

Promoting digital skills and the challenges of measurement

User empowerment through media and information literacy responses to the evolution of generative Artificial Intelligence¹

By Divina Frau-Meigs²

Introduction

Generative Artificial Intelligence (AI) is driving most of the AI systems today. Generative AI systems can reorganize statistically the vast amount of content they are trained on (text, images, videos, etc.). They can produce outputs that conform to instructions (“prompts”) given by users. These systems rely on foundation models (Jones, 2023) and are currently being used by millions of individuals and institutions around the world, with tools such as ChatGPT gaining 100 million global monthly active users in two months.

AI systems provide numerous benefits in almost all aspects of our lives, such as health and education (Trust et al., 2023), but they also raise concerns about oversight, regulation, and ethics. Ethical considerations include monitoring misalignments on human rights principles, ensuring responsible and unbiased use, respecting intellectual property rights, and addressing potential societal implications (UNESCO, 2022a). Research has shown, for instance, that AI tools and deepfakes, including those that use generative AI, have generated disinformation and hate speech and presented them convincingly as credible to users (Ngo et al., 2023). Such uses could have a deep impact on crucial moments of collective decision-making, such as elections or public consultations.

Since the release of generative AI in the public sphere, the heads of major digital labs have called for a “pause” (Future of Life Institute, 2023) and for “AI governance” (Open AI, 2023) on the grounds that AI poses an “existential risk” to humanity because a super-AI could outwit humans and program itself in ways that could contravene human interests and values. This request for oversight brings regulators and many other stakeholder groups and individuals into direct dialogue with digital platforms.

Many shapes of oversight are being considered, but the perspective of user empowerment has been

¹ Edited version of the homonymous policy brief published by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000388547>

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underserved and underplayed. This can be mitigated through MIL strategies and policies, which are increasingly necessary to equip people with pertinent knowledge, skills, attitudes, and values, not only to protect themselves from the risks, but also to benefit from the opportunities that AI brings. Promoting MIL for all is both preventive and restorative and responds to the felt need to enable citizens to participate in the current discourses about AI use in their lives, thereby enabling them to influence AI developments and to hold AI accountable for its intended and unintended consequences.

MIL encompasses the various and evolving information, digital, and media competencies required to navigate today's increasingly complex communication environment. It empowers people with critical thinking skills and other necessary competencies.

The urgency of MIL for all in the face of generative AI and synthetic media

WHY IT MATTERS

Users have progressively been exposed to narrow AI, created for specific tasks (Schlegel & Uenal, 2021), some of which are directly related to social media and streaming platforms. They are increasingly exposed to general AI. Generative AI, a form of general AI, is based on foundational models such as Large Language Models (LLM) that are pre-trained with massive databases containing millions of documents—including social media content (Bryant, 2023). Users also have to deal with synthetic media, defined as video, text, image, or voice content that has been generated in whole or in part by computer manipulation and modification of data (Stieglitz et al., 2022).

Looking at the timeline of media and AI evolution, the increasing convergence between the two domains points to the emergence of another massive shift in the digital communication ecology. This convergence culminates in artificial neural networks, which can modify their internal structure related to a functional objective (Grossi & Buscema, 2008), and deep learning, interpreted as a layered structure that tries to replicate the structure of the human brain (Möller, 2023). These are being used to make significant improvements in areas related to image recognition and generation, text and image classification, identification of objects, data curation, and algorithmic recommendation and prediction. The terms AI and generative AI are thus used interchangeably in this policy brief.

Consequently, five major areas, with their attendant pitfalls, are currently reaching fruition that affect media ecologies and consequently MIL: customer interaction (virtual assistants), decision-making (recommender systems), analytics (opinion mining, personalized learning), prediction (detecting people's gender, race, age, etc.), and communication (synthetic media, virtual reality experiences). An example of the latter are the popular generative AI systems shaped as "Generative Pre-trained Transformers" (GPT). These so-called conversational and text-prompted visual "AI assistants" are becoming embedded in many household goods and all kinds of information services. For instance, they can help users to draft briefs, write

scripts, or generate images that produce lifelike photographs that do not always have counterparts in the real world, making them hard to trace.

This generalization has the potential to revolutionize the very idea of information as a public good, amplifying it for more knowledge benefits or privatizing it behind “black boxes” (UNESCO, 2021). This urgently calls for AI literacy to inform people in their non-technical daily uses and interactions with mass, social, and synthetic media as they affect information, education, and culture. It puts AI literacy within the remit of MIL, as it can enlighten the interrelationships between media and data, and use familiarity with prior methods to facilitate knowledge acquisition on this new, rapidly evolving topic. This process of familiarity could make AI literacy less daunting to educators and learners, as it can be set within a learning and teaching continuity rather than requiring a huge leap in training and upskilling.

WHAT IS THE SHARED VISION?

Currently, AI literacy is still in its infancy and comes in the wake of “data literacy” and “algorithmic literacy.” Critical data literacy focuses on understanding data and tends to concentrate on privacy and consumer protection (Nguyen & Beijnon, 2023). Algorithmic literacy focuses on awareness as well as selection, organization, and presentation of content (Droguet et al., 2022), and posits that

Algorithmic literacy—a subset of information literacy—is a critical awareness of what algorithms are, how they interact with human behavioral data in information systems, and an understanding of the social and ethical issues related to their use. (Head et al., 2020, p. 49)

A limited body of literature also assesses budding AI literacy outside computer science-centric approaches for Science, Technology, Engineering, and Mathematics (STEM) specialists. Some researchers consider the competencies that users need to interact effectively with AI and to design learner-centered AI technologies and methodologies (Long & Magerko, 2020). The definition most directly akin to MIL posits that AI literacy is a “set of competencies that enables people to critically evaluate, communicate, and collaborate effectively with AI” (Hargittai et al., 2020). In this case, the emerging examples of AI literacy courses include content very similar to that found in the plethora of MIL courses and resources that exist globally.

Researchers of these nested literacies confirm the urgent need for education and training and point to major gaps. They call for more algorithmic literacy tools and resources to help young people and adults at large acquire the knowledge they need to protect themselves and their information in digital spaces. In the education field, additional challenges are observed: “(1) lack of teachers’ AI knowledge, skills, and confidence; (2) lack of curriculum design; and (3) lack of teaching guidelines” (Su et al., 2023, p. 1).

These approaches tend to confirm the strong linkages between data, algorithms, and AI as nested literacies. They also confirm that they can be part of the MIL paradigm as they promote critical thinking about data and foster ethical and social uses of information and AI tools. Rather than treating them as separate literacies, their inclusion in MIL encompasses the whole information-communication chain, from the production system to the users’ consumption. This holistic approach is

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characteristic of MIL as transliteracy (Frau-Meigs, 2012) that responds to the felt experience of people as they navigate information culture (media, documents, data), build their knowledge, form their identities, and make their choices.

To foster user resilience, MIL can provide solutions on “why” and “what” teach and learn, not only for children and youth, but also for adults whose everyday uses, attitudes, and values are affected by the rapidly evolving pace of AI systems. This holistic approach calls for a shared vision in the formulation and implementation of public policies to allocate the proper resources to support the empowerment of people through AI and generative AI.

Opportunities for MIL with AI and generative AI

For MIL, the expanded scope of AI and generative AI bolsters users’ empowerment by promoting civic agency (access to information, freedom of expression, synthetic media ethical uses, etc.) and employability (lifelong learning, creative industries, etc.).

MIL has often been legitimized on the grounds that it nourishes citizenship. That is, it promotes civic agency and the ethical use of media and information for better participation in societal affairs. Increasingly, though, the productive and participatory nature of media has opened another point in favor of MIL legitimacy: employability in a fast-evolving labor market that calls for creativity and human-media-machine interactions. Employability, defined as “an individual’s (perceived) ability to obtain and maintain employment throughout his or her career” (Römgens et al., 2020), relies on educational preparedness, which can then lead to all kinds of entrepreneurship. These two prongs, civic agency and employability, are deeply modified by AI and generative AI and, in turn, modify the way to think about and operationalize MIL.

The rapidly increasing use of generative AI systems, their commercialization, and their purported democratization can be seen as serving both citizenship and employability within the MIL framework of critical and creative thinking. They can enhance creativity in the production of media materials, from copy-paste to copy-create, with low barriers to content creation and diffusion. They can augment interactions with robots, sensors, and captors as well as chatbots and AI assistants.

This democratization affects the interrelated fields of MIL, such as information and communication sciences, library and documentation sciences, journalism, as well as data sciences, and creative industries. It has far-reaching implications for individuals and society as a whole, as more personalized digital media is on the rise, changing the way users communicate with each other to learn, work, and entertain themselves.

CIVIC AGENCY

MIL responses to generative AI systems and services can facilitate citizens' autonomy and users' agency in various fields and their related policy areas, such as information retrieval, social and synthetic media engagement, collaborative verification, and annotation, not to mention speech recognition and translation.

Table 1 – GENERATIVE AI ADVANCEMENTS AND MIL RESPONSES FOR CIVIC AGENCY

Advancements	Policy areas	MIL responses
Information search and access	Quality of data control	Empower users to ensure diversity in searches, such as results with gender perspectives.
Social media participation	Freedom of expression	Stimulate ethical use and the capacity to promote and protect human rights, including freedom of expression and gender equality.
Synthetic media creation	Creativity, innovation	Stimulate critical awareness and ethical use.
Voice recognition, computer vision	Accessibility for people with disabilities, non-discrimination	Help understand gaps—losses and gains in human digital technology interaction.
Speech to text, text to image, automated translation	Inclusion, intercultural dialogue, cultural diversity	Foster appreciation for translating texts from one medium to another (or one language to another); acknowledge dangers involved with changes in messages and media.
Cross-referencing of multiple sources, collaborative verification, annotation	Participation, contribution	Encourage appreciation of how digital technology can support research; empower citizens to avoid AI-generated problems during elections and key public moments.

Source: Prepared by the author.

EMPLOYABILITY

Similarly, embedding MIL in digital training can empower digital entrepreneurs online. The generations whose jobs are being affected more rapidly than predicted need to upgrade their competencies or risk being marginalized. And those most at risk are women. In addition, people from minorities and with lower incomes (Organisation for Economic Co-operation and Development [OECD], 2023). The competencies offered by MIL—whether in information management, critical thinking, or creativity—can thus address the current gap between training and employment that plagues labor conditions that are increasingly based on media and ICT. They can complement ICT skills in the workplace as many companies and organizations address the transition to digital literacy. They can support inclusion and help fight poverty, deprivation, and marginalization if supported by adequate policies.

