcher Aglaya Batz examines these challenges and discusses the role that innovation plays in successfully integrating AI.

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“If we want to compare artificial intelligence with human intelligence, we must begin with a fundamental difference: human beings perceive the world through sensory stimuli and experience. Artificial intelligence, by contrast, accesses the world through data. Its ability to recognize patterns, interpret information, and generate decisions therefore depends on how that data is collected, processed, and contextualized.” This is how Aglaya Batz Liñeiro, professor at the School of Management at Universidad del Rosario and Director of Innova, the university’s Innovation Center, explains the functioning of neural-network-based AI models.

In practical terms, technologies such as natural language processing (NLP), computer vision, text-to-speech systems, sensors, and robotic motion systems enable AI to acquire information from its environment and convert it into usable data. The speed and scale at which these systems capture, organize, and analyze information far exceed human capabilities.

Batz holds a doctorate (*Dr. rer. pol.*) in economic public policy from the University of Brandenburg, Germany. Her research at Universidad del Rosario focuses on understanding how knowledge flows through innovation networks. From this perspective, she identifies three capabilities that help explain why AI is transforming such a wide range of human activities:

1. The ability to extract information from large volumes of data
2. The ability to identify complex patterns across datasets that would require human intelligence significantly more time and effort to detect or interpret.
3. The ability to support prediction, analysis, and decision-making processes

However, for Batz, it is important not to confuse computational capacity with human intelligence, among other reasons, because a key question remains open: What does it mean to think? “Generative artificial intelligence models function, in simple terms, as prediction systems: they learn patterns from enormous volumes of data and generate the responses they determine to be most probable. In language models, this process occurs word by word, which is why they appear to engage in conversation. But therein lies one of their main limitations: they can produce coherent responses without truly understanding the social, historical, or cultural context in which that knowledge will be applied,” explains Batz.

For the researcher, this distinction is central to the current debate. Generative AI can write, summarize, classify, program, and produce sophisticated responses, but that does not mean it reasons like a person or understands the world in the same way humans do. “Attributing intelligence to these systems is part of the controversy. AI is already bringing about profound changes, but perhaps not on the scale or at the speed that major technology companies would like us to believe,” she says.

Public interest in generative AI surged following the launch of ChatGPT in 2022, although artificial intelligence did not begin with this chatbot. For decades, AI has been used in recommendation systems, search engines, financial services, logistics, manufacturing, healthcare, and marketing. The real change occurred in our everyday relationship with algorithms. “Chat-GPT did not usher in artificial intelligence, but it made it visible: users stopped interacting with algorithms in the background and began chatting with them, asking them to write, summarize, analyze, program, or propose solutions,” explains Batz.

It was only when AI reached ordinary citizens directly that widespread concern and controversy emerged regarding the scope and implications of this technology. However, Batz argues that the current enthusiasm also calls for a broader historical perspective. It is important to distinguish between what is genuinely new, what has existed for years, and what is now being presented under the label of artificial intelligence despite corresponding to earlier developments in machine learning.

How is AI being used?

In March 2025, Batz, together with data scientists David F. D’Croz-Baron, Carlos A. Ojeda-Sánchez, and Carlos Jesús Vega, published a study titled “Integrating Machine Learning into Business and Management in the Age of Artificial Intelligence” in the journal *Humanities & Social Sciences Communications*, published by Nature. The researchers analyzed more than 9000 peer-reviewed publications on the use of machine learning in business and management retrieved from the Scopus database and developed a taxonomy comprising 15 application clusters. These clusters were organized into five broad thematic areas: finance, customer relationship management, decision support, innovation and public policy, and data management and sustainability. Their findings

indicate that, well before the recent surge of interest in generative AI, machine learning had already been steadily transforming a wide range of business processes.

They also found that what is marketed as AI often is not. “Today, many companies and startups claim to be based on artificial intelligence, but when you look closely at the processes they use, you find something quite different: traditional machine-learning models, predictive analytics, process automation, or even relatively simple statistical rules. That does not mean these are not valuable solutions; it simply means we need to be more precise. Not everything marketed as AI is generative AI, nor is everything presented as technological innovation truly at the forefront of algorithmic development.”

