NIC.br
Sectoral Studies

ARTIFICIAL INTELLIGENCE IN EDUCATION:

Uses, opportunities, and risks in the Brazilian context

nic.br

Brazilian Network Information Center

Brazilian Network Information Center – NIC.br

NIC.br
Sectoral Studies

ARTIFICIAL INTELLIGENCE IN EDUCATION:

Uses, opportunities, and risks in the Brazilian context

Brazilian Internet Steering Committee – CGI.br
São Paulo 2025

CREDITS OF THE EDITION

EXECUTIVE AND EDITORIAL COORDINATION: Alexandre F. Barbosa (Cetic.br|NIC.br)
TECHNICAL COORDINATION: Graziela Castello, Rodrigo Brandão de Andrade e Silva, Daniela Costa, Javiera F. Medina Macaya, and Fabio Senne (Cetic.br|NIC.br)
FIELD RESEARCH COORDINATION: Priscila Vieira, Monise Picanço, Florbela Ribeiro and Gabriela Trindade (Brazilian Center for Analysis and Planning [Cebrap]), Alexandre Carvalho, Denise Alcântara, Ligia Rubega, and Rosi Rosendo (Ipsos-Ipec)
EDITING SUPPORT TEAM: Mariana Galhardo Oliveira (Cetic.br|NIC.br), Carolina Carvalho, Adriana Brito Goes and Leandro Esmelardi Espindola (Comunicação|NIC.br)
TRANSLATION: Prioridade Consultoria Ltda.: Isabela Ayub, Lorna Simons, Luana Guedes, Luísa Caliri, and Maya Bellomo Johnson
GRAPHIC DESIGN: Pilar Velloso
ILLUSTRATION: Pilar Velloso / Midjourney (v7)
PUBLISHING: Milena Branco

Dados Internacionais de Catalogação na Publicação (CIP)
(Câmara Brasileira do Livro, SP, Brasil)

Artificial intelligence in education [livro eletrônico] : uses, opportunities, and risks in the Brazilian context / organização Núcleo de Informação e Coordenação do Ponto BR ; tradução Prioridade Consultoria Ltda. -- 1. ed. -- São Paulo : Núcleo de Informação e Coordenação do Ponto BR, 2025.
PDF

Título original: Inteligência artificial na educação : usos, oportunidades e riscos no cenário brasileiro
Bibliografia
ISBN 978-65-85417-38-9

1. Educação - Tecnologia 2. Inteligência artificial - Aplicações educacionais 3. Pesquisa 4. Tecnologia da informação e comunicação I. BR, Núcleo de Informação e Coordenação do Ponto. II. Consultoria, Prioridade.

25-324663.3 CDD-371.334

Índices para catálogo sistemático:

1. Inteligência artificial : Educação 371.334
Maria Alice Ferreira - Bibliotecária - CRB-8/7964

Brazilian Internet Steering Committee – CGI.br

COORDINATOR
Renata Vicentini Mielli

CONSELORS
Alexandre Reis Siqueira Freire
Beatriz Costa Barbosa
Bianca Kremer
Cláudio Furtado
Cristiane Vianna Rauen
Cristiano Reis Lobato Flôres
Débora Peres Menezes
Demi Getschko
Henrique Faulhaber Barbosa
Hermano Barros Tercius
José Roberto de Moraes Rêgo Paiva Fernandes Júnior
Lisandro Zambenedetti Granville
Luanna Sant'Anna Roncaratti
Marcelo Fornazin
Marcos Adolfo Ribeiro Ferrari
Nivaldo Cleto
Pedro Helena Pontual Machado
Percival Henriques de Souza Neto
Rafael de Almeida Evangelista
Rodolfo da Silva Avelino

EXECUTIVE SECRETARY
Hartmut Richard Glaser

CONTENTS

ACKNOLEDGEMENTS

The Brazilian Network Information Center (NIC.br), through the Regional Center for Studies on the Development of the Information Society (Cetic.br), thanks all the professionals involved in the preparation of this publication. In particular, we thank Henrique Faulhaber Barbosa (Brazilian Internet Steering Committee [CGI.br]), Flora Ariza (University of São Paulo [USP]), Priscila Vieira, Monise Picanço, Florbela Ribeiro, and Gabriela Trindade (Brazilian Center for Analysis and Planning [Cebrap]), and Diogo Moyses (International Telecommunication Union [ITU]) for their valuable contributions.

PRESENTATION

The trajectory of information and communication technologies (ICT) is marked by their progressive incorporation into social, economic, and cultural life. From the earliest personal computers to the widespread diffusion of the Internet, there is a continuous process of interconnection among people, systems, and data that transforms how we communicate, produce knowledge, and learn. Artificial Intelligence (AI) constitutes, in this sense, a deepening of this technical and social evolution, by substantively redefining the dynamics of interaction.

The rapid adoption of applications that use AI is, above all, an expression of a complex social and technological context, shaped by decades of innovation, intensive data use, and increasing integration between people and digital infrastructures. Open networks, the continuous and consistent advancement of computational capacity, and the availability of large volumes of data have created the conditions necessary for its flourishing. AI-based applications are present in several domains—from health to urban mobility, from public management to education—offering new tools for analysis, content creation, and decision-making. This advance, however, is accompanied by ethical, technical, and social challenges of great complexity, which demand critical reflection and responsible governance.

The growing adoption of AI-based technologies in educational ecosystems has driven significant transformations in teaching, learning, and school management. This novelty in the educational field attracts special interest, as education occupies a central place in the information and knowledge society, benefiting from its advances while also facing some of its greatest challenges. Smart tools can support teachers with administrative tasks, expand access to digital educational resources, and offer more personalized teaching experiences, while assisting students with study, research, and experimentation processes, broadening learning possibilities. At the same time, however, such innovations show us that it is increasingly important to reflect on the need to preserve and strengthen human mediation in these processes, underlining the irreplaceable role of educators and the active participation of students in the construction of critical thinking and knowledge.

More than replacing existing practices, AI expands the possibilities of interaction and collaboration between people and intelligent systems. The focus in this context is to understand how human centrality can be preserved in an educational environment increasingly guided by algorithms and automated processes. Technology must be understood as an instrument to enhance critical thinking, ethical discernment, and creative capacity—dimensions of human experience, whose complexity technologies will hardly be able to fully emulate. The responsibility for guiding this use therefore falls on all the actors involved: educators, managers, researchers, policymakers, and technology developers.

Over the past 20 years, the Brazilian Network Information Center (NIC.br) has played a central role in consolidating an open, secure, and interoperable Internet in Brazil. This trajectory shows that, for technological advancement to be sustainable, it must be anchored in principles of inclusion, transparency, and respect for users' rights, ensuring that digital transformation occurs in an ethical, equitable, and public good-oriented manner. The same principles apply to AI: its adoption must take place in an ethical and responsible way, supported by evidence and guided by values that ensure broad but human-centered use. This publication is situated within this context, produced by the Regional Center for Studies on the Development of the Information Society (Cetic.br), a department of NIC.br that works in the production of statistics and analyses on the presence of digital technologies in Brazilian society, subsidizing the development of evidence-based public policies.

This study proposes a careful examination of the AI phenomenon in Brazilian education, with the aim of understanding its uses, motivations, and potential benefits and risks. More than just measuring the presence of technology, the research seeks to enrich the debate on the integration of AI in the school environment, providing inputs for the formulation and implementation of public policies that promote an inclusive and sustainable digital transformation in the school environment.

This study is another effort by NIC.br, through Cetic.br, to deepen understanding of the directions and trajectories of the advancement of AI technologies in the country. Cetic.br has already conducted similar analyses of AI adoption in the

healthcare and cultural sectors in Brazil, expanding knowledge about how this technology has been incorporated into different domains of social life. In its regular surveys, Cetic.br already produces public statistics, representative of the national reality, that enable to identify the adoption of AI tools by enterprises, government agencies, health care facilities, and educational institutions. In addition, it has begun conducting surveys on the use of AI among the general population and, in particular, among children and adolescents. In a complementary way, NIC.br conducts the Brazilian Artificial Intelligence Observatory (OBIA), a strategic initiative linked to the Brazilian Artificial Intelligence Plan (PBIA) and that acts as a focal point in monitoring and analyzing the impacts and evolution of AI in Brazil, consolidating and disseminating knowledge about its adoption and its effects on society.[1]

Initiatives like these are essential for the country to follow, with autonomy and responsibility, the ongoing digital transformations. The consolidation of an educational ecosystem capable of integrating AI's potential without compromising its core values—equity, criticality, ethics, and citizenship—is one of the great challenges of our time. The collective commitment to the responsible use of AI in education is also a commitment to the future of learning and to the very quality of democracy. It is therefore up to us to ensure that technological innovation continues to serve people and society, contributing to a truly inclusive, sustainable, and humanistic digital transformation.

Enjoy your reading!

Demi Getschko
Brazilian Network Information Center — NIC.br

1 Find out more: https://www.gov.br/lncc/pt-br/assuntos/noticias/ultimas-noticias-1/plano-brasileiro-de-inteligencia-artificial-pbia-2024-2028

PROLOGUE

The arrival of Artificial Intelligence (AI) technologies in the everyday life of Brazilian schools is already an unavoidable reality. Students turn to digital tools to research, produce content, organize studies, and streamline tasks, often without full awareness of how these AI-based systems work. This book aims to understand this concrete use: what AI is already transforming in educational practices, the opportunities it has offered, and the precautions that need to be taken so that its presence effectively contributes to the strengthening of basic education in the country. More than a technological phenomenon, it is a social process that involves values, practices, and public policies.