Table 2 – GENERATIVE AI ADVANCEMENTS AND MIL RESPONSES FOR EMPLOYABILITY

Advancements	Policy areas	MIL responses
Learning analytics	Lifelong learning, continuous education	Support awareness of data rights, protection, and redress; early detection of learning problems.
Teaching methodologies: data visualization, avatars, gamification	Curriculum design, course designs to support teachers and learners	Aid logical learning through multiple media based on reasoning, causes, and effects; learn through interaction linking formal and informal settings.
Variability across various types of learners	Inclusion, diversity	Bring to the attention of all the urgency to ensure MIL and digital competencies for all.
Enhanced feedback	Participation, contribution	Encourage critical analysis of digital engagement (gains and losses); call attention to the usefulness of the co-creation of MIL content, and content in general.
Multiple personalized pedagogies	Education, lifelong learning	Stimulate awareness of how individual background and experiences interact with messages and types of media used; foster co-design of learning projects (including MIL).
Platforms for music and video content creation	Creative industries, culture	Foster greater user intervention and participation in culture; stimulate audience engagement and women's engagement.

Source: Prepared by the author.

MIL responses to generative AI systems and services can facilitate people's employability in various fields and their related policy areas, such as higher education, e-learning, and creative industries (UNESCO, 2023b). MIL education is affected by synthetic media as AI systems help "mediate" learning and e-learning, as exemplified by AI video creation platforms such as Synthesia³ and Pictory⁴.

Challenges and risks for MIL with AI and generative AI

For MIL, the risks of generative AI impair users' empowerment by undermining citizenship (on issues such as disinformation, surveillance, privacy, ethics, etc.) and eroding employability (pseudoscience, source reliability, copyright, intellectual property, etc.).

³ Find out more: <https://www.synthesia.io/?r=0>

⁴ Find out more: <https://pictory.ai/>

CIVIC AGENCY

One major concern associated with generative AI comes from the fact that it is a technology in which algorithmic experimentation is carried out without understanding, that is, via the sheer might of computational calculations. This is in contrast to the experiments on human intelligence, where the search for understanding is the main drive. Another disturbing fact about synthetic media is how the act of creation is separated from the thought processes and the emotions involved in writing and visualizing. The efforts of human knowledge building and transfer that went into such creation—and still go into it—should not be underestimated and undervalued, let alone disappear. Generative AI systems should be designed with such values in mind from the very beginning and should comply with universal human rights.

The major risk to information lies in generative AI-produced and distributed disinformation, which can be automated through untraceable deepfakes, just a click away. This can lead to other disorders, such as producing automated content that is not gender-sensitive and racially biased, further reinforcing existing gender stereotypes and racial profiles (Ngo et al., 2023). In addition, factors driving gendered disinformation and its negative impacts (United Nations [UN], 2023), news personalization (Van Drunen et al., 2022), hate speech (Henderson et al., 2023), revenge porn (Garon, 2023), and data theft (Wach et al., 2023), as well as collective risks such as electoral fraud (Srivastava et al., 2023) and mass surveillance are other concerns, where MIL responses tend to overlap with human rights protection.

MIL responses to generative AI risks can foster users' agency in various fields and their related policy areas, such as freedom of expression, data privacy, commercial concentration, and surveillance. These risks predated AI, but generative AI has exacerbated them, making them more complex to address (UNESCO, 2023a).

Table 3 – GENERATIVE AI RISKS AND MIL RESPONSES FOR CIVIC AGENCY

Risks	Policy area	MIL responses
Existential/proliferation	Geopolitical competition ethics	Enable emphasis on self- and co-management; take stock of misaligned values, such as on gender equality.
Concentration/monopoly	Lack of level playing field, of fair competition, and therefore of pluralism in the digital ecosystem	Stimulate understanding of the importance of diversity and pluralism in information and digital technologies.
Spam, intrusive advertising	Lack of quality data and content	Empower users to know how to seek redress, hold actors accountable.
News personalization	Lack of diversity	Alert to filter bubbles and echo chambers.
Disinformation/deepfake	Loss of trust, loss of freedom of expression, and access to reliable information	Support learning of diverse fact-checking strategies.

CONTINUES ►

► CONCLUSION

Risks	Policy area	MIL responses
Algorithmic bias	Racism, social manipulation, inequalities, discrimination	Train users to identify biases; some are inherent and afford mitigation techniques.
Hate speech and cyberbullying	Defamation, loss of freedom of expression	Help to identify, debunk, and offer counter-narratives and defend freedom of expression, dialogue, tolerance, and ethics.
Revenge porn	Visual label and abuse, invasion of privacy	Enable emphasis on self- and co-management and user redress based on regulations.
Election fraud	Democratic disruption, loss of voter integrity	Enable user awareness and engagement, signaling, verifying, and safeguarding.
Data theft	Personal data violation, automated job loss	Empower through data rights awareness, privacy skills, and how to seek redress.
Mass surveillance	Invasion of privacy, loss of security, censorship	Stimulate awareness, independence, and transparency.
Environmental footprint	Sustainable development	Raise awareness of pollution caused by AI materiality (minerals, chips, data servers, etc.).

Source: Prepared by the authors.

There is no foolproof system for training an AI system to consistently refuse to produce disinformation or take harmful actions. Researchers have demonstrated the possibility of “jailbreaks”—special queries that can induce unintended responses from AI systems—and shown that they could bypass the barrier protections of LLM providers (Zou et al., 2023). The lack of safeguards puts many MIL actors at risk, as journalists, educators, and participants in media cultures at large find themselves faced with uncertainty about the content they access and use to make decisions. AI can thus undermine social cohesion and collective rights. User engagement and agency are also at risk as trust is eroded, and the polarization of audiences and communities could be amplified within synthetic echo chambers.

EMPLOYABILITY

The risks of generative AI for employability are more difficult to ascertain. They can be direct, linked to the quality of information for teaching and training (pseudoscience, plagiarism affecting the validity of degrees and qualifications), as well as the impact of the attention economy on users.

They can be indirect at work, in creative industries, due to the lack of competencies and upskilling, and the devaluation of the humanities as opposed to the STEM fields. Working conditions can be impacted as well with data collection, loss of privacy, or surveillance at work, not to mention the threat of job loss or displacement by automation. Furthermore, the gender gap may be widened, according to UNESCO’s report on *The Effects of AI on the working lives of women* (UNESCO, 2022b), noting, for instance, the persistence of AI voice assistants projected as young women.

The changes in the job market propelled by generative AI require workers to acquire new digital skills through education and lifelong learning. Not being able to be competent in critical, civic, and creative thinking can incapacitate people, keeping them in poverty or marginalizing them. Besides the misuse of information that becomes permeated with pseudoscience, “hallucinations” (Wach et al., 2023), and misinformation (Lo, 2023), where plagiarism and copyright infringements (Vincent, 2022) can be detrimental to acquiring ethical attitudes in the face of news, data, or documents.

Table 4 – GENERATIVE AI RISKS AND MIL RESPONSES FOR EMPLOYABILITY

Risks	Policy area	MIL responses
Robots and automation	Loss of jobs, displacement	Enable awareness of benefits and limitations and, thus, the need for monitoring and assessment.
Job search and hiring bias	Gender inequality, stereotypes	Afford people the competencies to detect gender discrimination and stereotypical representation in information and content.
Work performance monitoring	Gender inequality, loss of privacy	Help identify gender gaps and persistence of stereotypes; alert to data privacy.
Plagiarism	Loss of academic integrity	Emphasize ethical uses of information and digital technologies.
AI hallucinations and errors	Research and education	Enable emphasis on self- and co-management; resist AI imaginaries and myths.
Pseudoscience	Research and education	Reinforce trust in scientific inquiry through links with basic science literacy.
Source reliability	Lack of level playing field, of fair competition	Emphasize the ability to assess and engage in the information life cycle.
Intellectual property and copyright	Theft of authorship, loss of fair compensation	Stimulate ethical use and promotion of authorship and respect intellectual property rights.

Source: Prepared by the author.

MIL actors are responding in a variety of ways to these risks. In terms of access to quality information and a healthy online environment, source reliability has become a MIL issue linked to critical writing, fact-checking, and trustworthy indexing. Source reliability is critical to building trust in learning, searching, and research, in academia as in other fields such as journalism. It can directly affect employability if workers are not trained to produce reliable, verified, evidence-based content.

Designing an MIL-compatible AI competency framework involves spelling out the MIL competencies for AI and generative AI distributed among four categories: knowledge, skills, attitudes, and values, to empower educators and policymakers to evaluate the impact of such interventions and establish much-needed baselines for evaluation.

MIL considerations for user empowerment in AI and generative AI: User awareness and competencies

MIL strategies need to raise awareness of the risks of AI that is proactively or unintendedly trained to produce harmful content and carry out harmful actions (i.e., actions that are not aligned with human values and rights). They support human rights principles and sustain the civic agency of users to prevent the greatest danger of all, the threat to democratic societies and human autonomy. To establish a certain degree of MIL readiness for current and future challenges arising from generative AI, massive campaigns of sensitization of the public can be conducted, possibly using AI-powered tools and platforms that could allow for translation and localization. Sustaining wide-scale MIL for all programs, via massive online courses, for instance, can also empower many individuals of all ages and nationalities. Ultimately, MIL with AI should be treated as basic literacy, from K1 to K12, that young people need to live, learn, work, and create in a digital environment.

Additionally, significant gaps remain in designing and implementing gender equality-specific MIL training courses that foster gender responsive and gender transformative interventions (especially awareness-raising materials to fight AI-generated gender bias). This reality also applies to digital skills training, as demonstrated in *I'd blush if I could: Closing gender divides in digital skills through education* (UNESCO, 2019), and persists in emerging AI literacy courses. Users must be enabled to understand and question the gaps between men's and women's contributions to the development and use of AI (UNESCO, 2020). MIL can help raise people's awareness of the gendered implications of AI and empower citizens to advocate for the positive applications and benefits of AI for women's empowerment.

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Box 1 – MIL-COMPATIBLE AI COMPETENCY FRAMEWORK

- 1. Knowledge:** identifying AI (potentials and risks), recognizing the geopolitics of AI (actors, ownership, motivations), assessing consequences, and formulating responses to information benefits (LLM, chatbots and AI assistants, etc.) and information disorders (hate speech, disinformation, etc.), monitoring the ecological footprint of generative AI systems.
- 2. Skills:** using AI tools responsibly, navigating websites and quality databases, comparing search engines, discriminating across mass, social, and synthetic media, interacting with non-human agents and objects, curating and verifying information sources, mastering copy-creating tools and prompts.
- 3. Attitudes:** critically and creatively interpreting data, their uses, and algorithm effects, identifying and reporting harmful content (violence, hate speech, porn, disinformation, etc.), avoiding systemic risks (manipulation, virality, automaticity, data privacy, data theft, etc.), acknowledging one's own preconceptions, myths, representations, and imaginaries, devising counter-narratives to disinformation and communicating with others.
- 4. Values:** advocating for freedom of expression and opinion, promoting gender equality, supporting privacy, participation, and intellectual property, engaging in promotion of quality information and databases, opposing mass surveillance, and fostering security and well-being.