Although AI is already a reality, the greatest challenge lies in how organizations integrate it. It is not a matter of incorporating AI because it is fashionable or because of market pressure, but rather of embedding it thoughtfully into business processes so that it complements human talent and improves decision-making. “The challenge is not simply to adopt artificial intelligence, but to understand why it is being adopted, with what capabilities, and according to what criteria. Companies must ask themselves what problem they are trying to solve, what data they have available, what risks they are assuming, and how this technology can complement human work. The rise of AI also presents specific challenges: access gaps, dependence on external providers, data security, the actual profitability of algorithms, and ethical dilemmas concerning the information we share and the regulations designed to protect citizens,” concludes Batz.

Among the earliest effects of large companies adopting these AI tools are workforce cuts aimed at boosting productivity. Amazon announced in February 2026 that they would eliminate 16,000 corporate positions worldwide, while the World Economic Forum reported in 2025 that 41 % of companies globally were considering workforce reductions over the next five years as AI adoption expands.

However, the gap between large corporations and smaller organizations raises a more fundamental concern: for SMEs, startups, and local businesses, simply wanting to use AI is not enough. Data, infrastructure, talent, financial resources, and strategic clarity are all necessary. If these capabilities remain concentrated among a limited number of actors, AI may ultimately widen the very gaps it is expected to reduce. “The question is not only how powerful artificial intelligence may become, but who will have the means to benefit from it. Innovation cannot be reduced to the adoption of tools; it requires building capabilities, fostering collaboration, and creating the conditions that enable more organizations to embrace the technology,” argues Batz.

Types of Artificial Intelligence

Narrow AI: These are “small” systems, like Alexa, that recognize voice commands but cannot process complex language; search engines that, while capable of recognizing commands, cannot learn.

Generative AI: This type learns to interact with the user and generates content on demand. Examples include Gemini, Copilot, Claude, and ChatGPT.

General AI: The hypothesis is that it can mimic human behavior, with intelligence and self-awareness equal to those of humans, and the ability to solve any type of problem.

Source: Artificial Intelligence: A Modern Approach. 4Th edition (2020) Stuart Russell & Peter Norvig

During the 1990s, the Internet faced a barrier similar to the one artificial intelligence faces today: the technology was advancing, but the infrastructure needed to make it broadly accessible was still under construction. High-speed connections, payment systems, mobile devices, digital services, and markets large enough to sustain new business models were still lacking. Only when those pieces began to fall into place was it possible for platforms such as Uber, Airbnb, and Rappi to emerge, built on connectivity, smartphones, geolocation, and digital payments.

For Batz, something similar will occur with AI, but on a more demanding scale. The difference is that this technology requires unprecedented levels of capital, expertise, specialized talent, data, computing capacity, and infrastructure.

“With artificial intelligence, collaboration will be much more important because no single organization can solve all the challenges this technology poses on its own. It is not only about developing better algorithms, but also about building the ecosystem that enables their use: infrastructure, talent, data, energy, regulation, and business models,” explains Batz. “We will increasingly see collaboration even at the horizontal level, among companies that might otherwise appear to be competitors—such as Microsoft and its data centers working with OpenAI, or Amazon partnering with Rappi to expand into retail delivery.”

Frontiers of Innovation

The first frontier of innovation lies in algorithm development: making AI systems more efficient, less costly, and less dependent on massive computing resources. In a market dominated by companies with vast technological capabilities, competing does not necessarily mean having greater capacity, but rather making more effective use of existing resources. “Innovation in AI will not be limited to building the largest models, but will also involve developing algorithms that are more efficient, affordable, and adaptable. For many companies, especially in emerging economies, the advantage will not come from competing on scale, but from finding smarter ways to use limited resources,” she explains.

Aglaya Batz Liñeiro, professor at the School of Management and Director of Innova, the Innovation Center at Universidad del Rosario.

The case of China illustrates this tension. Faced with U.S. restrictions on access to advanced processors, several Chinese companies have pursued alternative strategies focused on algorithmic efficiency, reduced energy consumption, and the development of domestic technological capabilities. In January 2025, the company DeepSeek launched its eponymous chatbot. The system demonstrated competitive performance relative to leading Western models despite operating without access to the most advanced semiconductor chips, while reportedly requiring substantially fewer computational resources and lower development costs.