In recent years, the Regional Center for Studies on the Development of the Information Society (Cetic.br) has expanded its production of knowledge. In addition to the traditional quantitative research that measures the impact of information and communication technologies (ICT) on Brazilian society, Cetic.br has begun conducting sectoral studies and qualitative analyses that explore the social, human, institutional, and cultural dimensions of digital technology usage. This integrated approach reinforces the importance of understanding not only access to technologies, but also the contexts, meanings, and implications of their use. In 2022, this movement was consolidated with a study on AI in culture,[1] which inaugurated a new stage in Cetic.br's research agenda on the social impacts of this technology in Brazil. In 2024, these research efforts gained momentum with the publication of a qualitative study on the potentialities, risks, and perspectives of AI in health care for the country.[2]

Now, with research into the use of AI in education, Cetic.br offers an indispensable look into the future of the sector. This initiative is made possible through coordination with the Brazilian Internet Steering Committee (CGI.br) and the Brazilian Network Information Center (NIC.br), whose work is focused on the public interest and guided by the production

1 Available at: https://www.cetic.br/en/publicacao/inteligencia-artificial-e-cultura-perspectivas-para-a-diversidade-cultural-na-era-digital/

2 Available at: https://www.cetic.br/en/publicacao/inteligencia-artificial-na-saude-potencialidades-riscos-e-perspectivas-para-o-brasil/

of balanced recommendations for the digital ecosystem. The multisectoral model of CGI.br allows the country to produce solid diagnoses, understand social impacts, and propose policies that reinforce the principles established by the Brazilian Civil Rights Framework for the Internet.[3]

The studies and research produced by Cetic.br translate into practice a relevant dimension of CGI.br's mission: to guide the country's digital development based on evidence and respect for citizens' rights, while demonstrating its commitment to the continuous improvement of the Internet infrastructure in Brazil.

The results of this study show that students and teachers currently deal with AI-based tools in diverse and sometimes unequal ways. Although gains are observed in terms of agility and access to information, concerns also emerge about the superficiality of learning, technological dependence, and the reproduction of inequalities in access to education, technology, and the benefits they can provide. In many schools, for example, the presence of AI occurs spontaneously, without clear guidance and pedagogical guidelines. This finding reveals not only the speed of AI's advancement but also the urgency of strengthening the education system's capacity to use it ethically, responsibly, critically, and inclusively.

As a representative of the business sector in CGI.br, attentive to academic views and public policies, I argue that Brazil needs to adopt and develop technologies aligned with shared values: the protection of personal data, respect for the rights of children, the promotion of inclusion and transparency, the appreciation of education professionals, and the encouragement of students' critical thinking. In addition, it is strategic for the country to invest in national development of technological solutions for education, capable of meeting its own needs and reducing external dependence. Thus, technological autonomy must be a constitutive part of a long-term vision for Brazilian education and its digital sovereignty.

AI will not replace teachers or the human relationships that constitute the core of student learning and training. On the

3 Find out more: https://cgi.br/pagina/marco-civil-law-of-the-internet-in-brazil/180

contrary, it can be a powerful ally in expanding opportunities, improving processes, and democratizing access to educational resources. The challenge is to transform this potential into a collective benefit, which requires ethical choices, consistent public policies, and social commitment. May this study, therefore, serve as an invitation to reflection and action, so that AI, in all its forms, is always at the service of learning, equity, and the future of new generations.

Henrique Faulhaber
Board member, representative
of the corporate sector at CGI.br

CHAPTER 1

General introduction to the study and methodological notes

Graziela Castello[1] and Rodrigo Brandão[2]

1 A social scientist, she is the coordinator of Qualitative Methods and Sectoral Studies at the Regional Center for Studies on the Development of the Information Society (Cetic.br), a department of the Brazilian Network Information Center (NIC.br).

2 He holds a PhD in Sociology from the University of São Paulo (USP) and is a researcher under the Coordination of Qualitative Methods and Sectoral Studies at Cetic.br|NIC.br.

The emergence of Artificial Intelligence (AI) as a technological phenomenon of global reach has rapidly transformed debates in various social sectors, including education. Although digital technologies have been present in the Brazilian school environment since the end of the 20th century, with the spread of computers, the Internet, and learning platforms, the introduction of AI-based applications has brought new elements that go beyond the mere digitization of resources.

Generative AI, in particular, has inaugurated a new stage in the relationship between students, teachers, and knowledge. Tools such as ChatGPT, Gemini, and Copilot are capable of producing texts, solving exercises, creating images, and offering answers in natural language, based on simple commands. The impact of these technologies goes beyond expanding access to information: It is a qualitative change in the way knowledge mediation is conceived, with profound implications for the teaching-learning processes and civic education. For this reason, it is urgent to understand why AI is used in these processes ("Why AI?"), for what specific purposes and tasks the technology is mobilized ("AI: What for?"), and how it is actually used ("AI: How?"). The main objective of this study is to offer initial answers to these three questions, using basic education in Brazil as a reference.

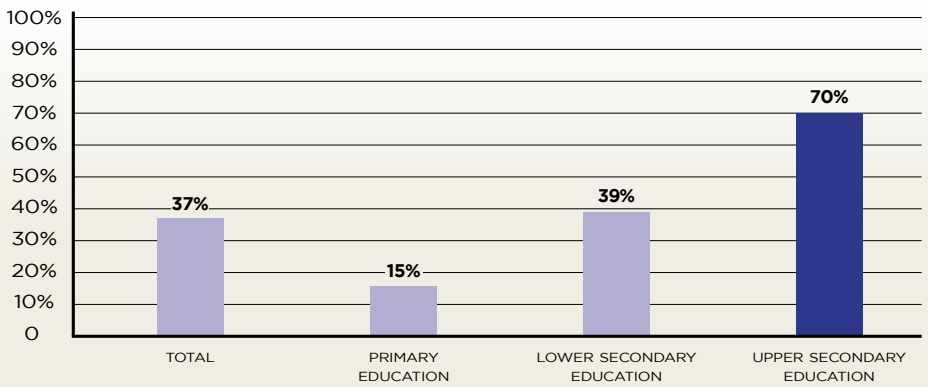
PRESENCE OF AI IN EDUCATION IN BRAZIL

The relevance of this research stems not only from the potential impact of AI on teaching and learning processes but also from the strong presence of this technology in the Brazilian educational context, which expands both its possibilities and risks. This presence is evidenced by the results of the ICT in Education 2024 survey (NIC.br, 2025), which revealed the significant use of AI applications by teachers and students throughout the country. Among elementary and secondary school students who are Internet users more than a third (37%) stated they had used AI tools in research and school-related activities (Chart 1). This use was already particularly widespread among upper secondary education students—70% (approximately 5.2 million

students) reported using generative AI tools for research and school-related activities. Among students in lower secondary education, the percentage was approximately 40%, while among students in primary education, it reached 15%.

CHART 1 - STUDENTS WHO USED AI TOOLS IN SCHOOL-RELATED ACTIVITIES AND RESEARCH

Total number of students who are Internet users in Brazil (%)

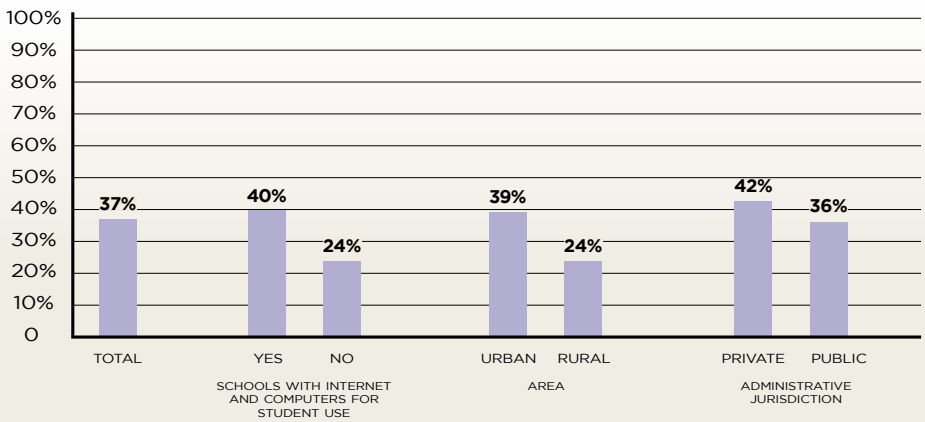


SOURCE: NIC.BR (2025).

Chart 2 indicates, in turn, that the use of AI tools for educational purposes was more frequent among students in schools with Internet and computers for student use, those in urban areas, and those in the private schools.

CHART 2 - STUDENTS WHO USED AI TOOLS IN SCHOOL-RELATED ACTIVITIES AND RESEARCH

Total number of students who are Internet users in Brazil (%)

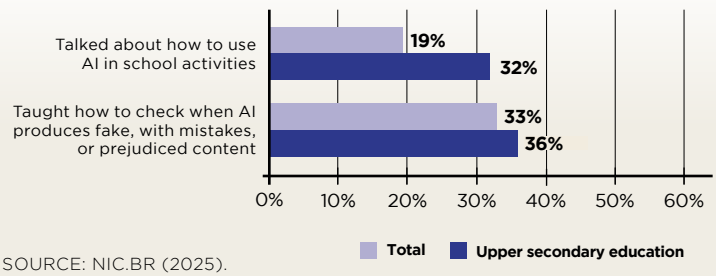


SOURCE: NIC.BR (2025).

Chart 3 shows that students' uses of AI still occurred with little teacher mediation: among students who used the Internet, only 19% said they had talked to their teachers about how to use AI in school activities, and just over a third (33%) reported that they had received guidance on how to identify when AI produces false, incorrect, or biased content. Even in upper secondary education, where its use was more widespread than in primary and lower secondary education, these percentages remained modest: 32% and 36%, respectively.

CHART 3 - STUDENTS WHO RECEIVED GUIDANCE FROM TEACHERS ON THE USE OF AI, BY TYPE OF GUIDANCE

Total number of students who are Internet users in Brazil (%)

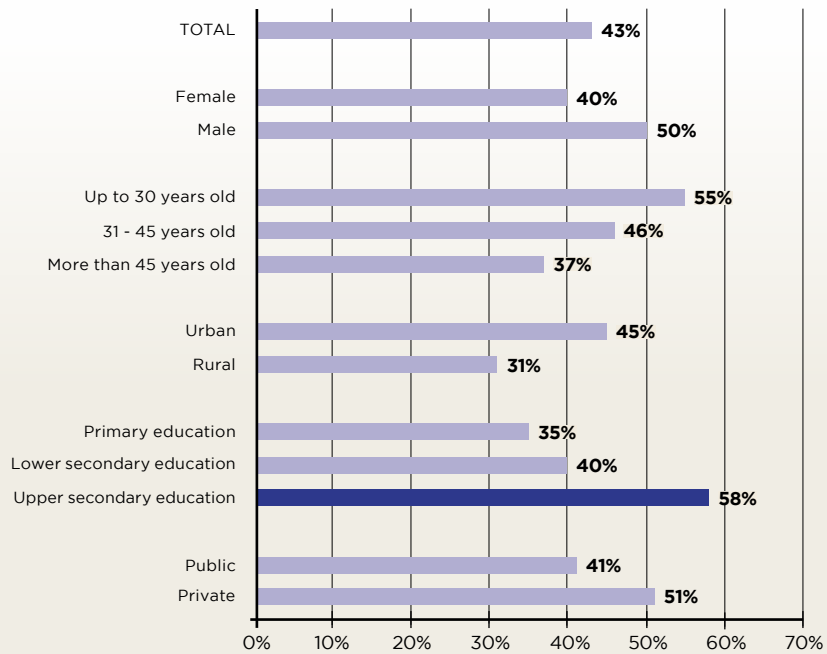


SOURCE: NIC.BR (2025).