Source: Prepared by the author.

Promotion and protection of MIL in the face of AI and generative AI governance: Public policy responses

Although digital platforms have made strides in AI safety, the safeguards put in place can be intentionally or unintentionally breached and put to unethical use. The lack of human oversight and control can create damaging distrust in computer technology, in institutions and actors that promote it, as well as in professional media and other established institutions of governance (governments, state entities, intergovernmental organizations, etc.). The current responses by other stakeholders show emerging frameworks of AI governance policy at the global and national levels, as AI platforms and tech companies either resist or call for co-regulation.

Most frameworks (with the exception of UNESCO's) tend to focus on risk management and transparency and to ignore issues of MIL education, making very vague mentions in broad strokes about education as a human-centered way of integrating AI into society, without details for implementing and funding it. Among these frameworks, the principles most akin to user empowerment and most related to MIL are connected to accountability and explainability. They are the most likely to provide the checks and balances to counteract the risk that AI poses to AI governance: the worsening of governance because of unintended results, internal instability, and existential threats to humans, including the transfer of government decision-making powers to robots and their human enablers.

However, without active appropriation by citizens, these frameworks will have limited impact and will not be sustainable. Unless citizens are aware of their existence and intended benefits, they cannot act as AI watchdogs with their own trusted third parties. User representatives, such as those found in MIL community

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actors and civil society in general, should be included in the regulatory mechanisms being considered for generative AI. They can participate in discussions occurring at the local, national, and global levels concerning AI governance and can be seen as assets in its implementation, deployment, and monitoring.

Government regulators are currently woefully underprepared to take over the stewardship and oversight of AI in order to draw up proper regulations. Furthermore, there are regulatory risks, the risks of inaction or lack of implementation and enforcement. At the public action level, public policymakers should take greater steps to educate themselves on the latest AI development, to be able to apply the appropriate safeguards and monitoring tools.

Putting the onus of training and awareness on sole individuals is an insufficient solution and must be accompanied by systemic and structural changes to the AI and generative AI market. Governments should support user advocacy to promote fair competition, prevent potential geopolitical strife, and ensure that data privacy laws are effectively implemented. Governments should also ensure that generative AI developers prioritize ethical considerations such as privacy, accountability, and security in the design of their systems. They have to restore trust and goodwill among users with respect to information and data by curtailing social manipulation and surveillance. They also have to pay attention to the well-being of the growing audiences and communities using synthetic media.

Looking at AI through the lens of MIL yields renewed perspectives on how to deal with AI governance and restore trust in media and information. Scaling up citizens' agency and resilience is key to democratic societies' capacity to harness the benefits of data, algorithms, and AI while reducing their negative effects on information quality and transparency. Tying such training to problem-solving activities in everyday life can lead to better sense-making practices that incorporate crucial algorithmic and AI concepts. MIL education for the whole citizenry can foster such capacity-building and coalition-building without starting from scratch or reinforcing silos. It can help bridge the digital divide by providing solutions between the STEM and non-STEM sectors, training technical and non-technical people to master the basic concepts needed to use AI proficiently, safely, and ethically.

Ultimately, with and beyond AI systems, the goal for humanity is to construct viable and sustainable knowledge societies with collective intelligence—an environment in which ensuring MIL citizens is an imperative.

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Interview I

Data production for sustainable development

In this interview, Svein Østtveit, interim director of the UNESCO Institute for Statistics (UIS), shares his experiences in education. He discusses the challenges faced by the UIS and the activities it has developed to measure progress toward Sustainable Development Goal (SDG) 4,⁵ which focuses on quality education. He also discusses the relationship between SDG 4 and the development of digital skills.

Internet Sectoral Overview (I.S.O.)_ What are the main challenges of producing cross-nationally comparable data for monitoring the progress of SDG 4 – Quality education?

Svein Østtveit (S.O.)_ As the global custodian agency for SDG 4 monitoring, UIS plays a central role in collecting, validating, and disseminating internationally comparable education data. UIS supports countries in reporting on a wide range of topics—from enrollment, completion, and teacher qualifications to learning outcomes, education finance, digital skills, and equity indicators.

Over the past years, UIS has achieved major progress in expanding data coverage and improving quality. For instance, our most recent database, refreshed earlier this year (2025), added over 800,000 new national data points, with notable gains in SDG 4 indicators such as skills in information and communication technology (ICT), out-of-school rates, and participation in technical and vocational education. Coverage now spans 195 countries, and new disaggregations—by sex, location, and socioeconomic status—have strengthened the ability to monitor equity and inclusion. Despite these achievements, key challenges remain. National data systems vary widely in capacity, leading to gaps in coverage and timeliness. Differences in definitions and classifications—such as how countries define education levels or trained teachers—complicate comparability. Learning outcomes are particularly difficult to align across countries due to variations in assessment frameworks and methodologies. UIS addresses this through the *Global Proficiency Framework*⁶ and related tools, but uptake is uneven.

Timeliness is another concern. Some countries release education statistics years after collection, limiting their relevance for policy. UIS has responded by streamlining its annual survey process to accelerate reporting. Additionally, the rapid evolution of education content, especially digital skills, requires regular updates to indicators and survey instruments.



Photo: Personal archive

⁵ Find out more: <https://sdgs.un.org/goals/goal4>

⁶ Find out more: https://gaml.uis.unesco.org/wp-content/uploads/sites/2/2022/06/Global-Proficiency-Framework-Overview_EN.pdf

"Continued investment in national capacity, harmonization of standards, and methodological innovation are essential to ensure that data can effectively guide progress toward inclusive and equitable quality education for all."

In sum, while UIS has made substantial progress in expanding and improving SDG 4 data, producing cross-nationally comparable statistics remains a complex task. Continued investment in national capacity, harmonization of standards, and methodological innovation are essential to ensure that data can effectively guide progress toward inclusive and equitable quality education for all.

I.S.O._ What activities has the UIS developed to promote data production for SDG 4, particularly in the Global South?

S.O._ UIS has implemented a range of initiatives to strengthen SDG 4 data production, especially in low- and middle-income countries. As the custodian agency for SDG 4 indicators, UIS provides global methodological leadership through platforms like the Education Data and Statistics Commission (EDSC) and the Global Alliance to Monitor Learning (GAML),⁷ which help countries align definitions and standards.

To identify and address data gaps, UIS developed tools such as Learning Assessment System Evaluation for Reporting (LASER),⁸ which enables countries to assess their education data ecosystems. The SDG 4 Scorecard, produced jointly with the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Global Education Monitoring Report team, benchmarks national progress and highlights areas needing attention.

UIS conducts annual surveys to collect data directly from national governments, covering SDG 4 and other priority education indicators. We continuously revise tools and quality checks to ensure more timely and relevant reporting.

Supporting national capacity development is a core priority for UIS. Through workshops, tailored technical assistance, and online resources, UIS helps governments adopt and apply internationally recognized statistical frameworks, classifications, methodologies, and best practices. These efforts strengthen national education data systems, improve the production of SDG 4 indicators, and promote the effective use of data for policy planning and decision-making.

To improve the availability and comparability of learning outcomes data, UIS has developed a suite of tools, including the Assessment for Minimum Proficiency Levels (AMPL).⁹ AMPL is a flexible instrument that can be embedded within national assessments or used independently. It aligns with the *Global Proficiency Framework* and enables countries to report on SDG indicator 4.1.1. Countries such as Lesotho, Rwanda, and Kenya have successfully implemented AMPL to strengthen their national assessment systems. In addition, UIS has developed methodologies to support the alignment of large-scale international and regional student assessments with the *Global Proficiency Framework*, facilitating consistent reporting on learning outcomes under SDG indicator 4.1.1, which measures the proportion of youth and adults with ICT skills by type.

⁷ Find out more: <https://gaml.uis.unesco.org/about/>

⁸ Find out more: <https://tcg.uis.unesco.org/laser-global-report/>

⁹ Find out more: <https://ampl.uis.unesco.org/>

I.S.O._ In what ways is the development of digital skills related to achieving SDG 4? What lessons have been learned about data production in this field?

S.O._ Digital skills are essential to achieving SDG 4, particularly the target 4.4, which focuses on equipping youth and adults with relevant skills for employment and entrepreneurship. In today's digital economy, ICT literacy is foundational for meaningful participation in society and the workforce.

Monitoring digital skills has become a core concern in education statistics. Most countries rely on household surveys, asking respondents about specific digital tasks performed recently. While cost-effective, this self-reported approach has limitations, including overestimation or underestimation of actual skills.

To improve accuracy, UIS and partners advocate for performance-based assessments. The *International Computer and Information Literacy Study* (ICILS)¹⁰ is one example, using computer-based tasks to evaluate students' digital competencies and computational thinking.

It is also important to regularly update survey instruments. As technology evolves, so do the skills we should measure. Therefore, we need to constantly update measurement tools to reflect emerging competencies, including mobile and cloud-based skills.

Triangulating data sources—combining survey results with school infrastructure data and learning assessments—provides a fuller picture. For instance, low ICT skill levels often correlate with limited school connectivity, especially in remote regions and low-income countries.

Overall, digital skills are both an outcome and an enabler of SDG 4. Effective measurement requires harmonized indicators, direct assessments, and continuous adaptation to technological change.

I.S.O._ How does the spread of emerging technologies, such as Artificial Intelligence (AI), impact the achievement of SDG 4 and the development of digital skills? Are there any examples of innovative methods for measuring these phenomena in education?

S.O._ Emerging technologies, particularly AI, offer transformative potential for achieving SDG 4. In education, AI can personalize learning experiences, support teachers with real-time analytics, and streamline administrative tasks. In resource-constrained settings, AI tools may help mitigate teacher shortages and expand access to quality education.

AI is also reshaping how digital skills are defined and taught. As AI tools become more widespread, education systems are adapting curricula to include data literacy, coding, and responsible AI use, advancing progress toward SDG target 4.4.

"As technology evolves, so do the skills we should measure. Therefore, we need to constantly update measurement tools to reflect emerging competencies, including mobile and cloud-based skills."

¹⁰ Find out more: <https://www.iea.nl/studies/iea/icils>

“Unequal access to technology can widen educational disparities, particularly in low-income regions. Ethical concerns—such as data privacy, algorithmic bias, and overreliance on automation—must be addressed.”