Following the announcement, shares of Nvidia, the leading U.S. manufacturer of AI chips in the world, fell by approximately 18 %.

"True disruption will not come solely from incorporating AI tools, but from creating new ways to solve problems, deliver services, organize processes, and generate value."

Beyond this specific case, the message for Batz is clear: when access to cutting-edge technology is limited, innovation can emerge from the need to do more with less. "Efficiency is also a form of innovation. If a company does not have unlimited access to chips, data, or infrastructure, it must become more resourceful: optimize its algorithms, reduce costs, adapt solutions, and develop its own capabilities. That can become a competitive advantage," she says.

The second frontier is infrastructure. The expansion of AI does not depend solely on software; it also requires data centers, processors, energy, cooling systems, water, critical minerals, and supply chains capable of sustaining growing demand. As the number of users and applications increases, so does the pressure on the physical resources that make the technology possible. "AI may seem intangible, but it is not. Behind every model are data centers, chips, energy, water, cooling systems, and minerals. That is why the scalability of artificial intelligence is not merely a technological challenge; it is also an environmental, energy, and industrial challenge," warns Batz.

This pressure is likely to drive innovation in areas such as energy efficiency, cooling technologies, water recycling, mineral recovery, chip design, component reuse, and e-waste reduction. In 2022, approximately 62 million metric tons of electronic waste were generated worldwide. Placed end to end on trucks, this volume would form a line roughly equivalent to the straight-line distance between New York and Athens. Recycling these materials—particularly valuable minerals such as gold, silver, copper, palladium, and aluminum—generated nearly $22 billion in revenue in 2025 and is projected to reach $43 billion by 2035.

The promise of AI will therefore depend, in part, on the ability to build a more sustainable technological infrastructure.

The third frontier lies in business models. For Batz, the transformative potential of AI lies not in the tools themselves but in creating new ways to solve problems, deliver services, organize processes and generate value. That is the point at which innovation ceases to be primarily technological and becomes strategic. "Now the question is not just what AI can do, but what new business models can be built from it. A company can use ChatGPT and not innovate at all. Innovation involves rethinking processes, understanding real problems, connecting capabilities, and creating solutions that make sense within a specific context," she argues.

The Role of Universities

This is where universities become particularly important. If AI performs best in standardized environments but becomes more limited when confronted with complex social, business, or regional challenges, universities can help bridge that gap. Their mission cannot be reduced to teaching how to use technological tools. Rather, they must cultivate critical judgment by teaching students how to reason, formulate better questions, identify biases, and assess whether a technological solution truly addresses the problem and context in which it will be applied.

"The role of universities cannot be limited to teaching how to use AI; they must create innovation labs, spaces for experimentation, and capabilities to test algorithms, prototypes, and new business models. But above all, their responsibility is to foster critical thinking: teaching students to reason, to understand the concepts behind a response, and to distinguish between a well-formulated solution and one that is genuinely appropriate for the problem being addressed," Batz states.

This contribution extends beyond the university itself through its participation in the development of new AI-based business models. It is not merely a matter of testing algorithms, but of experimenting with solutions that connect technology, expert knowledge, and real-world needs. "AI can accelerate responses, but innovation demands something more: understanding the problem, connecting capabilities, and building business models that generate value in a specific context. Here, universities play a key role because they can create safe spaces to experiment, test prototypes, evaluate impacts, and train talent capable of using technology without losing the ability to think critically," she concludes.

From this perspective, AI does not replace innovation; it puts it to the test. Its true impact will depend on the ability of companies, universities, governments, and entrepreneurs to collaborate, develop talent, and design business models that are not only efficient but also relevant to the contexts in which they are applied.

“AI should only support judicial decisions, not replace them”

As in many other sectors, the use of AI tools—including generative AI systems—by judicial officials presents both opportunities and risks. Professor Erick Rincón, Associate Dean of the School of Law, discusses how these technologies are being adopted by public institutions in Colombia, as well as the need for appropriate regulation and training to ensure their responsible use.