Data from ICT in Education 2024 (NIC.br, 2025) also showed that the use of AI was already present among teachers (Chart 4): 43% of elementary and upper secondary education teachers resorted to technology in the 12 months prior to the survey for the preparation of teaching materials, which corresponds to approximately 1 million teachers nationwide. This use was more frequent among upper secondary education teachers, younger teachers (up to 30 years old), male teachers, those working in the private network, and those in urban areas.

CHART 4 - TEACHERS BY USE OF GENERATIVE AI IN THE PREPARATION OF TEACHING MATERIALS

Total number of teachers in primary and secondary education schools in Brazil (%)



SOURCE: NIC.BR (2025).

Taken together, the data suggests that the incorporation of AI into Brazilian education, besides already being quite pronounced—considering the novelty of this technology—occurs unequally and asymmetrically (Charts 2, 3, and 4).

Access to the tools and their pedagogical appropriation are already associated with some important markers—such as technological infrastructure, geographic location, and administrative jurisdiction—as well as with sociodemographic variables, including the teachers' age and gender. At the same time, the observed incipient teachers' pedagogical mediation (in relation to how students already use this technology) suggests that the expansion of the use of AI in Brazilian schools may not necessarily translate into educational practices guided by criteria of ethics, responsibility, and criticality, if actions and policies in this direction are not encouraged.

Thus, Brazil is keeping pace with the global transformation driven by AI, but within a context permeated by historical inequalities, in which regional diversity, disparities between public and private schools, and gaps in teacher training shape how technology is appropriated in daily school life, especially during this initial phase of adopting this type of technology. The continuation of this narrative does not need to follow this path; therefore, it is necessary to identify and qualify how these dynamics operate in order to establish policies and actions that reduce (rather than amplify) these asymmetries.

As can be seen, the dissemination of AI in Brazilian education constitutes a multifaceted phenomenon that demands investigations capable of clarifying not only the opportunities that technology can offer the country, but also the barriers, risks, and potential negative impacts associated with its adoption by teachers and students. The rapid spread of the use of these tools, as evidenced by the indicators presented, signals the importance of investigating, beyond the incidence of use, how these tools have been used, what the purposes are, and the different levels of knowledge of educational users about the tools, their potential, and their risks.

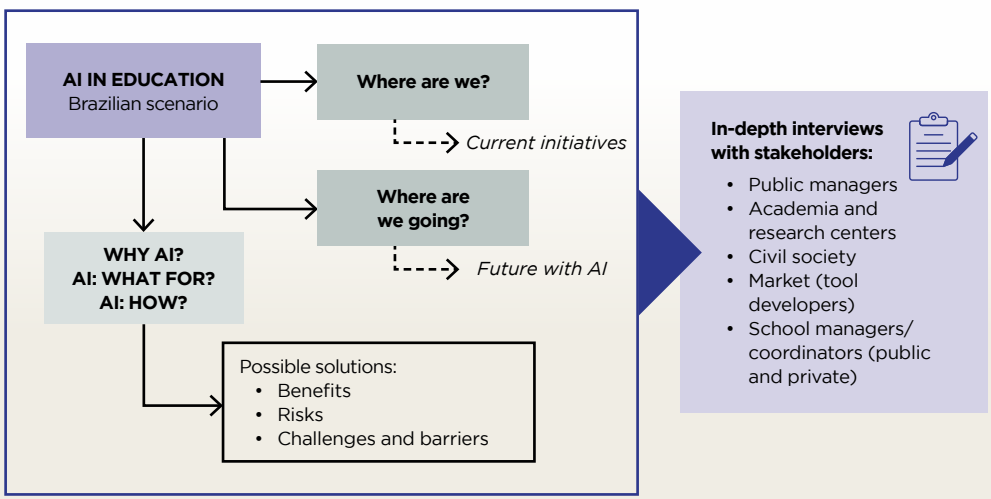
The study presented in this publication, whose results are developed in the following chapters, proposes to contribute in this direction, based on two qualitative research approaches, presented below in the "Methodological Notes" section.

METHODOLOGICAL NOTES

In the following chapters of this publication, the results of an original qualitative study conducted in 2025 and structured into two simultaneous research approaches will be presented. These approaches aimed to substantively explore the uses, opportunities, and risks of AI in education within the Brazilian context.

The first approach sought to understand the Brazilian scenario for the development and use of AI technologies in Brazilian education, attempting to understand the current stage ("Where are we?") and gathering input on the directions the country should take in this field ("Where are we going?"), identifying the risks, opportunities, and potential barriers to the development of this agenda in Brazil (Figure 1). To this end, in-depth interviews were conducted with strategic actors in education from different segments with strong influence on this debate, as detailed below. The results of this study are presented in Chapter 3 ("Benefits, risks and purposes of using Artificial Intelligence in education: The Brazilian scenario") of this publication.

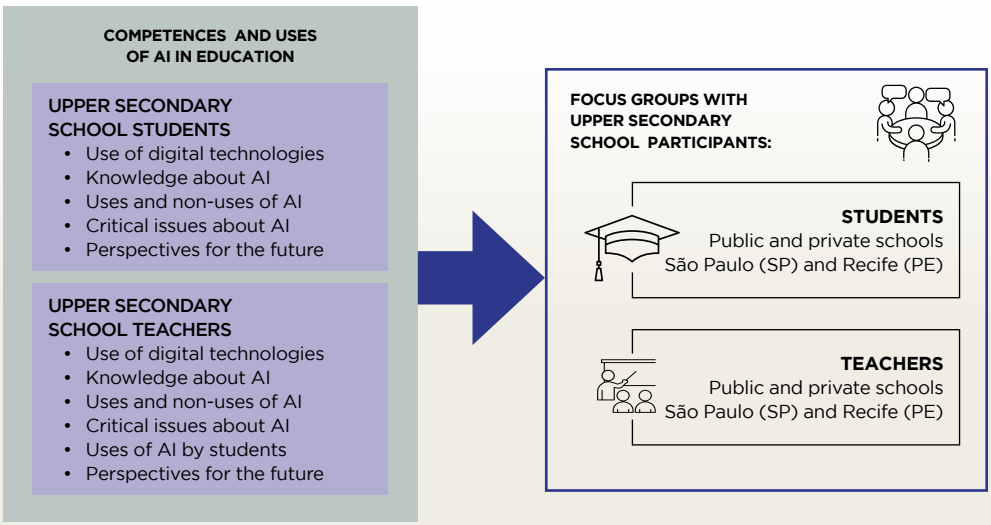
FIGURE 1 – INVESTIGATION FRONT: AI IN EDUCATION AND THE BRAZILIAN SCENARIO



SOURCE: PREPARED BY THE AUTHORS.

The second front of investigation, in turn, focused on identifying the skills and uses already implemented by upper secondary education students and teachers in Brazil (Figure 2). To this end, the uses and non-uses were examined, as well as these actors' knowledge about these tools and how they function, the ways in which they perceive the opportunities, challenges, and risks associated with the use of AI in education, and their expectations for the future. In this case, focus groups were conducted with upper secondary education students and teachers in public and private schools in two Brazilian capitals. The methodological procedures are detailed below. The results of this study are presented in Chapter 4 ("Competences and uses of Artificial Intelligence in education: A qualitative study with upper secondary education students and teachers in Brazil") of this publication.

FIGURE 2 – RESEARCH FRONT: AI IN EDUCATION, SKILLS, AND USES IN BRAZIL



SOURCE: PREPARED BY THE AUTHORS.

The following two subsections detail the specific objectives and methodology employed in each of the research areas developed. At the end of this detailed description, the last section provides a general overview of the upcoming chapters in this publication.

AI IN EDUCATION: THE BRAZILIAN SCENARIO

To map the current stage of AI use in the field of education in Brazil and the paths the country has taken in this area, a qualitative exploratory approach was adopted, based on conducting in-depth interviews with strategic actors (stakeholders) in the field of education, in sectors such as academia, public management, the market, civil society, and school management. In this context, the selection of respondents focused exclusively on individuals with practical experience and active involvement in AI in education.

Seeking to ensure the relevance and representativeness of the group, the following criteria were established for the selection of participants: (a) diversify the segments represented in the field of education; (b) include individuals who hold leadership and/or management positions in the organization where they work or who have a recognized expertise in the area; (c) include individuals with strong engagement in the AI in education agenda, considering their presence in public debate, scientific production, participation in related events, and media exposure associated with the topic.

Based on these criteria, a mapping of potential respondents was carried out through the analysis of publicly available content, scientific production, presence at events, and media exposure on the topic, active searching in forums and institutional websites, as well as recommendations from publicly recognized actors. This mapping resulted in an initial list of names of possible respondents, from which participants were recruited to ensure a minimum number of respondents per represented segment, with the allocation of at least five interviews per segment. In each segment, the selection of respondents also prioritized organizational diversity; individuals from the same institution were not selected. In the end, a total of 27 interviews were conducted. The distribution of interviews among the different segments is detailed in Table 1.

TABLE 1 - DESCRIPTION OF SEGMENTS AND TOTAL NUMBER OF INTERVIEWS

SEGMENTS	DESCRIPTION	TOTAL NUMBER OF INTERVIEWS
ACADEMIA	Universities, research centers, think tanks, and reference centers	6
PUBLIC MANAGEMENT	Ministries, government secretariats, and agencies	5
MARKET	Developers of AI solutions in education, including Edtechs and companies of all sizes	5
SCHOOL MANAGEMENT	Directors of studies, principals, and managers of public and private schools	6
CIVIL SOCIETY	Non-governmental organizations (NGO), associations, and foundations in education	5
GRAND TOTAL		**27**

SOURCE: PREPARED BY THE AUTHORS.