In the field of data and statistics, AI is increasingly being used to enhance data collection, processing, and analysis. For example, AI-powered algorithms can automate the scoring of open-ended student responses, analyze process data to understand learning behaviors, and support predictive modelling for education indicators. In this way, these applications improve efficiency, consistency, and scalability in monitoring learning outcomes.

However, the integration of AI also presents risks. Unequal access to technology can widen educational disparities, particularly in low-income regions. Ethical concerns—such as data privacy, algorithmic bias, and overreliance on automation—must be addressed. UNESCO’s 2023 guidance¹¹ calls for a human-centered, age-appropriate approach to AI in education, emphasizing the importance of safeguarding equity and inclusion.

Innovative measurement methods are emerging to capture the impact of technology in education: the Programme for International Student Assessment (PISA)¹² 2025, of the Organisation for Economic Co-operation and Development (OECD), introduces a “Learning in the Digital World”¹³ domain to assess students’ ability to solve problems using digital tools; ICILS evaluates computer and information literacy through performance-based tasks; projects like GIGA¹⁴ use real-time geospatial data to map school connectivity, providing insights into digital readiness.

Together, these innovations support more effective monitoring of both the integration of technology in education systems and the competencies learners need to thrive in a digital world.

¹¹ Find out more: <https://www.unesco.org/en/articles/guidance-generative-ai-education-and-research>

¹² Find out more: <https://www.oecd.org/en/about/programmes/pisa.html>

¹³ Find out more: <https://www.oecd.org/en/topics/sub-issues/learning-in-the-digital-world/pisa-2025-learning-in-the-digital-world.html>

¹⁴ Find out more: <https://giga.global/about-us/>

Article II

Literacy and numeracy skills of Brazilian youth and adults in an increasingly digital context

Ana Lucia Lima¹⁵

Introduction

The purpose of the Functional Literacy Index (Inaf)¹⁶ is to foster public debate on the quality of education and the defense of educational rights, aiming to ensure that all Brazilians acquire the necessary skills to live in a literate society and exercise their citizenship with autonomy.

For Inaf, literacy is an individual's ability to comprehend and use written information in everyday situations. It is conceived as a continuum, ranging from the simple recognition of letters and numbers to more complex cognitive operations that integrate textual, numerical, and graphic information with each person's knowledge and worldview.

In seeking to estimate the extent to which proficiency in reading, writing, and mathematics influences the social practices of Brazilian youth and adults, the indicator must reflect the transformations that have been taking place in how people access information, communicate, study and work, consume, entertain themselves, take care of their health, participate in social and community spaces, build relationships, and develop both individually and collectively in contemporary society.

The social isolation caused by the COVID-19 pandemic accelerated both the expansion of access and the diversification of everyday activities that can—and often must (or have to)—be carried out online. This shift significantly altered people's engagement with reading, writing, and mathematics, which are increasingly mediated by digital environments.

In this context, the 2024 edition of Inaf—the 11th since its inception in 2001—introduced an important innovation: a new test specifically designed to assess literacy and numeracy skills in the digital environment. With this “hybrid” approach to monitoring functional literacy trends in Brazil, it was possible to meet a dual challenge: incorporating a new set of skills specific to digital contexts while maintaining the comparability of the historical data series.



Photo: Leandro Asai

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e Gestão

¹⁵ She holds a degree in Economics and is a partner and director at Conhecimento Social – Estratégia e Gestão, a consultancy specialized in producing knowledge in the social field. She served as CEO of Ibope Mídia from 1987 to 2003, overseeing the expansion of operations in Latin America. In 2000, she took part in the conception and founding of the Instituto Paulo Montenegro (IPM), becoming its executive director in 2005. In 2015, following the closure of IPM's activities, she took on the responsibility of continuing several of its projects, including the Inaf.

¹⁶ Find out more: <https://alfabetismofuncional.org.br/>

To be functionally literate in the 21st century requires adopting reading, writing, and mathematical practices within digital environments as part of everyday life. The degree of mastery of these skills can expand opportunities, but it can also deepen exclusion for those deprived of the chance to develop them.

The following pages present a brief retrospective of Inaf's trajectory, which is about to complete a quarter of a century, and share the main stages, findings, reflections, and challenges arising from this first set of evidence on literacy in the digital context.

The findings and reflections of the 2024 Inaf directly engage with the theme of this publication, *Promoting digital skills and the challenges of measurement*. To be functionally literate in the 21st century requires adopting reading, writing, and mathematical practices within digital environments as part of everyday life. The degree of mastery of these skills can expand opportunities, but it can also deepen exclusion for those deprived of the chance to develop them.

Inaf 2024 – Continuity and innovation

First developed and applied in 2001 through a partnership between the social organization Ação Educativa and the IPM (affiliated with the Brazilian Institute of Public Opinion and Statistics [Ibope]), Inaf aims to measure literacy levels among the Brazilian population 15 to 64 years old. Since the 2018 edition, following the closure of Ibope and the IPM, the partnership has been between Ação Educativa and Conhecimento Social, which are now responsible for the overall coordination of the study and for carrying out its 11th edition, Inaf 2024,¹⁷ launched in May 2025.

The 2024 edition maintains the methodological characteristics adopted throughout the ten previous editions to preserve the comparability of data in its historical data series. Thus, to estimate literacy levels, a sample¹⁸ of 2,000 individuals 15 to 64 years old (representative of the Brazilian population within this age group) is assessed through a test conducted in face-to-face household interviews, based on reading and interpreting texts, tables, charts, and other images that draw on literacy and numeracy skills present in everyday social practices.

Based on test performance, each individual is classified into one of five literacy levels: Illiterate, Rudimentary, Elementary, Intermediate, and Proficient. The first two levels are associated with the concept of functional illiteracy, while the three subsequent levels describe different degrees of mastery of reading, writing, and mathematics skills in various social contexts (Table 1).

¹⁷ The 2024 edition is also an initiative of the Itaú Foundation, in partnership with the Roberto Marinho Foundation, the Unibanco Institute, the United Nations Children's Fund (UNICEF), and the United Nations Educational, Scientific, and Cultural Organization (UNESCO). This edition also has the technical partnership of the Ipsos-Ipec Institute for sample design, data collection, and processing, and of the Rede Conhecimento Social for communication and mobilization efforts.

¹⁸ The sample is stratified, with allocation proportional to the Brazilian population in each region. In each region, probabilistic samples were selected in three stages (regions, municipalities, and census enumeration area) using the probability proportional to size method. The selection of individuals to be interviewed was made by proportional quotas, according to gender, age, education, and employment status.

Table 1 – LITERACY LEVELS IN BRAZIL ACCORDING TO INAF

Detailed scale 5 Levels	Synthetic scale 3 Levels	2 Groups
Illiterate	Functionally illiterate	Functionally illiterate
Rudimentary		
Elementary	Literate at elementary level	Functionally literate
Intermediate	Literate at consolidated level	
Proficient		

Source: Inaf (n.d.).

In addition to the cognitive test, each participant answers a questionnaire designed to characterize sociodemographic, economic, cultural, and educational background of the respondents, which includes demographic (gender, age, educational level, race/ethnicity), socioeconomic (employment status and conditions, household income), and territorial (region of residence, municipality size and location) variables. In this latest edition, issues related to access, use, and perception of information and communication technology (ICT) skills were explored in greater depth, including references and indicators from studies conducted by the Regional Center for Studies on the Development of the Information Society (Cetic.br) of the Brazilian Network Information Center (NIC.br).

Additionally, to facilitate more detailed analyses of the youth population 15 to 29 years old—and especially those 15 to 19 years old (still within the age range compatible with regular basic education)—a disproportionate sampling design was implemented for the younger cohorts. Thus, 480 additional interviews with individuals 15 to 19 years old were added to the traditional sample of 2,000 cases. For the calculation of results, the interviews were weighted so that each age group carried a weight equivalent to its proportion in the target population.

The estimated margin of error for the total sample was 2 percentage points. For the age groups 15 to 29 and 15 to 19, the sampling error was 3 percentage points, considering an estimated 95% confidence level.

WHAT THE HISTORICAL INAF DATA SHOW

As background for a better understanding of the findings specific to the digital context, it is useful to examine the evolution of literacy levels (Table 2) since the beginning of the historical data series in 2001.

/Internet Sectoral Overview

Table 2 – LITERACY LEVELS IN BRAZIL ACCORDING TO INAF (2001-2024) (%)

Level	2001 2002	2002 2003	2003 2004	2004 2005	2007	2009	2011	2015	2018	2024
Illiterate	12	13	12	11	9	7	6	4	8	7
Rudimentary	27	26	26	26	25	20	21	23	22	22
Elementary	28	29	30	31	32	35	37	42	34	36
Intermediate	20	21	21	21	21	27	25	23	25	25
Proficient	12	12	12	12	13	11	11	8	12	10
Total	100	100	100	100	100	100	100	100	100	100
Functionally illiterate*	39	39	38	37	34	27	27	27	30	29
Literate at elementary level	28	29	30	31	32	35	37	42	34	36
Literate at consolidated level**	32	33	33	33	34	38	36	31	37	35
Total	100	100	100	100	100	100	100	100	100	100
Functionally illiterate	39	39	37	37	34	27	27	27	29	29
Functionally literate***	61	61	63	63	66	73	73	73	71	71
Total	100	100	100	100	100	100	100	100	100	100

* Individuals classified at the illiterate and rudimentary levels make up the group classified as Functionally Illiterate.

** Individuals classified at the intermediate and proficient levels make up the group called Literate at consolidated level.

*** Individuals classified at the elementary, intermediate, and proficient levels make up the group called Functionally Literate. The criterion for rounding fractions of results allows for total percentages that differ from the sum of the rounded numbers.

Source: Prepared by the authors, based on data from Inaf (n.d.).

Despite the six-year gap since the previous Inaf edition in 2018, no significant changes were observed in the landscape of functional literacy in Brazil. As has been observed, after a continuous decline in the proportion of functionally illiterate individuals until 2009, this proportion has since stabilized, remaining unchanged: 29% (almost 1 in 3 youth and adults in Brazil) are functionally illiterate. At the other end of the scale, the proportion of proficient individuals has shown virtually no progress since the beginning of the historical data series in 2001 (Inaf, n.d.).

The continuous increase in the average educational attainment of the Brazilian population is reflected in the literacy profile of the country: while 16% of individuals 15 to 29 years old are functionally illiterate, this proportion rises to 23% among those 30 to 39 years old, 33% among those 40 to 49 years old, and reaches 51% among those 50 to 64 years old (Inaf, n.d.). Despite near-universal access to primary education and increasing rates of enrollment and completion in upper secondary

education, Inaf data reflect the deep and persistent economic and social divide in Brazil. These inequalities are both a cause and a consequence of low literacy levels.