By Juan Manuel Sarasua
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The constitutional protection action, one of the principal mechanisms for protecting fundamental rights in Colombia, was established under the 1991 Constitution. At that time, the Constitutional Court received approximately 57,800 petitions for review annually, equivalent to about 160 constitutional protection action cases per day. By 2019, that figure had risen to roughly 2400 daily filings, and by 2026 it had reached 5000 per day, according to Justice Paola Meneses, president of the Constitutional Court since February 2026, in an interview with El Tiempo.

The backlog in the country’s justice system has been a well-recognized and widely noted phenomenon for decades. Its effects are reflected in the level of public trust in the justice systems and its institutions. According to the 2024 Justicia Cómo Vamos report, produced by the *Corporación Excelencia en la Justicia*, 26.3 % of Colombians considered turning to the courts to address their legal needs because of concerns related to efficiency and trust. This perception is reinforced by international indicators. According to the Global Impunity Index (IGI), Colombia ranked 66th among 94 countries in 2024.

“To streamline the enormous workload of the justices, in 2019 the Constitutional Court began testing the Prometea software, developed at the Law School of the Universidad de Buenos Aires,” explains Professor Erick Rincón Cárdenas, associate professor and Dean of the School of Law. The implementation of this software in Colombia was led by Grenfieth Sierra Cadena, Director of the Public Law Research Group at Universidad del Rosario.

Prometea produced uncontestable results in Argentina. A 2020 study by the Inter-American Development Bank showed that the software reduced the time required to resolve a procurement bid from 90 minutes to one minute (99 %), and for pretrial proceedings, processing times decreased from 167 to 38 days (77 %). Previously, the Prosecutor’s Office took three months to finalize cases and issue rulings; with Prometea, that time was reduced to a maximum of five days, according to the study.

Under the new name of PretorIA (derived from the term “Praetor,” the magistrate responsible for administering justice in ancient Rome), the software’s objective was to assist in the review of constitutional protection rulings by supporting the selection and preselection of cases, enabling the Court to reduce the time required to determine whether a case warranted review. “PretorIA selects cases based on the judge’s criteria, but it does not replace judicial decision-making; it merely supports an administrative process,” Rincón explains.

To ensure that these decision-making processes remain objective and non-discriminatory, rigorous transparency and oversight mechanisms are required, particularly because algorithmic systems often operate as “black boxes,” making it difficult to fully understand how their outputs are generated. As a tool for distribution, management, information retrieval, and classification, AI has already demonstrated considerable benefits. However, concerns about bias become more significant if these systems move beyond administrative support and begin influencing core judicial functions such as the evaluation of facts, evidence assessment, and decision-making.

Professor Rincón Cárdenas and attorney Valeria Martínez Molano published the article “*A Study on the Possibility of Applying Artificial Intelligence in Judicial Decisions*” in a 2021 issue of Revista Direito GV of the Getulio Vargas Foundation. In this article, the authors explain that the speed of AI systems in judicial processes can contribute to reducing

Erick Rincón Cárdenas is a professor and researcher with the Private Law Research Group at the School of Law of Universidad del Rosario.

court congestion and, consequently, increase public trust in the administration of justice.