The fieldwork for this study took place between June and August 2025. The interviews lasted approximately one hour and were conducted remotely via pre-scheduled video calls with the recruited stakeholders. Participation was voluntary, without payment or any type of material incentive. Before the interviews, all participants signed an "Informed Consent Form" detailing the nature and objectives of the study, as well as the use and processing of the collected data, in accordance with the Brazilian General Data Protection Law (LGPD) (Law No. 13.709/2018).

For conducting the in-depth interviews, a semi-structured script was developed, divided into three sections. In the first section, broader questions on the topic were presented, seeking to explore the interviewee's impressions regarding the benefits and risks of AI in the educational context, their opinion on encouraging the use of these technologies, possible variations between countries, challenges and barriers to adoption in Brazil, factors that favor this adoption, and differences between public and private education scenarios. The second section sought to gather information on the current state of AI in education in Brazil, questioning projects developed in the interviewee's organization, initiatives evaluated positively and negatively, concrete cases of use in schools, actions that promote or restrict AI, the level of preparedness of teachers

and students to use these technologies, and an assessment of the current stage of the technology in the country. Finally, in the third section, questions were asked about future trends, inviting respondents to critically reflect on the type of AI that society needs in education, its characteristics, functions, origins, and the beneficiaries of this technology.

After conducting in-depth interviews and transcribing the recordings, the qualitative data collected in the fieldwork were coded to systematize and analyze the results. This process involved systematically categorizing the transcripts to identify relevant patterns and themes in the interviews. The construction of a coding plan, which used the questions from the script as a thematic guide, directed the analysis carried out with the support of Atlas.ti software, which allowed the selection of specific excerpts from the texts for the assignment of codes according to the identified themes. Finally, a database was generated from the coded excerpts to support the analysis of this study's results.

AI IN EDUCATION: SKILLS AND USES IN BRAZIL

To identify how upper secondary education students and teachers in Brazil use AI tools in education, which skills they mobilize for this purpose, how they perceive the associated opportunities, challenges, and risks, as well as their expectations for the future, focus groups were conducted with both audiences.

The focus group is a research technique that enables the exploration of collective perceptions, while fostering the exchange of experiences and the construction of shared meanings among participants. For this reason, when the objective is to identify common perceptions among individuals with the same profile, it is common to form homogeneous groups, so that the variation in individual profiles is more pronounced between groups than within them.

It is important to note, however, that this methodology does not allow for the generalization of the results obtained: The convergent opinions among the members of a focus group cannot be indiscriminately attributed to all individuals with a profile similar to that of the participants. Even so, conducting focus groups allows for the recognition of perception patterns,

the mapping of recurring arguments, and the identification of nuances of meaning that would hardly emerge in individual data collection methods, thus offering a denser and more contextualized understanding of the representations on the investigated topic.

To meet the study's objectives, in total, eight focus groups were conducted: Four with upper secondary education students and four with upper secondary education teachers. The study focused only on this educational level in the case of students, with the expectation that, at this level, they would be better able, compared to elementary and lower secondary education students, to elaborate on their uses of AI and problematize the different issues raised by the research in the focus group format. Based on this choice, the design of the focus groups with students was mirrored for the focus groups with teachers, including to allow better articulation of the observed results for these two profiles, since they represent perspectives within the same school environment.

Furthermore, aiming for some regional diversity of repertoires, groups were conducted in two capital cities, Recife and São Paulo, which are located in the federative regions with the largest population contingents in the country (Northeast and Southeast), with the caveat that it is understood that Brazil, as a whole, is not exclusively representative of these cities, nor of the regions to which they belong. It is also important to note that choosing two capital cities imposes several restrictions, such as not representing the reality of rural areas; however, this delimitation was necessary to operationalize the study within the available time and costs.

Furthermore, the groups were also separated by public or private school networks. Each group, in each city, was always composed of students or teachers from public or private schools, to guarantee the homogeneity of the participants' profile in each group in this respect. Each group had eight to nine participants. Tables 2 and 3 detail the design of the eight focus groups conducted.

TABLE 2 - DESIGN OF THE FOCUS GROUPS CONDUCTED WITH UPPER SECONDARY EDUCATION STUDENTS

	FOCUS GROUPS	TYPE OF SCHOOL	LOCATION
STUDENTS UPPER SECONDARY SCHOOL	1	Public school	São Paulo – SP
	2	Private school	São Paulo – SP
	3	Public school	Recife – PE
	4	Private school	Recife – PE

SOURCE: PREPARED BY THE AUTHORS.

TABLE 3 - DESIGN OF THE FOCUS GROUPS CONDUCTED WITH UPPER SECONDARY EDUCATION TEACHERS

	FOCUS GROUPS	TYPE OF SCHOOL	LOCATION
TEACHERS UPPER SECONDARY EDUCATION	1	Public school	São Paulo – SP
	2	Private school	São Paulo – SP
	3	Public school	Recife – PE
	4	Private school	Recife – PE

SOURCE: PREPARED BY THE AUTHORS.

In recruiting participants for the eight focus groups, we sought to ensure gender parity; specifically, in the selection of teachers, we sought to recruit professionals from different disciplines. It is worth noting that the recruitment of students or teachers from the same school in the same group was not permitted, nor were students and teachers from technical secondary education or federal institutes included: Only students and teachers from regular upper secondary education were considered.

The focus groups were conducted in person between May and June 2025 and lasted an average of 100 minutes. All focus groups were recorded, transcribed, and the data anonymized, ensuring the confidentiality of the participants' identities. Subsequently, the transcripts were coded using Atlas.ti software, based on a coding plan that used the script of questions asked as a thematic guide for the analysis.

The semi-structured script, developed for conducting the students' focus groups, was divided into five sections. The first one, a warm-up, addressed the use of digital technologies, with questions that encouraged students to share their experiences

and perceptions about the use of these technologies in their daily lives and in the school environment. The second sought to gather information on students' levels of knowledge about AI, as well as their perceptions, experiences, and learning expectations regarding the subject. In the third, the questions focused on the effective use of AI tools by students, exploring practical experiences, motivations, perceptions of usefulness and difficulties, as well as ethical dilemmas, in both daily life and the school context. The fourth addressed critical issues related to AI, including questions about how the tools work, the reliability of the answers, risks, data protection, biases, and students' perceptions of the importance of including these topics in the school curriculum. Finally, the fifth addressed the students' views regarding the impact of AI on their personal lives and future professional trajectories, as well as on the educational environment.

In contrast, the focus groups with teachers were conducted using a different script, also semi-structured, but divided into six sections. The first addressed the uses of digital technologies in teachers' personal lives and teaching practices. The second explored the level of knowledge and perceptions of teachers about AI. In the third, the questions dealt with teachers' experiences, considering the uses of AI tools, motivations for use or non-use, observed benefits, and difficulties encountered. The fourth addressed teachers' perceptions of students' use of AI, including pedagogical opportunities and challenges. In the fifth, critical themes related to AI were explored, such as the role of schools in fostering students' critical education and the need for teacher training on the subject. Finally, the sixth explored teachers' future perspectives on the impact of AI on education and teaching practice.

It should be noted that the scripts used in the focus groups were constructed based on the documents *AI competency framework for teachers* (Miao & Curukova, 2024) and *AI competency framework for students* (Miao et al., 2024), with particular attention to the latter. The first document starts with the diagnosis that

> AI has transformed the traditional teacher–student relationship into a teacher–AI–student dynamic.

> This shift requires a re-examination of teachers' roles and the competencies they need in the AI era. Yet, few countries have defined these competencies or developed national programmes to train teachers in AI, leaving many educators without proper guidance. The *AI competency framework for teachers* addresses this gap by defining the knowledge, skills, and values teachers must master in the age of AI (Miao & Curukova, 2024, p. 3).

The document *AI competency framework for students*, in turn, is based on the understanding that "integrating AI learning objectives into official school curricula is crucial for students globally to engage safely and meaningfully with AI" (Miao et al., 2024, p. 3). In order to assist educators in this integration, the document outlines "12 competencies across four dimensions: Human-centred mindset, Ethics of AI, AI techniques and applications, and AI system design" (Miao et al., 2024, p. 3). These competencies encompass three levels of progression: understanding, applying, and creating. Thus, the framework details the curricular objectives and specific pedagogical methodologies of the area (Miao et al., 2024) (Table 4). The scripts used in the focus groups were mainly based on the "understanding" level.

TABLE 4 - FRAMEWORK FOR AI COMPETENCIES FOR STUDENTS

COMPETENCY ASPECTS	PROGRESSION LEVELS		
	UNDERSTAND	APPLY	CREATE
HUMAN-CENTERED MINDSET	Human agency	Human accountability	Citizenship in the era of AI
ETHICS OF AI	Embodied ethics	Safe and responsible use	Ethics by design
AI TECHNIQUES AND APPLICATIONS	AI foundations	Application skills	Creating AI tools
AI SYSTEM DESIGN	Problem scoping	Architecture design	Iteration and feedback loops

SOURCE: MIAO ET AL. (2024).

PUBLICATION OVERVIEW

This publication is structured in five main chapters, in addition to this one, which presents a general introduction to the study and methodological notes (Chapter 1).

Chapter 2 ("Artificial Intelligence and education: History, fundamental concepts, and literature review on uses") presents a review of recent literature on the subject and reveals a rapidly expanding and still consolidating field. Recent literature (2020-2025) indicates that, despite promises of efficiency and innovation, there are significant gaps between the proposed uses of AI and the educational challenges they intend to address. The most critical debate warns of ethical and pedagogical risks, such as the possible reinforcement of inequalities, the incorporation of cultural biases, and the reduction of teacher agency, in addition to arguing that the integration of AI into education should be guided by educational purposes and not just by logics of technological efficiency or market forces. The body of studies reviewed reinforces that the responsible use of AI in education depends on intentionality and transparency, ongoing training for teachers and administrators, as well as data governance that ensures respect for students' rights and the specificities of school contexts.

Chapter 3 ("Benefits, risks, and purposes of using Artificial Intelligence in education: The Brazilian scenario") presents the results of in-depth interviews conducted with representatives from academia, the public sector, the market, school management, and civil society. The perceptions of the respondents converge around an understanding of AI as a support tool (and not a replacement), capable of improving learning, personalizing teaching, and optimizing teaching and administrative tasks. Although the technology is seen as inevitable and urgent, its adoption requires ethical planning, consistent teacher training, and adequate infrastructure. Among the potential benefits mentioned are: reducing teacher workload, using data for educational management, and increasing student inclusion and engagement.