The inertia observed in the Inaf historical data series suggests that advances in nominal schooling have not been accompanied by proportional progress in consolidating the literacy and numeracy skills that are essential for the full participation of individuals in an increasingly and progressively literate society.

Main steps for integrating the digital dimension into Inaf 2024

CONCEPTUAL REFERENCES AND REVIEW OF THE SKILLS MATRIX

Taking the discussions in the field of digital literacy as a framework, the main international studies¹⁹ and contributions of specialists in digital literacy, multiliteracies, and media education, several conceptual approaches and ways of operationalizing their measurement were evaluated.

The next step in introducing the digital dimension into Inaf was a review of the Skills Matrix, which began to include both historically assessed and new skills, integrating literacy and numeracy domains with capabilities inherent to the digital environment, such as searching, selecting, and critically analyzing content. The Skills Matrix was then organized into four groups: (a) recognize/decode; (b) locate/identify; (c) understand/infer; and (d) evaluate/reflect.

By associating these skills with multiple fields of social action, and different media, text genres and contexts that shape literacy and numeracy practices in everyday life, the matrix guided the selection of the item set that make up both the printed cognitive test—administered in the traditional way—and the test specifically designed to measure literacy in the digital context—administered using mobile phones.

THE PERFORMANCE TEST IN THE DIGITAL ENVIRONMENT

To administer the digital skills test, a digital interface²⁰ was developed to be accessed via mobile phones provided by the interviewers. The test was structured around three tracks illustrating situations from the daily lives of many Brazilians. The items developed for this test enabled the assessment of mastery of operational skills (such as clicking on a link or recognizing the function of an icon, etc.), information handling, critical reading of content, and text production within the digital interface. In addition to the answers themselves, the digital interface was programmed to record data related to the procedures carried out, such as the number of clicks made before finding the correct answer and screen scrolling.

The degree of difficulty and the level of autonomy required to complete the tracks increased progressively: in the first track, greater interaction was expected with the interviewers, who read the questions and recorded oral responses from the participants; in the second, the interaction was partial; and in the third, it was carried out entirely autonomously by the participants.

The items developed for this test enabled the assessment of mastery of operational skills (such as clicking on a link or recognizing the function of an icon, etc.), information handling, critical reading of content, and text production within the digital interface.

¹⁹ Among the references, we can mention Digcomp 2.2 (Vuorikari et al., 2002), Transmedia Literacy (Scolari, 2018), and works by the New London Group (<https://www2.iel.unicamp.br/tecle/encyclopedia/o-grupo-de-nova-londres/>).

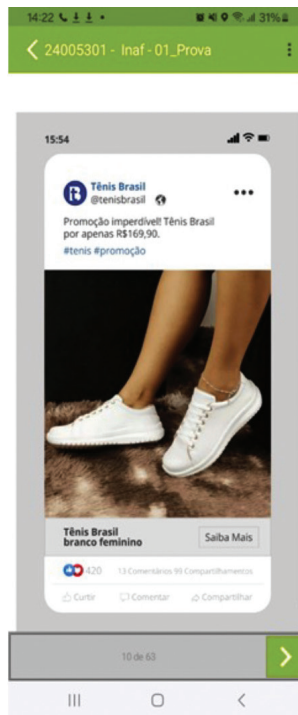
²⁰ The knowledge and experience of Ipsos-Ipec, Inaf's technical partner since its first edition, were decisive in the construction of the interface.

Below is a brief summary of each of the tracks used in the test:

TRACK 1

The first situation concerned the purchase of a pair of sneakers, prompted by an advertisement on a social network. In this track, the respondent was required to select the product, choose the shoe size, and click on links to complete the purchase. At the end, a link was presented, asking the participant to evaluate the reliability of the browsing and payment process.

Figure 1 – PURCHASE IN DIGITAL COMMERCE



Source: Inaf (2024).

TRACK 2

The second situation involved a conversation in a messaging application between two colleagues who wanted to watch a movie. The situation involved browsing movie streaming applications and exchanging instant messages, requiring the participant to combine information from different digital environments to make decisions related to choosing a movie and planning their meeting to watch it.

Figure 2 – NAVIGATION IN AN APPLICATION

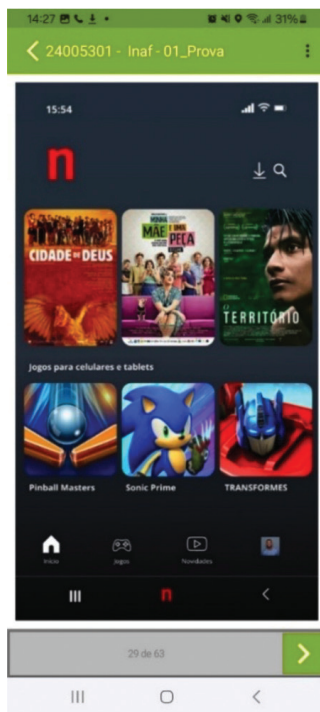


Figure 3 – INSTANT MESSAGING EXCHANGE



Source: Inaf (2024).

TRACK 3

The third situation involved registering a colleague for a music festival via an online form. In addition to filling out the form with the colleague's personal information—respecting predefined formats (such as date and phone number)—the task required creating a password according to specific criteria (such as using different types of characters) and attaching image files from the device's photo album.

Figure 4 – HOME SCREEN FOR PARTICIPANT REGISTRATION



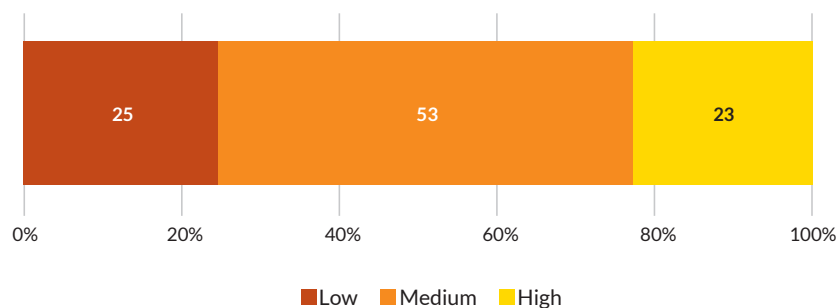
Source: Inaf (2024).

INITIAL PERFORMANCE RESULTS IN DIGITAL ACTIVITIES

To obtain the first results of the digital test, three performance levels were defined based on the percentage of correct answers: low (up to one-third of the items answered correctly), medium (between one-third and two-thirds), and high (above two-thirds). The charts below present the main results obtained in the digital test.

Approximately one in every four respondents (23%) demonstrated high performance in solving the digital context activities. In contrast, just over half (53%) achieved medium performance, and 25% showed low performance in the set of items that made up the test (Chart 1).

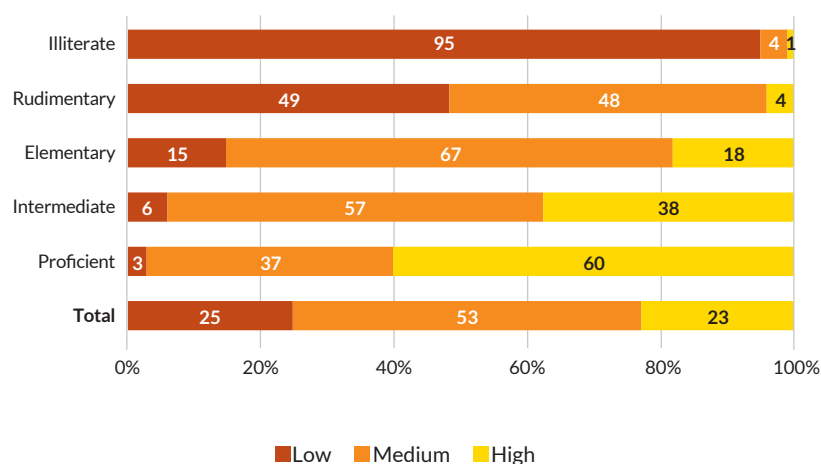
Chart 1 – PROPORTION BY PERFORMANCE IN THE DIGITAL TEST



Source: Inaf (n.d.).

Next, the distribution of low, medium, and high performance in the digital test is presented in relation to the literacy levels historically measured by Inaf (Chart 2).

Chart 2 – PERFORMANCE IN DIGITAL ACTIVITY BY LITERACY LEVELS



Source: Inaf (n.d.).

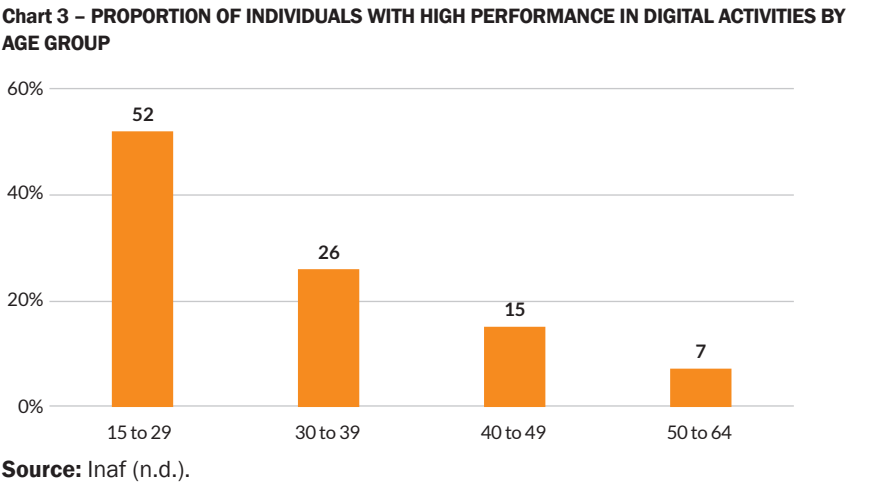
The data showed a strong association between performance on the digital test and the literacy levels traditionally measured by Inaf (n.d.). However, in each literacy level, there were significant proportions of individuals who reached performance levels in digital activities either above or below what would be expected.

(...) in each literacy level, there were significant proportions of individuals who reached performance levels in digital activities either above or below what would be expected.

IN SUMMARY
Illiteracy: As would be expected, among individuals at this literacy level, 95% showed low performance on the digital test, managing to carry out only a limited number of activities.
Rudimentary literacy: Individuals classified at this level of literacy were divided into two nearly equivalent groups, with 49% exhibiting low performance and 48% medium performance on the digital test.
Elementary literacy: Approximately 2 out of 3 individuals (67%) demonstrated a medium level of performance, consistent with their literacy level. The others were divided between those with low performance (15%) and those with high performance (18%).
Intermediate literacy: In this group, the proportion of individuals with high performance rose to 38%, solving more than two-thirds of the situations presented in the digital test. The remaining 63% showed medium (57%) or low (6%) performance in digital activities.
Proficient literacy: 6 out of 10 individuals (60%) achieved high performance in digital activities, while 4 out of 10 (40%) reached only medium performance.