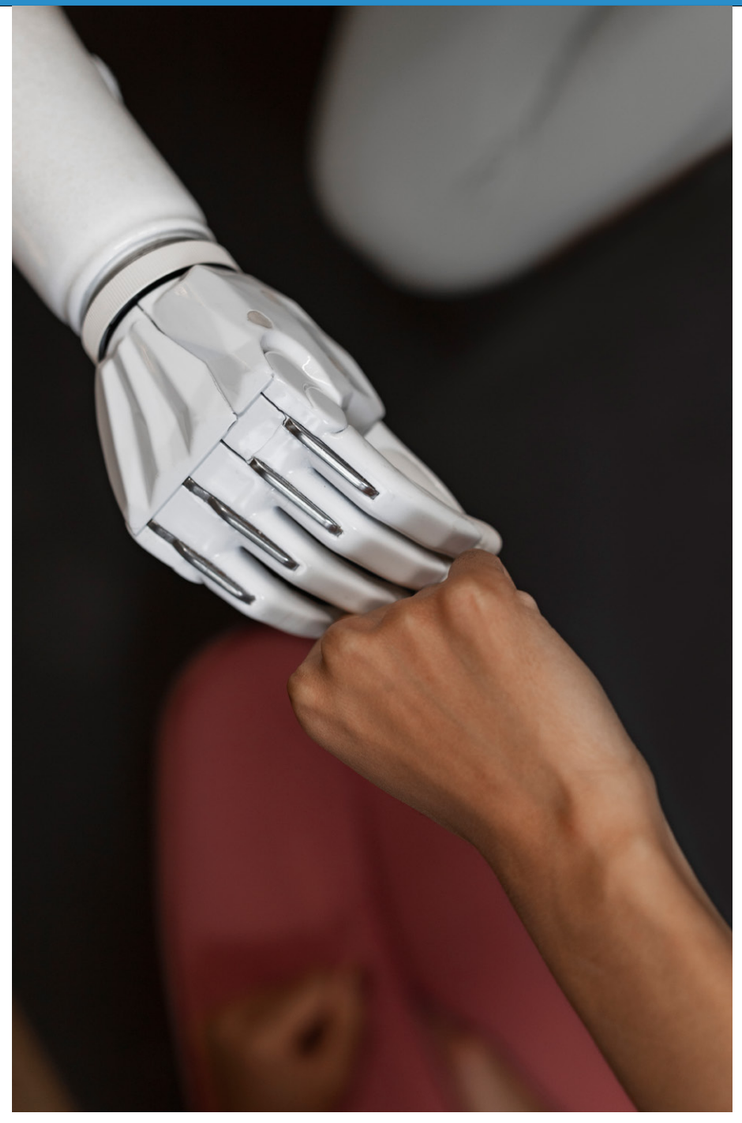
The benefits are evident in streamlining tasks such as searching for regulations, analyzing precedents, and organizing evidence, as well as in reducing judicial backlogs by enabling rulings to be issued more quickly and optimizing resources by freeing up time previously devoted to repetitive tasks.

However, experts caution that the ultimate responsibility for any judicial decision must always rest with a human judge. "To strengthen the rule of law, the development and implementation of these technologies must adhere to strict ethical principles, such as respect for human autonomy, transparency, responsibility and accountability, robustness and security, and justice," explains Rincón.

Nevertheless, a major challenge remains in implementing this process in Colombia. "It's a technical issue; very little of the country's legal system is digitized, so its implementation across the entire territory is still a very distant reality," says Rincón. "National law—that produced by the government and its agencies—has only been digitized since 1991, whereas territorial law has not; it still relies on printed copies, or even handwritten records, in territorial courts."

Initiatives in the Justice System

PretorIA is not the only initiative seeking to harness the potential of AI. For example, the



Court also has the Office of the Rapporteur's Case Law Search Engine, a tool that "allows users to quickly and with a high degree of precision find the rulings issued by the Court and published by the Office of the Rapporteur". In March 2025, the National Judicial Disciplinary Commission launched "AI Judgments for the People," an initiative designed to create short videos summarizing court rulings.

The Office of the Attorney General has also taken steps in this direction. In January 2025, it began using an AI model for "automatic case assignment," and since May of the same year, the *Think Project* has assisted with the "processing and analysis of unstructured data, such as audio, video, and images."

Implementation of IBM's *Watson Explorer* program began in 2017 as an initiative promoted by former Attorney General Néstor Humberto Martínez. Later renamed Prosecutor Watson, the program was deployed to "match cases registered in the Oral Accusatory Criminal System (SPOA)." However, no public information is available regarding its use or performance statistics, and the website of the Office of the Attorney General contains only references dating back to 2018. The 2024–2028 Strategic Direction Plan does not mention Watson, although it highlights the importance of "adopting Big Data, artificial intelligence, and machine learning technologies." In 2024, the Karisma Foundation, in coordination with *Derechos Digitales*, produced a report on Prosecutor Watson and gathered information on the program through a right-to-petition request, among other sources.