On the other hand, concerns about algorithmic biases, ethical risks, data security, and loss of pedagogical autonomy appear recurrently, indicating that benefits and risks go hand in hand. The study shows that Brazil is still in the initial stages

of implementing AI in education, with isolated experiences and significant structural gaps, especially in infrastructure, teacher training, and regulation.

Chapter 4 ("Competences and uses of Artificial Intelligence in education: A qualitative study with upper secondary education students and teachers in Brazil"), dedicated to the analysis of the focus groups conducted, presents the perspective of upper secondary school teachers and students on the daily use of AI in educational activities (inside and outside of school). The results show that technology is already present in the school routine, albeit in a fragmented way, accompanied by enthusiasm, insecurity, and a lack of institutional preparedness. The perceptions reveal generational asymmetries and different ways of appropriating technology. Teachers tend to associate AI with risks of dependency and the widening of inequalities between schools, advocating for its ethical, planned, and pedagogically mediated use, while students express enthusiasm about the possibility of more agile and personalized learning, despite fearing the effects of automation on the labor market and the future of professions. In common, both groups recognize that the central challenge lies not only in making tools available, but also in building spaces for training and critical reflection that give pedagogical meaning to the use of AI and bring technological innovation and educational practice closer together.

Finally, the Final Considerations ("Artificial Intelligence and education: Possible pathways for public policy") chapter revisits the evidence presented throughout the work and highlights the main points of attention for the formulation of policies and actions in the country that enable the ethical, equitable, and pedagogical development and incorporation of AI in Brazilian education.

REFERENCES

Brazilian General Data Protection Law - LGPD. Law No. 13.709, of August 14, 2018. (2018). Provides for the processing of personal data, including in digital media, by natural persons or legal entities under public or private law, with the objective of protecting the fundamental rights of freedom and privacy and the free development of the personality of the natural person. https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/lei/l13709.htm

Brazilian Network Information Center. (2025). *Survey on the use of information and communication technologies in Brazilian schools - ICT in Education 2024* [Microdata]. https://cetic.br/en/pesquisa/educacao/microdados/

Miao, F., & Curukova, M. (2024). *AI competency framework for teachers*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000391104

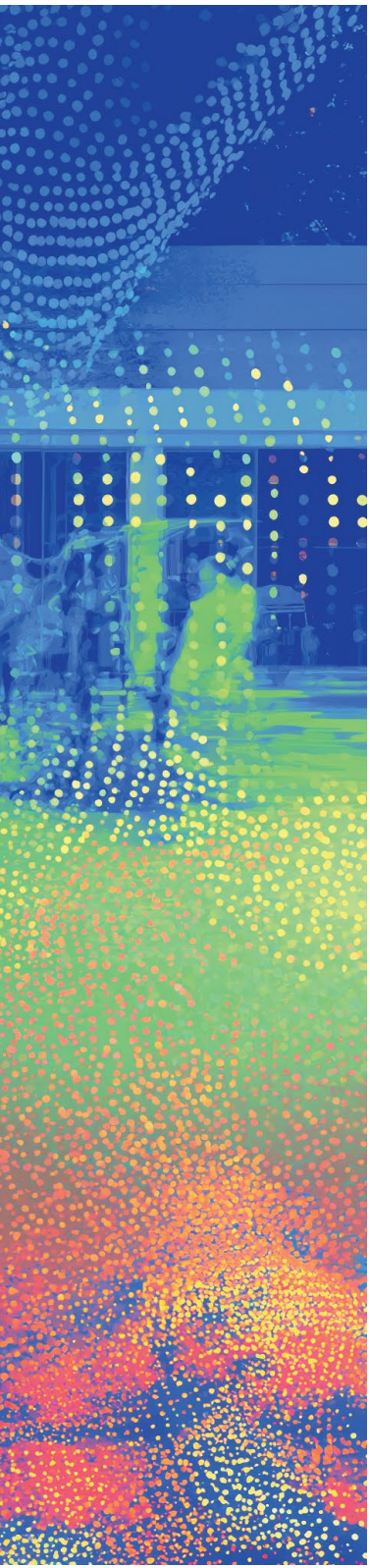
Miao, F., Shiohira, K., & Lao, N. (2024). *AI competency framework for students*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000391105

CHAPTER 2

Artificial Intelligence and education: History, fundamental concepts, and literature review on uses

Flora Ariza[1]

1 PhD candidate in Sociology at the School of Philosophy, Languages, and Human Sciences (FFLCH) of the University of São Paulo (USP). Researcher at Deseduca – Empirical Research on Education and Social Inequalities. Associate researcher in the Understanding Artificial Intelligence (UAI) network at the Institute for Advanced Studies (IEA) of USP. Professor and consultant.



INTRODUCTION

Digital technologies whose architecture corresponds to what has been conventionally called Artificial Intelligence (AI) have established themselves as a prevalent theme in the most diverse sectors of society and occupy a growing space in public debate, corporate investments, and agendas for academic research and public policymaking. In the educational field, a similar movement is observed: The integration of AI into formal schooling processes has joined a broad range of debates, demands, and practices relevant to educational systems and stakeholders.

Although the use of AI in educational processes is not new (as presented in the first part of this text), it received renewed attention from the 2010s onward, as AI development gained traction due to computing development and the availability of large volumes of data originating from individuals' digital activities on the Internet. Thus, the integration of AI into the educational universe began to be addressed by governments and multilateral organizations as a strategic theme for the future of education. In May 2019, for example, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), in partnership with the Chinese government, organized the International Conference on Artificial Intelligence and Education, held in Beijing, which gave rise to the Beijing Consensus on Artificial Intelligence and Education. The document connects Sustainable Development Goal (SDG) 4 (Quality Education)[2] to a series of recommendations for actions aimed at integrating, evaluating, and monitoring the use of AI in education, in a way that is aligned with the educational and legal contexts of each country, seeking to balance educational benefits and promote equity and respect for ethical principles (UNESCO, 2019b).

Furthermore, two recent global events have contributed to AI's presence in education becoming an unavoidable topic. First, the COVID-19 pandemic, which began in 2020, forced educational systems to modify their traditional activities and

2 Find out more: https://sdgs.un.org/goals/goal4

turn to digital technologies, which were often the only way to maintain students' connection to their school routines. This scenario created room for educators and schools to rethink the role and place of educational technologies in school routines, which continued even after the pandemic ended. Subsequently, the popularization of products such as ChatGPT, a Large Language Model (LLM)[3] developed by OpenAI and commercially launched in the second half of 2022, enabled access to generative AI for ordinary citizens, including students and teachers. Since then, we have witnessed an intensified debate on the interaction of AI with various dimensions, such as the quality of teaching and learning processes, access to educational opportunities, improving student academic performance, school retention, school management systems, curriculum development, among others.

In a context of information profusion and new technological trends, it is crucial to understand the role AI technologies can play in the real-world dilemmas faced by educational systems. Thus, the objective of this chapter is to highlight the main uses of AI in education today, aiming to answer three questions: (a) "AI: What for?," what are the concrete possibilities for using AI in different educational settings?; (b) "Why AI?," how can AI technologies contribute to addressing the real problems and challenges facing contemporary education?; (c) "AI: How?," what are the necessary conditions for the use of AI to be fruitful, and what are the risks associated with its use in education? To this end, we reviewed recent studies (between 2020 and 2025) that address practical implementation scenarios for AI technologies applied to basic education.

In the section "A brief history of the relationship between AI and education," we address the connection between these two fields since the inception of AI research and how the development of AI paradigms relates to the types of technologies currently used in education. Next, in the section "AI in education: Fundamental concepts and overview of uses," we present a summary of the conceptual and educational premises that underpin AI technologies applied to education,

3 LLM are AI systems trained on large volumes of data, designed to recognize language patterns and generate outputs in these languages, such as texts, audio, video, and images.

in addition to reviewing several studies that analyze the uses of these applications in basic education, focusing on three main users: students, teachers, and institutions. The content presented in these studies is discussed in the section "Discussion: AI for what purpose, why, and how," which also highlights aspects of critical approaches to the use of AI in education, highlighting the main points of attention for the widespread implementation of these technologies. Finally, in the "Conclusion," we take stock of the aspects discussed throughout the text.

A BRIEF HISTORY OF THE RELATIONSHIP BETWEEN AI AND EDUCATION

When we discuss "AI and Education," we bring together two terms that can encompass multiple meanings and imply different spheres of social experience. The term "Artificial Intelligence" can describe a field of science that connects distinct areas of knowledge, such as computing, logic, and cognitive science; it can also refer to the development of technologies applicable in various economic sectors. Within this context, different architectures and techniques can be grouped under the term "AI." Indeed, the specialized literature presents varied definitions and maintains that there is no single definition accepted by all experts (Holmes & Tuomi, 2022). Something similar occurs when we discuss the term "education": It can refer to everything from the cognitive processes an individual develops when learning something new to broader social institutions, involving the organization of educational systems, with distinct curricular offerings and a myriad of actors occupying different positions and roles within these institutions.

Holmes and Tuomi (2022) argue that, although the term "AI" is widely used in the educational field—especially in the marketing of educational products and solutions—there is considerable ambiguity about what it actually means and how it operates in educational applications and technologies. The research suggests clarifying the uses of AI in education based on two central paradigms: symbolic AI (knowledge-based) and connectionist AI (data-based). Following this approach, this section revisits some key aspects of the history of the

relationship between AI and education, seeking to clarify how these AI paradigms relate to education, presenting concepts addressed in the context of this literature review.

Many authors point to two events as foundational historical milestones in the field of AI studies. The first is the publication of the article *Computing Machinery and Intelligence* in 1950, in which Alan Turing pioneered the idea that there are strong analogies between the human brain and the functioning of computers, raising the provocative question of machines' capacity for think (Mitchell, 2019). The second event was the workshop Dartmouth Summer Research Project on Artificial Intelligence in 1956 at Dartmouth College (United States [US]). However, as Doroudi (2023) points out, there is an often-overlooked aspect in narratives about the origins of AI: Some of the main organizers and attendees of this event were researchers in psychology and cognitive science, such as Herbert Simon, Allen Newell, and Marvin Minsky, and they were deeply committed to understanding and improving human learning processes. For Doroudi, the engagement of these pioneering scientists with the educational implications of cognitive science justifies us in thinking of education, not just as another area of application of AI, but rather as a field intrinsically connected to its development (Doroudi, 2023).