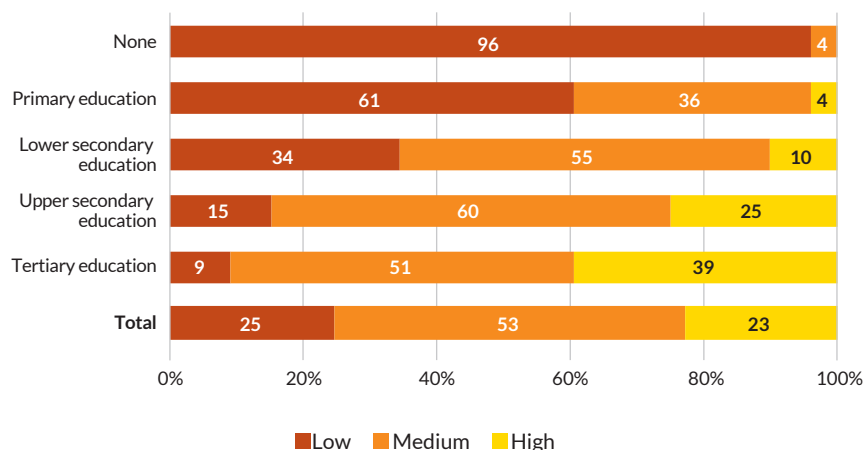
Many differences in digital activity performance among people with the same level of literacy were related to the age of respondents: younger individuals—especially those between 15 and 29 years old, as well as those between 30 and 39 years old—performed better on the digital test compared to people in older age groups.

For younger people, interacting on digital platforms poses significantly fewer challenges than it does for older people (Chart 3). Even so, it is worth noting that only about half of young people 15 to 29 years old (52%) were able to complete more than two-thirds of the proposed activities (Inaf, n.d.).



Education level is another factor clearly associated with performance in digital activities: the higher the level of education, the better the performance tends to be. However, even among those who had reached upper secondary or tertiary education, there were still significant percentages of only average performance in the digital test—60% and 51% respectively—and only 4 out of 10 (39%) of individuals who had reached or completed tertiary education achieved high performance in these activities (Chart 4). Education, therefore, while important, is not sufficient on its own to ensure mastery of digital competencies.

Chart 4 – PROPORTION OF INDIVIDUALS WITH HIGH PERFORMANCE IN DIGITAL ACTIVITIES BY LEVEL OF EDUCATION



Source: Inaf (n.d.).

The data released so far from the 2024 edition of Inaf treat digital skills as a dimension that is external to the literacy construct, without incorporating individuals' performance in the digital context as part of the proficiency that defines literacy levels.

Perspectives

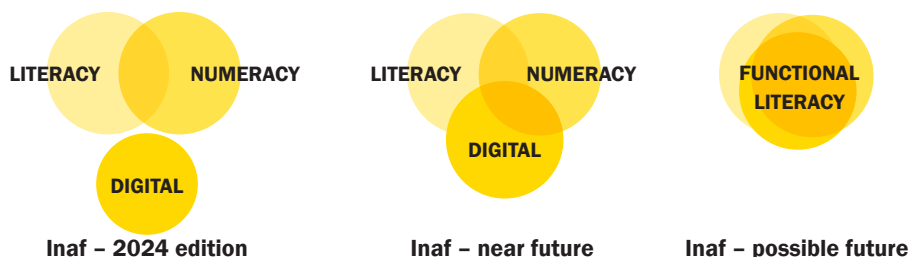
Based on the preliminary results presented here, the Inaf coordinators—Ação Educativa and Conhecimento Social—invite researchers and experts on the subject to deepen the analyses, to improve the indicators related to digital skills, and expand the reflection on the perspectives of Inaf in light of profound transformations that may affect even the very concept of literacy.

The data released so far from the 2024 edition of Inaf treat digital skills as a dimension that is external to the literacy construct, without incorporating individuals' performance in the digital context as part of the proficiency that defines literacy levels.

Drawing on the lessons learned from this edition, it will be possible to assess the effects of incorporating digital skills into the literacy scale, weighing the pros and cons of this decision. For future editions—always maintaining as a central premise of Inaf the measurement of individuals' mastery of reading, writing, and math skills in social practices—it is possible that the boundary between these dimensions will become irrelevant. In this regard, the following diagram (Figure 5) illustrates a possible path:

(...) the mechanisms of social exclusion associated with limited literacy and numeracy skills tend to be reproduced in the digital environment, restricting opportunities for qualified access to technologies and further exacerbating the exclusion of a growing proportion of Brazilians from the full exercise of citizenship in its multiple dimensions.

Figure 5 – EVOLUTION OF THE DIMENSIONS ASSESSED IN INAF



Source: Prepared by the authors.

The participation of multiple voices in this reflection will be essential to ensure that Inaf maintains its relevance as a reference for measuring literacy levels of the Brazilian youth and adult population.

Final considerations

The transformations that have occurred and those that are yet to come in the near future as a result of the incorporation of technology into virtually all aspects of daily life bring new and immense challenges for Brazilian society, especially in light of the persistent inequalities that structure it.

Turning these challenges into opportunities to promote the qualified incorporation of a greater proportion of young and adult Brazilians into the world of education and work, conscious consumption practices, access to information, culture, and social participation, and the construction of a more just and harmonious social fabric depends on a wide range of factors. Among them are included: accessible technological infrastructure with meaningful connectivity; cross-cutting public policies with a clear intention to reduce social divides; stimulation and support for the productive sector and entrepreneurship; a legal environment and citizen governance; and the mobilization of society. These are some of the fronts that need to be strengthened so that the inevitable incorporation of technology is associated with the expansion of opportunities.

In this scenario, Inaf seeks to contribute to public reflection and debate. Its data suggest that the mechanisms of social exclusion associated with limited literacy and numeracy skills tend to be reproduced in the digital environment, restricting opportunities for qualified access to technologies and further exacerbating the exclusion of a growing proportion of Brazilians from the full exercise of citizenship in its multiple dimensions.

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Interview II

Measuring digital skills: Challenges and solutions

Dr. Riina Vuorikari, independent expert on digital skills and digital education, reflects on the importance and the challenges of measuring digital skills across diverse contexts. In this interview, she discusses the challenges of producing globally comparable information and communication technologies (ICT) skills indicators as a rapporteur of the International Telecommunication Union's (ITU) Expert Group on ICT Household Indicators (EGH) skills subgroup and shares her insights about digital skills and the growing presence of emerging technologies in our routines.

Internet Sectoral Overview (I.S.O.)_ Why is it important to measure digital skills, and what are the main challenges involved?

Riina Vuorikari (R.V.)_ If we want to be sure that digital technologies allow all people to take advantage of digital transformation, it is important to know if this is the case or not. Measuring digital skills to better understand the state of the digital divide is a step in the evolution; first, the digital divide was driven by access to the Internet, devices, and digital tools, now it is about skills to take advantage of them. Achieving both will enable individuals to start realizing more tangible outcomes. There are many pieces in the puzzle to make it work!

One of the challenges is to come up with the right questions or measurement tools to capture what digital skills entail, especially if we want to measure them at a global level. Even if social media and commercial Internet seem ubiquitous, we all know that digital tools available at the local level have particularities driven by cultural and national needs. This makes things more complex, especially when we want to use the same measurement tool everywhere to get comparable data. This was also one of the major challenges in creating the new ICT skills indicators to calculate one of the United Nations (UN) Sustainable Development Goals (SDG)²¹ Indicators, namely “4.4.1: Proportion of youth and adults with ICT skills, by type



Photo: Astro Albania

Dr. Riina Vuorikari

Independent expert on digital skills and digital education

²¹ Find out more: <https://sdgs.un.org/goals>

"Today, it is not enough to have digital skills in only one area; skills in all five areas are needed to reap the benefits of digitalization in a confident and safe way."

of skill."²² Contributing to that work as rapporteur of the ITU's sub-working group was very important for me, as it supports the values that I want to put forward with digital technologies. In that context, the collaboration with the Regional Center for Studies on the Development of the Information Society (Cetic.br) of the Brazilian Network Information Center (NIC.br) was very valuable!

I.S.O._ How does the Digital Competence Framework for Citizens (DigComp)²³ address these issues?

R.V._ DigComp helped the work by providing a common definition and vocabulary to use, which made it easier to create a common vision of what should be measured. Furthermore, DigComp focuses on competencies to perform tasks, solve problems, and achieve goals with the help of digital tools, so it does not matter if people perform these tasks using computers or smartphones with Internet connections, or even feature mobile phones connected to mobile networks. This is important to note, and the approach by DigComp was helpful in this respect, as it does not focus on specific software, applications, or digital devices, but more on activities where digital tools help achieve goals. This is also the focus of measuring digital skills using the new ICT skills indicators.

Last, DigComp defines digital skills as a combination of competences in various areas, of which there are five. Today, it is not enough to have digital skills in only one area; skills in all five areas are needed to reap the benefits of digitalization in a confident and safe way. For example, a person who uses a smartphone for communication without knowing about safe practices (such as protecting devices, online identities, and personal data) might not be able to mitigate harm if encountering fraudulent practices or when security incidents occur.

These were some of the lessons that were used by the working group that recommended the updated method for measuring digital skills using ITU's ICT skills indicators. Now the next challenge is for the national ICT household surveys to implement these recommendations!

I.S.O._ What difficulties arise from developing a comprehensive and internationally comparative framework for measuring digital skills? Are there any particular challenges associated with implementing it in countries in the Global South?

R.V._ As I mentioned before, when focusing on measuring digital skills, local and national contexts set some limitations. This means that, among other issues, digital services made available by authorities differ a lot from one country to another, not to mention the area of micropayments and how monetary transactions take place. As an example, think about how digital technologies have made monetary transactions easier, from mobile payments on feature phones to in-application purchases and more complex e-banking applications. This can have both big economic and social implications everywhere, including countries in the Global

²² Find out more: <https://unstats.un.org/sdgs/metadata/files/Metadata-04-04-01.pdf>

²³ Find out more: https://joint-research-centre.ec.europa.eu/projects-and-activities/education-and-training/digital-transformation-education/digital-competence-framework-citizens-digcomp_en

South. These are also exactly the type of tasks that become important for understanding if individuals' digital skills are sufficient for managing everyday tasks in society.

Previously, these data were not comprehensively gathered, which can prevent us from making a systematic effort regarding digital skills gaps in all segments of the population.