The Office of the Attorney General also implemented, for a period, the Recidivism Risk Profile System for Requests for Penitentiary Measures (PRISMA), a tool designed to predict the likelihood of criminal recidivism. According to the Office of the Attorney General, "a common mistake made by prosecutors and judges is that they release many very high-risk individuals and impose pretrial detention on people with a very low risk level." Its use has since been suspended; however, the system was intended to help "determine whether to request pretrial detention in a correctional facility, house arrest, or no pretrial detention at all". The projected outcomes were ambitious. According to data provided by the Office of the Attorney General, the use of this recidivism prediction tool could reduce crimes committed by repeat offenders by 25 % and decrease the use of custodial measures by 36 %.

Combating the Risks

The use of commercial AI models in judicial decision-making may jeopardize not only national sovereignty in matters of governance but also the personal and private data of millions of Colombians, potentially undermining the administration of justice as a fundamental right. Consequently, rigorous oversight by judicial institutions is essential to ensure that necessary corrections can be made, as illustrated by Constitutional Court Ruling T-323 of 2024.

The Court received a petition to review a case involving the violation of a minor's right to health. The minor had been diagnosed with autism spectrum disorder, and in the case, the second-instance judge used ChatGPT 3.5 to support her decision in favor of the child. The court considered whether there had been any violation of due process and issued Ruling T-323 of 2024, in which it analyzed the use of generative AI by the country's judges, examining the associated risks.

Following this decision, the Superior Council of the Judiciary issued Agreement PCSJA24-12243 of December 16, 2024, whereby "guidelines for the respectful, responsible, safe, and ethical use and application of artificial intelligence are adopted in the Judiciary," and mandated training for judicial officials on the ethical and responsible handling of these technologies. It also published a Manual on the Use of AI so that judges and other officials could understand how they should use the tools, a practice that appears to be widely adopted.

* These systems are compiled by the interdisciplinary project "Public Algorithm Systems" of the School of Government at Universidad de los Andes, which "seeks to contribute to knowledge about algorithmic systems in the public sector of Latin America and the Caribbean."
https://algoritmos.uniandes.edu.co/

AI Education Is One of Our Best Weapons

Researchers at Universidad de los Andes conducted a study titled "Uses, Perceptions, and Governance of Artificial Intelligence Systems in the Judiciary: Findings from Three Surveys in Colombia." The study's findings make it clear that it is necessary to "take the bull by the horns" and take the initiative to educate and publish clear and effective regulations on the proper use of AI.

The study consists of three surveys of judicial officials to understand how they used AI tools in their daily work. Two of the surveys were conducted before and after the officials attended the course "Artificial Intelligence for the Administration of Justice: Fundamentals, Applications, and Best Practices," offered by Universidad de los Andes and the Rodrigo Lara Bonilla School of the Superior Council of Law.

A total of 1391 judicial officials were interviewed before the course and 824 after. The third survey, conducted by the CSJ, was administered to 3152 prosecutors.

Some results were:

- One-third of respondents reported using AI tools to facilitate their work: ChatGPT (38 % of users), Copilot (20 %), and Gemini (11 %).
- Before the course, 10.5 % of respondents reported using these technologies daily or weekly. Upon completing the course, this usage increased from 26 % to 44 %.
- The course boosted the use of these tools for searching case law (59 %), searching legislation (49–52 %), looking up meanings and definitions (46–51 %), and summarizing texts (40–47 %).
- 79–85% accessed free versions of AI tools, raising concerns about personal data protection and information confidentiality.
- 77–89 % identified potential negative aspects associated with the use of generative AI tools in the administration of justice.
- Additionally, the course appears to have contributed to a 12-percentage-point increase in awareness of ethical risks.
- The main barriers identified by officials were lack of training (81 %), absence of institutional guidelines (67 %), and access difficulties (61%). 91% had not received formal training, but 93 % considered it necessary to receive it.
- 75–88% considered it necessary to establish mandatory standards for the use of AI by law officials, and 76–87 % for its use by lawyers.
- Despite the identified risks, optimism prevailed: more than 70 % anticipated positive impacts of AI on society and the administration of justice. In addition, 85 % of those who have never used AI expressed interest in doing so.