In its early days as a scientific field, the dominant paradigm was symbolic AI, an approach based on the idea that intelligence can be modeled through the manipulation of symbols and formal rules. As Mitchell (2019) explains, proponents of this conceptualization relied on the paradigm of classical cognitive science, which conceives of thought as a type of computation based on symbols. From this perspective, human intelligence is considered to be a system that mobilizes internal representations through logical rules to solve problems. These researchers hypothesized that this process could be modeled by computer programs that did the same: process symbols and rules, making inferences and solving problems through explicit representations of knowledge.

One of the main applications of this approach was in expert systems, where the knowledge of human experts was encoded in the form of heuristic rules, i.e., practical rules that guide decisions or actions. Holmes and Tuomi (2022) refer to these as "knowledge-based systems" because the computer acts

not merely as a calculating machine but rather as a system capable of using inference mechanisms to apply rules and make decisions in specific domains of knowledge. This process simulates the decision-making or problem-solving of an expert in the field; in this logic, the intelligence of symbolic AI lies in the conceptual structures extracted from human experts. Therefore, the system's operation depends less on calculation algorithms and more on inference mechanisms that select, among the stored rules, those that should be applied in each situation. The focus, therefore, is on the representation and symbolic manipulation of information, often organized in structures such as ontologies, decision trees, semantic graphs, or concept networks (Holmes & Tuomi, 2022; Mitchell, 2019).

The work of pioneers Herbert Simon and Allen Newell (1971, as cited in Doroudi, 2023) developed within this AI and cognitive science paradigm and provided the theoretical foundations for the creation of the first intelligent tutors and adaptive instructional technologies. Even before the Dartmouth workshop, they had developed a system called "Logic Theorist," capable of proving logical theorems by manipulating symbolic structures, and for decades, they continued collaborating on the topic of problem-solving through information processing. According to Doroudi (2023), in 1966, Simon coined the term "learning engineering," anticipating contemporary approaches based on instructional design and the use of data to improve educational practices. As for Newell, in 1967, he and his student James Moore worked on the development of Merlin, an intelligent tutoring system (ITS), a computer system that simulates the behavior of a human tutor, focused on providing personalized, automated, and user-tailored instruction (Holmes & Tuomi, 2022). Although Merlin was not successful in its practical implementation, the innovative efforts of Simon, Newell, and Moore left an important conceptual legacy for the cognitive tutors that would later be developed.

Marvin Minsky and Seymour Papert were also key figures in the development of AI applications in education. Minsky was one of the organizers of the 1956 Dartmouth workshop, and Papert joined forces with him in 1964 at the Massachusetts Institute of Technology (MIT), where they founded the MIT AI

Lab. Before turning his career to AI research, Papert had spent years studying with Jean Piaget, a psychologist and biologist who studied children's learning and founded psychogenetic theory and constructivism as a pedagogical approach. According to Doroudi (2023), although Minsky and Papert also located themselves in the symbolic AI paradigm, their approach to the relationship between cognitive processes and computation differered significantly from the one adopted by Simon and Newell: While the latter placed greater emphasis on the performance aspect of problem-solving, which should reach the expert levels, Minsky and Papert were more interested in the developmental processes of learning, influenced by the knowledge about children's cognition and thinking that Papert brought as baggage from his period of studies with Piaget.

Unlike Simon and Newell, who sought a unified and general model of how the mind works, Minsky and Papert understood it as a complex interaction of smaller structures. Driven by an interest in understanding how the process of combining these elements took place, and equipped with this perspective on human cognition, Papert researched and developed educational environments based on the idea of "microworlds," which he had developed with Minsky as part of his AI research (Doroudi, 2023). Famously, he developed the LOGO programming language, designed to help children learn to program and develop math, science, and art intuitively.[4]

The symbolic AI paradigm, also known as Good Old-Fashioned AI (GOFAI), was the prevailing approach in computing until the 1980s, when new computational advances and improvements in neural network algorithms began to change the landscape. In the decades that followed, the combination of this development and the increased availability of data for training algorithms strengthened another approach to AI, called the connectionist paradigm (currently the dominant paradigm in AI). The connectionist AI paradigm, therefore, relies on the intensive use of large

4 It is worth noting that Minsky and Papert directly influenced the field of educational technology research in Brazil, having been at the State University of Campinas (Unicamp) in 1975 and 1976, sharing their experiences in AI and education with participants in the Center for Applied Informatics in Education (Nied) and other members of the academic community (Valente, 2006).

volumes of data (Big Data) and statistical learning algorithms to train systems capable of identifying patterns, performing classifications, and making predictions based on previous examples. Instead of operating using explicit rules provided by humans (as in GOFAI), these systems "learn" automatically, iteratively adjusting their internal parameters to improve their performance. Machine learning techniques fall within this field; Mitchell (2019) considers that the most emblematic form of this approach is artificial neural networks, especially those used in deep learning, which computationally model the structure of the human brain in interconnected layers. These networks are capable of solving complex problems such as speech recognition, computer vision, and natural language processing with increasing accuracy. However, unlike systems based on symbolic AI, they present greater challenges in terms of explainability and transparency, since the internal processes that lead to a given decision or outcome are often opaque, creating what is known as a "black box" (Holmes & Tuomi, 2022; Mitchell, 2019).

Holmes and Tuomi (2022) stated that, although connectionist AI is a protagonist in contemporary technology development, the symbolic paradigm remains predominant in educational AI development. As mentioned, this approach was historically central to the development of intelligent tutoring systems, which continued to be developed in the 1980s and 1990s. These systems simulated the behavior of a human teacher by guiding students through diagnoses, suggestions, questions, and corrections. These systems were carefully designed based on psychological and pedagogical theories, such as cognitive psychology, and required extensive manual modeling of student behavior. Automated reasoning, in these cases, is transparent and auditable, as it allows us to identify why a system made a particular inference or recommendation. This characteristic makes symbolic (knowledge-based) AI especially attractive for educational applications that require clear pedagogical explanations and personalized feedback, based on cognitive or instructional models.

Despite this prevalence, some researchers, such as Vicari (2021), emphasize that recent developments in AI point to potential innovations in the educational field. The dialogue

between AI and neuroscience has been fundamental to the advancement of deep learning and has given rise to new proposals for simulating mental processes, which is crucial for educational applications (Vicari, 2021). Holmes and Tuomi (2022) pointed out that machine learning (and therefore connectionist paradigm AI) has opened up new possibilities for educational applications, such as adaptive learning platforms, content recommendation systems, predictive analysis of student performance, school dropout detection, and sentiment analysis or engagement during online activities. To illustrate some possible applications, algorithms trained with large data sets on academic performance, attendance, and school dropout rates can predict which students are at greatest risk of failing based on digital behavior patterns, identify students who require greater attention from the school to prevent dropout, or even suggest personalized learning paths based on historical interaction with educational content and academic performance.

Finally, it is worth highlighting some aspects of the conceptions of education and human learning that are in dialogue with the development of educational AI presented in this chapter, in order to signal that they are not univocal. According to Doroudi (2023), educational applications developed throughout the history of AI rely heavily on a conception of learning as information processing, also known as cognitivism. This author emphasized that this is just one perspective among many and that it presents limitations compared to other approaches that consider learning as dependent on the context in which it occurs. In this sense, the late 1980s witnessed the strengthening of critical reactions to the development of AI by researchers united around the situated perspective on learning, generally informed by sociocultural theories of learning based on the work of Russian psychologist Lev Vygotsky (n.d., as cited by Doroudi, 2023). The situated perspective did not emerge outside AI, but within it, as an internal critique of its limitations. However, although many pioneers of the situated perspective on learning worked with intelligent tutors, they began to criticize these approaches for being too restrictive and decontextualized (Doroudi, 2023).

The contribution of the situated perspective on the uses of AI in education has shifted the focus from learning as individual

knowledge acquisition to learning as participation in social practices, which has led researchers of this approach to value qualitative methods, such as ethnographies and case studies, situating learning in real contexts. In the development of educational technologies, these perspectives have challenged the model of the "omniscient" tutor and inspired the design of more open, collaborative, and context-sensitive environments, even though, over time, situationist researchers have prioritized qualitative approaches over computational solutions (Doroudi, 2023).

In the following section, we will outline how the development of the relationship between AI and synthesized education finds its predominant contemporary expression in the field of educational application studies and development. We will then outline an overview of the main solutions and tools developed, providing the reader with a non-exhaustive overview of some of the types of AI-based technologies most commonly used in education.

AI IN EDUCATION: FUNDAMENTAL CONCEPTS AND OVERVIEW OF USES

FUNDAMENTAL CONCEPTS OF EDUCATIONAL AI

According to Doroudi (2023), the historical development (presented in the previous section) led to the formation of a field of study known as AI in education (AIED). This author drew attention to the fact that the area was previously referred to as Artificial Intelligence and education, and associates this name change with a transition in the field: from an area of study that linked cognitive science and human learning processes to computing to a field primarily dedicated to the development of educational software (Doroudi, 2023). Holmes and Tuomi (2022) agreed with this perspective, also emphasizing that, since 2010, the area, which was previously a focus of interest primarily among computer scientists, has begun to attract more commercial interest, transforming it into a market that could reach approximately US$20 billion by 2030 (Global Market Insights [GMI], 2022, as cited in Holmes & Tuomi, 2022). In addition to designating a field of research and a scientific community, the term is also associated in

literature with AI-based technologies and solutions developed for application in education. Therefore, in the remainder of this text, when we develop an overview of the main contemporary uses of educational AI, we will use the term AIED in both senses, depending on the context.

To make this overview more understandable, we define some fundamental concepts about these technologies. According to the specialized literature, the main objective of AIED since its inception has been to foster student learning with the support of AI technologies. This concept is based on the work of Bloom (1984), a psychologist who developed experiments comparing the academic performance of students who received individualized tutoring with that of those who underwent exclusively collective instruction processes (in the classroom). This author found that, when measured by standardized tests, the performance of the first group was superior to that of the second group, with a variation of approximately two standard deviations upward. This effect, known in the literature as the "2-sigma effect," is associated with "learning gains" in contexts where the educational objective is the acquisition of predefined knowledge: Gains are typically measured through experimental situations that include tests prior to and after the process, the study situation, or exposure to the target content. According to Roll and Willie (2016), the primary focus of AIED has been to develop technologies that support this effect, which is why "personalization of teaching" is a privileged aspect in the development of these technologies, since, in this conception, the student can dedicate more time to more necessary or effective content or learning strategies (Holmes & Tuomi, 2022; Roll & Wylie, 2016; UNESCO, 2021).