Another example is the lack of digital skills for content creation; previously, creating content on mobile phones was not properly considered. Thinking of the mobile-first population, especially in the Global South, it is important to capture their digital skills in this respect, as digital content is so easily created using smartphones and shared in messages and through social media. Moreover, for everyone today, understanding more about how digital content is created, and having the skills to create it, will play an important role also in fighting disinformation and misinformation: in the era of generative Artificial Intelligence (AI), as synthetic online content grows rapidly, without this know-how, it can be hard to distinguish it from real-world events.

I.S.O._ What opportunities does the DigComp framework offer for digital skills in the context of emergent technologies and AI?

R.V._ Today's version of DigComp 2.2²⁴ offers examples of individuals interacting with AI systems, focusing on knowledge, skills, and attitudes that have become crucial in using these digital technologies in a safe, confident, and critical way. Interestingly, we noticed that with emerging technologies such as generative AI, it is not just about the digital skills to use them, but users' attitudes about how they are being used also become an important driving force for action. Attitudes also include ethical and societal reflections, issues such as transparency, and clearly indicating when AI is used for what purposes and in which way. This is also important when interacting with other people, as generative AI is more and more used for communication purposes. I dread seeing a future where I am only corresponding with AI bots instead of personnel in public services or businesses, or when all e-mails are answered by generative AI!

Another important insight was users' autonomy. We focused on human agency when interacting with AI systems. They should support humans in making informed decisions in accordance with their own goals, instead of deciding on their behalf, for example, what video clip to watch next on social media or what to buy online. The new DigComp 3.0²⁵ update, due by the end of 2025, will have more fine-grained learning outcomes for each of the DigComp competencies, focusing on AI and taking into account some other emerging technologies. I have had a chance to contribute to this new development work as the author of the previous versions of DigComp, and it has been very rewarding and a privilege too! I look forward to seeing how education authorities and digital skills training providers in general will take advantage of these new insights into their policy actions and curriculum development!

"Moreover, for everyone today, understanding more about how digital content is created, and having the skills to create it, will play an important role also in fighting disinformation and misinformation (...)"

²⁴ Find out more: <https://digital-skills-jobs.europa.eu/en/latest/opinions/helping-people-interact-ai-systems-confident-critical-and-safe-way>

²⁵ Find out more: https://joint-research-centre.ec.europa.eu/projects-and-activities/education-and-training/digital-transformation-education/digital-competence-framework-citizens-digcomp/current-developments-digcomp-2024-2025_en

Domain Report

Domain registration dynamics in Brazil and around the world

The Regional Center for Studies on the Development of the Information Society (Cetic.br), department of the Brazilian Network Information Center (NIC.br), carries out monthly monitoring of the number of country code top-level domains (ccTLD) registered in countries that are part of the Organisation for Economic Co-operation and Development (OECD) and the G20.²⁶ Considering members from both blocs, the 20 nations with the highest activity sum more than 96.82 million registrations. In August 2025, domains registered under .de (Germany) reached 17.61 million, followed by China (.cn), United Kingdom (.uk), and Netherlands (.nl), with 12.11 million, 8.86 million, and 6.10 million registrations, respectively. Brazil had 5.50 million registrations under .br, occupying 6th place on the list, as shown in Table 1.²⁷

²⁶ Group composed by the 19 largest economies in the world and the European Union. More information available at: <https://g20.org/>

²⁷ The table presents the number of ccTLD domains according to the indicated sources. The figures correspond to the record published by each country, considering members from the OECD and G20. For countries that do not provide official statistics supplied by the domain name registration authority, the figures were obtained from: <https://research.domaintools.com/statistics/tld-counts>. It is important to note that there are variations among the date of reference, although the most up-to-date data for each country is compiled. The comparative analysis for domain name performance should also consider the different management models for ccTLD registration. In addition, when observing rankings, it is important to consider the diversity of existing business models.

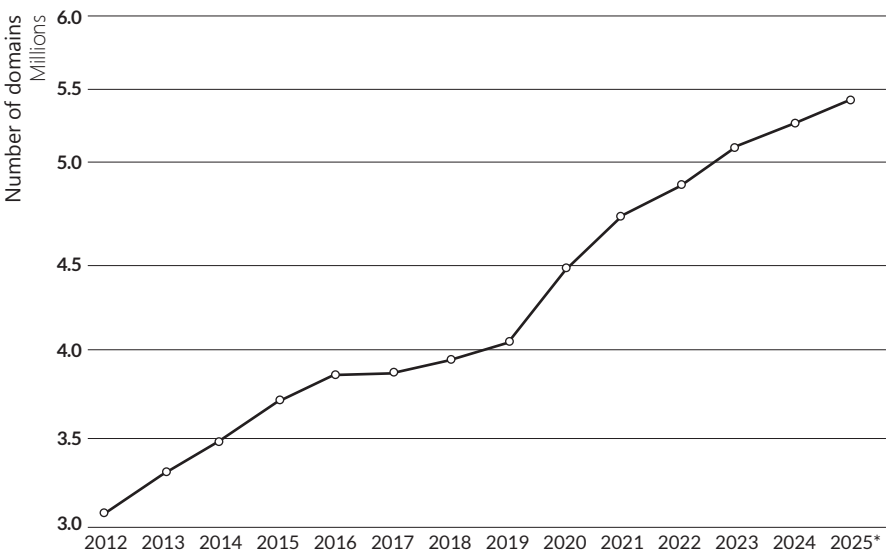
Table 1 – TOTAL REGISTRATION OF DOMAIN NAMES AMONG OECD AND G20 COUNTRIES

Position	Country	Number of domains	Date of reference	Source (website)
1	Germany (.de)	17,615,318	01/09/2025	https://www.denic.de
2	China (.cn)	12,111,849	01/09/2025	https://research.domaintools.com/statistics/tld-counts/
3	United Kingdom (.uk)	8,868,632	31/07/2025	https://www.nominet.uk/news/reports-statistics/uk-register-statistics-2025/
4	Netherlands (.nl)	6,109,417	01/09/2025	https://stats.sidnlabs.nl/en/registration.html
5	Russia (.ru)	5,962,115	01/09/2025	https://cctld.ru
6	Brazil (.br)	5,506,031	31/08/2025	https://registro.br/dominio/estatisticas/
7	France (.fr)	4,268,033	30/08/2025	https://www.afnic.fr/en/observatory-and-resources/statistics/
8	Australia (.au)	4,178,915	01/09/2025	https://research.domaintools.com/statistics/tld-counts/
9	European Union (.eu)	3,642,209	01/09/2025	https://research.domaintools.com/statistics/tld-counts/
10	Colombia (.co)	3,520,382	01/09/2025	https://research.domaintools.com/statistics/tld-counts/
11	Italy (.it)	3,512,268	31/07/2025	https://stats.nic.it/domain/growth
12	Canada (.ca)	3,450,272	01/09/2025	https://www.cira.ca
13	India (.in)	3,201,600	01/09/2025	https://research.domaintools.com/statistics/tld-counts/
14	Switzerland (.ch)	2,570,702	15/08/2025	https://www.nic.ch/statistics/domains/
15	Poland (.pl)	2,501,646	01/09/2025	https://research.domaintools.com/statistics/tld-counts/
16	United States(.us)	2,199,917	01/09/2025	https://research.domaintools.com/statistics/tld-counts/
17	Spain (.es)	2,134,160	31/07/2025	https://www.dominios.es/es/sobre-dominios/estadisticas
18	Portugal (.pt)	2,033,364	01/09/2025	https://www.dns.pt/en/statistics/
19	Japan (.jp)	1,812,778	01/09/2025	https://jprs.co.jp/en/stat/
20	Belgium (.be)	1,628,950	01/09/2025	https://research.domaintools.com/statistics/tld-counts/

Collection date: September 1, 2025.

Chart 1 shows the performance of .br since 2012.

Chart 1 – TOTAL NUMBER OF DOMAIN REGISTRATIONS FOR .BR – 2012 to 2025*



*Collection date: August 31, 2025.
Source: Registro.br
Retrieved from: <https://registro.br/dominio/estatisticas>

In August 2025, the five generic Top-Level Domains (gTLD) totaled more than 190.32 million registrations. With 156.59 million registrations, .com ranked first, as shown in Table 2.

Table 2 – TOTAL NUMBER OF DOMAINS AMONG MAIN gTLD

Position	gTLD	Number of domains
1	.com	156,595,317
2	.net	12,301,467
3	.org	11,309,422
4	.xyz	5,242,390
5	.top	4,881,183

Collection date: September 1, 2025.
Source: DomainTools.com
Retrieved from: research.domaintools.com/statistics/tld-counts

Internet markers in Brazil

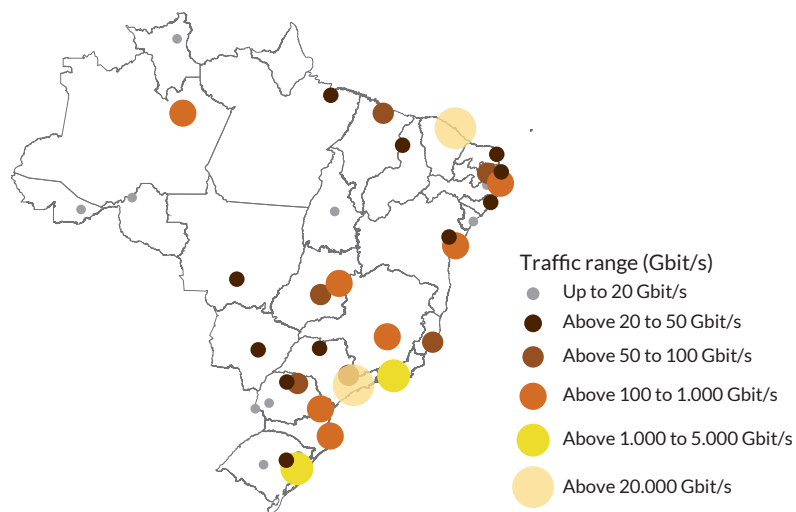
IX.br: Data on Internet Exchange Points

IX.br (Brazil Internet Exchange) is an initiative of the Brazilian Network Information Center (NIC.br), supported by the Brazilian Internet Steering Committee (CGI.br), which promotes and implements Internet Exchange Points (IXP), the necessary infrastructure for direct interconnection between the networks, also known as Autonomous Systems (AS), which make up the Internet in Brazil.

The interconnection of several AS in an IXP simplifies Internet transit, establishing more direct traffic to a given destination. This improves quality, reduces costs, and increases network resilience.

The initiative currently encompasses 38 independent IXP, distributed throughout Brazil (Figure 1), and is one of the most important clusters of IXP worldwide. Chart 1 shows the continuous traffic growth of the IXP cluster that comprises IX.br over the past five years.

Figure 1 – IXP IN BRAZIL, BY TRAFFIC RANGE

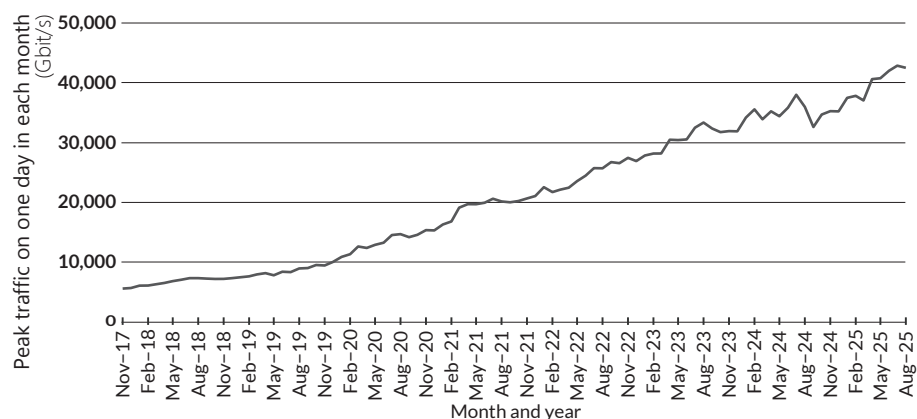


Reference period: September 2025.

Source: IX.br | NIC.br

Retrieved from: <https://ix.br/trafego/agregado/>

Chart 1 – TRAFFIC PEAK FOR THE IX.br IXP CLUSTER – 2017 to 2025

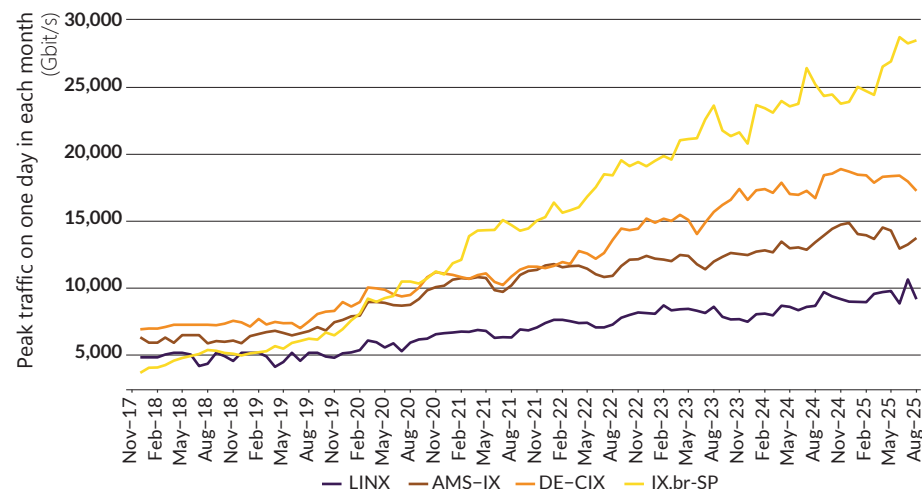


Source: IX.br | NIC.br

Retrieved from: <https://ix.br/agregado/>

Chart 2 compares the peak traffic of the São Paulo IXP, the largest in Brazil, with the three largest in Europe: LINX (London, England), AMS-IX (Amsterdam, Netherlands), and DE-CIX (Frankfurt, Germany), between 2017 and 2025.

Chart 2 – LONDON (LINX), AMSTERDAM (AMS-IX), FRANKFURT (DE-CIX) AND SÃO PAULO (IX.br-SP) IXP, BY TRAFFIC PEAK - 2017 to 2025



Source: IX.br | NIC.br

Retrieved from: <https://www.de-cix.net/en/locations/frankfurt/statistics>;

<https://www.ams-ix.net/ams/documentation/total-stats>;

<https://portal.linx.net/services/lans-snmip>; <https://ix.br/trafego/agregado/>



Here you can find more information about IX.br's activities and statistics.

/Answers to your questions

DIGCOMP AND THE LEVELS OF DIGITAL SKILLS IN BRAZIL



The European Union's Digital Competence Framework for Citizens (DigComp) 2.2²⁸ proposes an understanding of the key digital skills areas. Considering the changes brought about by the presence of emerging technologies, this approach has been updated to reflect the knowledge, skills, and basic competencies necessary for the population to manage digital life, seize opportunities, and mitigate associated risks.

The framework includes five skill areas (Table 1), which in turn encompass indicators related to individuals' online activities. The results are then reprocessed and converted into skill levels: none, basic level (reports only one activity per area), and above basic (reports more than one activity per area).

Table 1 – DIGCOMP 2.2 AREAS AND SKILL INDICATORS

SKILLS AREAS	INDICATORS
1 Information and data literacy	1.1 - Browsing, searching and filtering data, information, and digital content 1.2 - Evaluating data, information, and digital content 1.3 - Managing data, information, and digital content
2 Communication and collaboration	2.1 - Interacting through digital technologies 2.2 - Sharing information and content through digital technologies 2.3 - Engaging in citizenship through digital technologies 2.4 - Collaborating through digital technologies 2.5 - Netiquette 2.6 - Managing digital identity
3 Digital content creation	3.1 - Developing digital content 3.2 - Integrating and re-elaborating digital content 3.3 - Copyright and licenses 3.4 - Programming
4 Safety	4.1 - Protecting devices 4.2 - Protecting personal data and privacy 4.3 - Protecting health and well-being 4.4 - Protecting the environment
5 Problem-solving	5.1 - Solving technical problems 5.2 - Identifying needs and technological responses 5.3 - Creatively using digital technologies 5.4 - Identifying digital competence gaps

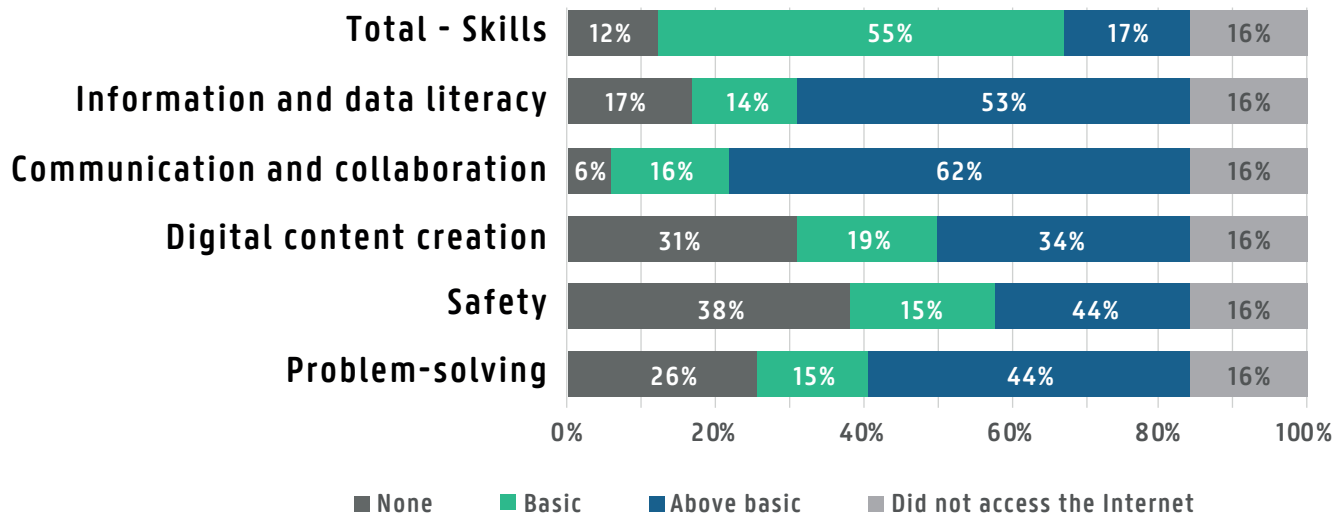
²⁸ Available at: https://joint-research-centre.ec.europa.eu/projects-and-activities/education-and-training/digital-transformation-education/digital-competence-framework-citizens-digcomp_en

/Answers to your questions



The indicators collected in the ICT Households 2024²⁹ survey were reprocessed following the DigComp framework. Below are the results for each area and skill level of the Brazilian population. The overall results on digital skills show that just over half of the population (55%) falls into the basic level, and only 17% are at the above-basic level (Chart 1).

Chart 1 – DIGITAL SKILL LEVELS BY AREA
Total population (%)



²⁹ Data from the ICT Households 2024 survey, by Cetic.br | NIC.br. Available at: <https://www.cetic.br/en/tics/domicilios/2024/individuos/>

/Credits

TEXT

DOMAIN REPORT

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PUBLISHING

Grappa Marketing Editorial

ENGLISH REVISION AND TRANSLATION

Prioridade Consultoria Ltda.: Isabela Ayub, Lorna Simons, Luana Guedes, Luísa Caliri and Maya Bellomo Johnson

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Alexandre F. Barbosa, Graziela Castello, Javiera F. M. Macaya, Rodrigo Brandão, and Mariana Galhardo Oliveira (Cetic.br | NIC.br)

ACKNOWLEDGMENTS

Divina Frau-Meigs (Sorbonne Nouvelle University)

Svein Østtveit (UIS)

Ana Lucia Lima (Conhecimento Social – Estratégia e Gestão)

Riina Vuorikari (Independent expert)

Daniela Costa and Winston Oyadomari (Cetic.br | NIC.br)

ABOUT CETIC.br

The Regional Center for Studies on the Development of the Information Society – Cetic.br (<https://www.cetic.br/en/>), a department of NIC.br, is responsible for producing studies and statistics on the access and use of the Internet in Brazil, disseminating analyzes and periodic information on the Internet development in the country. Cetic.br acts under the auspices of UNESCO.

ABOUT NIC.br

The Brazilian Network Information Center – NIC.br (<http://www.nic.br/about-nic-br/>) is a non-profit civil Entity in charge of operating the .br domain, distributing IP numbers, and registering Autonomous Systems in the country. It conducts initiatives and projects that bring benefits to the Internet infrastructure in Brazil.

ABOUT CGI.br

The Brazilian Internet Steering Committee – CGI.br (<https://cgi.br/about/>), responsible for establishing strategic guidelines related to the use and development of the Internet in Brazil, coordinates and integrates all Internet service initiatives in the country, promoting technical quality, innovation, and dissemination of the services offered.

*The ideas and opinions expressed in the texts of this publication are those of the respective authors and do not necessarily reflect those of NIC.br and CGI.br.



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