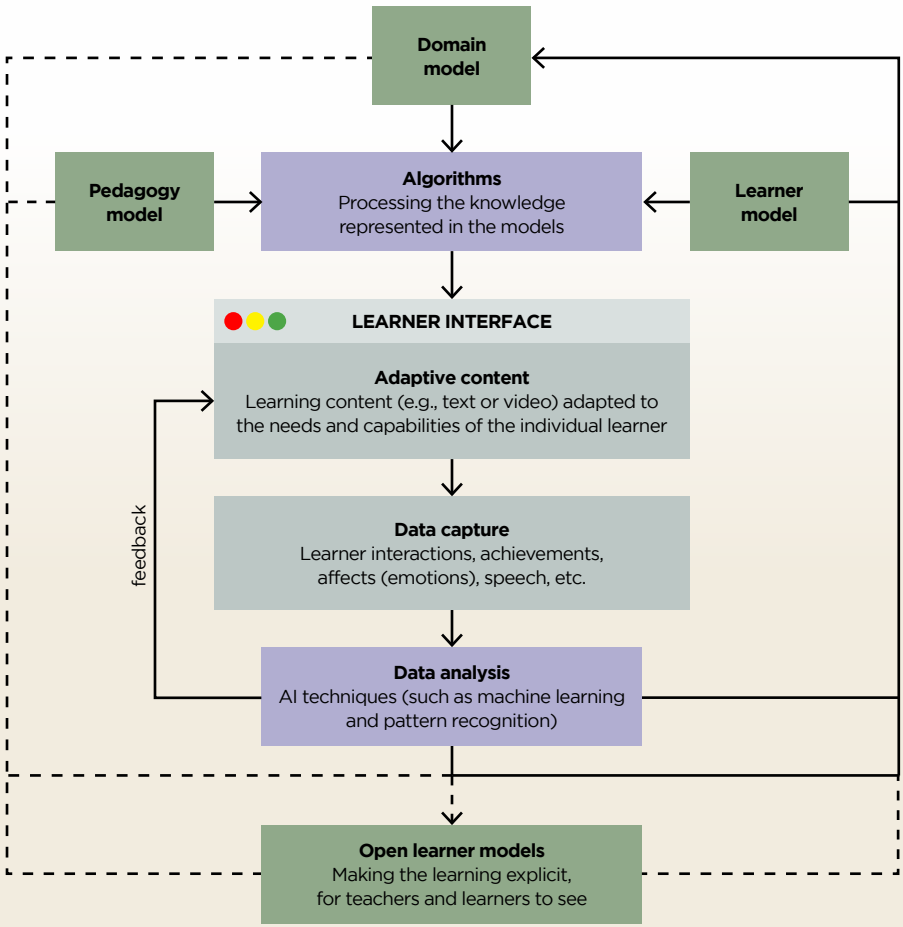
Luckin and Holmes (2016) defined this area as a multidisciplinary field to develop adaptive learning environments: digital solutions that adapt teaching, learning, and didactic resources to the individual needs of students, thereby promoting personalization, engagement, and effectiveness. According to these authors, a classic AIED system consists of four main models that work in an integrated manner to achieve this personalization effect. The domain model represents the knowledge to be learned, including concepts, relationships, and content structure, while the learner model

stores information related to each learner's level of knowledge, such as more or less developed skills, difficulties faced in problem-solving, and progress over time. The pedagogical model defines teaching strategies, deciding how and when to present content, propose activities, or provide feedback, based on information from the learner model. Finally, the interface model manages the interaction between the student and the system, ensuring clear and efficient communication.

A system like this operates cyclically. Students interact with the interface, which sends data to the learner model. This is updated and used by the pedagogical model to define the next instructional action. The domain model provides the appropriate content, which the interface presents again to the student. Luckin and Holmes (2016) state that this continuous cycle allows for dynamic and personalized adjustments based on the student's profile and real needs, thus fulfilling the premise of personalization. Additionally, these systems often feature open learner models, which model and present information about the process to the students themselves, as well as to teachers and educational administrators, on digital dashboards, for use in the analysis and planning of subsequent teaching actions and interventions.

The classic AIED model, as explained by Luckin and Holmes (2016) (Figure 1), is based on the symbolic AI paradigm; however, the connectionist paradigm has become increasingly present in AIED development. A very current example is the incorporation of LLM into solutions developed for automatic text correction or for predicting students at risk of dropping out—two applications explored in subsequent subsections. In these approaches, current advances in AI development, understood as the massive use of data and the use of statistical models, constitute the main technological paradigm. Also in this paradigm, there are recent experiences of applying generative AI in educational contexts, analyzed more frequently in scientific publications, especially after the launch of ChatGPT, developed by the company OpenAI, in 2022.

FIGURE 1 - AIED SYSTEM WITH SIMPLIFIED REPRESENTATION OF A TYPICAL MODEL-BASED ADAPTIVE TUTOR



SOURCE: LUCKIN AND HOLMES (2016).

In the studies conducted by Deng et al. (2025) and Adiguzel et al. (2023), the authors mapped and analyzed the uses of ChatGPT by students and teachers at different educational levels, identifying applications ranging from supporting academic essay writing to the production of teaching materials and assessments. Within the context of the review presented in this chapter, we did not include studies on uses of generative

AI in education more extensively for two reasons: First, most publications (such as the aforementioned articles) concerned tertiary education audiences, which fall outside the scope of our analysis; and second, most studies of this nature were published in preprint repositories and have not yet received broad scrutiny from the scientific community. However, although the mentioned authors focused on the use of a specific product (ChatGPT), several LLM-based solutions have been explored for educational applications. This is a trend that deserves to be monitored and followed, both because it is becoming more frequent in basic school education contexts and because it presents risks to academic and information integrity or to the security and privacy of students' data (Miao & Curukova, 2025; Miao & Holmes, 2023).

Although technologies aimed at personalizing education are considered the "foundational reason" for AIED and have received the most investment in research and development (Dillenbourg, 2016; Roll & Wylie, 2016), other educational dimensions also consider AI's potential for gains. Generally, the literature classifies AIED developments into student-focused, teacher-focused, and institution-focused technologies (Holmes & Tuomi, 2022; UNESCO, 2021). Holmes and Tuomi (2022) used this classification to propose a taxonomy of AIED systems, although the purposes of the technologies often overlap. The following is a representation of the typology proposed by these authors, classified according to their level of development and availability for use in educational contexts: speculative, researched, and commercially available (Table 1).

TABLE 1 - A TAXONOMY OF AIED SYSTEMS

A TAXONOMY OF AIED SYSTEMS	
STUDENT-FOCUSED AIED	
Intelligent tutoring systems (ITS)	Available for sale
AI-assisted apps (e.g., math, text-to-speech, language learning)	Available for sale
AI-assisted simulations (e.g., game-based learning, VR, AR)	Available for sale
AI to support learners with disabliities	Available for sale
Automated essay writing	Available for sale
Chatbots	Available for sale / Researched
Automated formative assessment (AFA)	Available for sale / Researched
Learning network orchestrators	Available for sale / Researched
Dialogue-based tutoring systems	Available for sale
Exploratory learning environments	Researched
AI-assisted lifelong learning assistants	Speculative
TEACHER-FOCUSED AIED	
Plagiarism detection	Available for sale
Smart curation of learning materials	Available for sale
Classroom monitoring	Available for sale
Automatic summative assessment	Available for sale / Researched
AI teaching assistants (including assessment assistants)	Available for sale / Speculative
Classroom orchestration	Researched
INSTITUTION-FOCUSED AIED	
Admissions (e.g., student selection)	Available for sale
Course planning, scheduling, timetabling	Available for sale
School security	Available for sale
Identification of dropouts and students at risk	Available for sale
e-proctoring	Available for sale

SOURCE: HOLMES AND TUOMI (2022).

OVERVIEW OF THE USES OF EDUCATIONAL AI

For the literature review presented below, we drew on Holmes and Tuomi's (2022) taxonomy. Then, we contrasted the types presented with the categories of technologies presented by manuals, guides, and government guidelines in the grey literature[5] as most recurrent in education (Holmes & Porayska-Pomsta, 2022; Miao & Homes, 2023; UNESCO, 2019a, 2021). This first phase of literature analysis identified three categories of AIED as most relevant due to their potential in basic school education contexts: (a) intelligent tutoring systems; (b) automatic summative assessment; and (c) systems for identifying school dropouts.

Once the categories of AIED to be included were defined, we proceeded with the literature review. We chose to conduct a bibliographic survey that was neither exhaustive nor bibliometric in nature, but rather illuminated the main motivations and conditions of use of the AIED categories currently in circulation. The first stage of the bibliographic review was conducted using the snowball method, in which we collected studies that were frequently cited in the literature and were by authors considered relevant in the field of studies and research on educational technologies. We then conducted a complementary search in the Scopus database,[6] associating each of the three types of AIED with the basic education category (K-12)[7] and using operators that excluded studies focused on higher education. Studies published between 2020 and 2025, and those of the literature review and original article types, were filtered. Applying both bibliographic survey techniques resulted in a set of 51 studies.

Based on the reading of the abstracts of these studies, we conducted a second selection stage, applying exclusion criteria aligned with the objectives of this text. Because the focus was to clarify the educational motivations, application types, and conditions and challenges for the use of AIED in formal,

5 Grey literature is a concept that indicates a set of documents that, although produced outside the formal publishing and editorial commercialization circuits, have scientific, technical, or academic value.

6 Find out more: https://www.scopus.com/home.uri

7 An educational system that covers kindergarten through 12th grade, equivalent in Brazil to compulsory basic education—that is, from early childhood education, including primary and lower secondary education, through upper secondary education.

school, and basic education contexts, we excluded from the initial list: (a) articles focused exclusively on the technical development of educational technologies; (b) articles that speculatively addressed the educational potential of AIED, imagining possibilities and future scenarios; and (c) studies on the use of AIED in teaching English as a foreign language or exclusively online education contexts. The final database of texts analyzed consisted of 15 articles.

In addition to the texts that analyze technology use cases, we also gathered a set of 10 articles, mobilized in the "Discussion section: AI for what purpose, why, and how," which address the use of AIED from a critical perspective, addressing the main associated risks and ethical challenges.

Finally, it is important to highlight some points observed regarding studies in the field. Although the literature on AIED is vast and prolific, the studies that meet the analysis criteria of this literature review are relatively few. Most of the articles and reviews evaluated refer to AIED applications in higher education, in activities such as massive open online courses (MOOC[8]), English as a foreign language (EFL) teaching, or predominantly technical studies on the development of AI models. The relative scarcity of research and empirical evidence focusing on the applications of AIED in real-world school settings with basic education students is consistent with the findings of leading authors in the field, who warn of the lack of solid evidence on the uses of AIED in school settings (Holmes & Porayska-Pomsta, 2022; Holmes & Tuomi, 2022; Selwyn, 2019, 2022; UNESCO, 2023). Furthermore, much of the research of this nature is concentrated in countries of the Global North and China. To balance this situation and provide a framework of analysis more consistent with the Brazilian context, studies conducted in Brazil or other developing countries were included whenever possible.

In the following subsections, we present a review of the selected studies, grouping them by primary end-user type: students, teachers, and institutions.

8 MOOC are distance learning courses offered online by educational institutions or professionals and aimed primarily at students in tertiary education or continuing professional training.

STUDENT-FOCUSED AIED

According to Holmes and Tuomi (2022), the most widely researched, developed, and commercialized version of AI technologies applied to education aims to personalize teaching and is called an intelligent tutoring system. As outlined in the subsection "Fundamental concepts of educational AI," these are systems that work with well-defined and structured content and disciplines, and present a sequence of exercises adapted to each student based on information generated by the students' interaction with the presented content: errors and successes, time spent on each stage of the teaching activities, texts produced by the student, etc. Furthermore, in school contexts, it is common for teachers and school administrators to access data related to student activities through dashboards.

Létourneau et al. (2025) conducted a systematic review of 28 studies on the use of different intelligent tutoring systems, aiming to evaluate the effects of these technologies on the learning of basic education students. The selected studies analyzed use cases in the United States, China, Taiwan, Turkey, Spain, Chile, South Korea, Malaysia, the Philippines, and the United Kingdom, almost all published before 2020. Most interventions occurred in science, technology, engineering, and mathematics (STEM) disciplines, especially mathematics and science, but there are also studies in reading, writing, and reading comprehension, as well as some focused on multiple curriculum areas. A total of 4,597 basic education students participated in the analyses, which used quasi-experimental designs in which an experimental group (treatment) used the intelligent tutoring system, while a comparison group (control) received traditional instruction, a modified version of the intelligent tutoring system, or a digital system without AI.

This type of research design is widely used to assess the effectiveness of AIED learning aimed at personalized instruction, as it involves pre- and post-tests to measure changes in performance and evaluate the intervention's effect. According to Létourneau et al. (2025), studies have generally shown positive effects on student learning and performance in STEM subjects. One difficulty they identified was the comparability of study results, as methodological differences prevent standardized calculations and generalization

of findings. Nevertheless, they pointed out that studies indicated learning gains in treatment groups when compared to traditional instruction, but these were less significant when compared to non-intelligent digital systems (i.e., without embedded AI). The authors interpreted this aspect as suggesting that part of the impact stems from other factors associated with the technological learning environment, such as the possibility of interactivity, immediate feedback, and visual stimulation, and not necessarily from specific adaptive intelligence functionalities. They believed that the "novelty" factor represented by technologies, or even simple access to a structured digital learning environment, can generate positive effects, and therefore recommended research designs capable of isolating the personalization effect of AI. Furthermore, they pointed out that older students (in school years equivalent to Brazilian upper secondary education) tend to benefit more than younger students, possibly due to their greater degree of autonomy when interacting with technologies (Létourneau et al., 2025).

Lin et al. (2023) conducted a systematic review to understand how intelligent tutoring systems can support what they call sustainable education, defined by the authors as an educational model that promotes not only the learning of knowledge objects, but also the development of skills, values, and attitudes necessary to face global challenges, such as climate change, social inequalities, and technological transformations (Lin et al., 2023). The review analyzed 37 studies published between 2014 and 2023, conducted in China, the United States, the United Kingdom, Australia, Singapore, Spain, Germany, Canada, and South Korea. Most of the selected studies addressed AI as an auxiliary tool in the development of skills, values, and pedagogical strategies focused on sustainability, and seven addressed AI as the topic of study, in its relationship to implications, opportunities, risks, and challenges for sustainability.

The anallysis of Lin et al. (2023) indicated that the 14 studies that used quasi-experimental designs reported significant increases in test scores, problem-solving speed, or student mastery of concepts; one study reported an increase in student engagement (defined as the time spent interacting with the

technologies), attributed to the fact that the material was tailored to the students' individual level and pace. Finally, nine of the 37 studies recorded positive student attitudes toward the clarity, usefulness, motivation, and appropriateness of the personalized content offered by intelligent tutoring systems, collected primarily through structured questionnaires and semi-structured interviews and, in some cases, through spontaneous comments posted on the digital platforms themselves. The authors noted, however, that much of this evidence was produced from short-term studies and, in part, based on self-reports, which limits the robustness of the conclusions (Lin et al., 2023).

On the other hand, the review by Lin et al. (2023) also highlighted challenges identified in the use of intelligent tutoring systems. Regarding the technical aspect, the most frequently cited obstacles include: lack of adequate technological infrastructure in some institutions, limitations in interoperability between different educational systems and AI tools, connectivity and maintenance issues, and lack of quality educational data to train algorithms effectively and without bias. Regarding explainability gaps the study pointed out that many technologies included in the analyzed works did not offer teachers and administrators a clear understanding of how decisions and recommendations were made, which led to feelings of distrust regarding the pedagogical suitability of intelligent tutoring systems. Finally, flaws in the curricular integration process were also highlighted, as these systems were often implemented as additional resources or in pilot projects, without full alignment with the objectives, content, and methodologies previously established in the curriculum, thus reducing their impact and long-term sustainability (Lin et al., 2023).

In addition to quasi-experimental studies, the literature review revealed a certain recurrence of studies that focused on teachers' perceptions of the use of intelligent tutoring systems. Sperling et al. (2022) investigated how elementary school teachers in Sweden perceived and used AI systems in the classroom, identifying barriers and facilitators to their adoption. For them, the system analyzed was not specified, but simply identified as "a machine-learning solution for mathematics teaching that recommends personalized content

in real time" (Sperling et al., 2022, p. 586). The authors adopted the theoretical-methodological perspective of Actor-Network Theory,[9] drawing on ethnography and semi-structured interviews, to understand how school actors perceive the construction of their interactions with technologies. The main finding reported was that the algorithmic decisions of intelligent tutoring systems, which teachers considered unexpected or inappropriate (because they were not adjusted to students' needs, as perceived by the teachers), were offset by the work itself. Personalized teaching emerged from the sociotechnical network, that is, from a combination of technology and humans, rather than from the algorithm's action alone. Furthermore, they considered that the complete automation of school processes is not feasible in the near future, since the use of intelligent tutoring systems requires constant teacher intervention.

On the other hand, the studies conducted by Kim and Kim (2022) and Chounta et al. (2022), although employing different methodologies, obtained similar qualitative results. The first study, conducted in the United States, investigated STEM teachers' perceptions of a writing scaffolding[10] system, focusing on argumentation development and dynamic feedback, used with elementary education students. The teachers, although well-qualified, had no prior experience with educational AI. In turn, Chounta et al. (2022), in Estonia, conducted a survey of 140 elementary education teachers to map perceptions and expectations about the use of AI to support teaching practice, without testing a specific technology. In both cases, the research identified limited teacher knowledge of AI but a positive willingness to adopt it, as well as optimistic attitudes toward the use of technologies to personalize learning. However, the studies also captured concerns about changes in the expected role of

9 Actor-Network Theory (Latour, 2012), formulated in the 1980s by Bruno Latour, Michel Callon, and John Law, proposes analyzing societies as networks of associations between human beings and other entities, such as technologies. It is a widely used approach in science and technology studies because it allows mapping the interactions and interdependencies between society and technology.

10 According to Luckin and Holmes (2016), in educational contexts, scaffolding refers to teaching strategies that, throughout the execution of tasks, offer support to students as needed. In general, the literature on AIED presents this term in association with, and often equivalent to, the concept of intelligent tutoring systems.

teachers in a context of intensive use of technologies, as well as the perception of risks of excessive dependence on intelligent tutoring systems and a lack of clarity about how the systems work, that is, how AI arrived at certain recommendations (Chounta et al., 2022; Kim & Kim, 2022). The studies, despite being qualitative in nature and relying on relatively small sample sizes, exemplify the concern of researchers in the field of AIED to produce evidence that supports materials aimed at teacher qualification and preparation for more intensive use of AI in the educational context.

TEACHER-FOCUSED AIED

According to the research literature, AIED systems whose primary focus is teacher activities are significantly fewer in number than studies dedicated to intelligent tutoring systems. Teachers are generally included in these systems through open learning models, which provide aggregated information on student learning so that teachers can use it to monitor their development and plan pedagogical interventions tailored to their students' needs. In general, when it comes to the dimension of teaching tasks, the main gain attributed to technologies is the possibility of automating tasks considered repetitive, in order to optimize teaching work, assuming that, in this way, teachers can dedicate their "extra" time to activities of greater pedagogical value for students (Baker, 2019; Holmes & Tuomi, 2022; UNESCO, 2021).

In Holmes and Tuomi's (2022) typology, AIED applications aimed at automatic summative assessment[11] (including automated essay correction and grading) fall into the category of teacher-focused solutions, as they significantly reduce the teaching effort of grading and verification. These authors stated that this category of technology is the second most invested in development, after intelligent tutoring systems. On this topic, Owan et al. (2023) summarized the

11 Summative assessment refers to the process of evaluating learning at the end of a teaching process or period (such as a bimester or trimester), in which a grade is typically assigned to the student. It differs from diagnostic assessment (which seeks to understand students' prior learning, usually conducted before the school year) and formative assessment (conducted throughout the teaching process, with a view to making necessary adjustments to the process).

possible uses of LLM in educational assessment. Based on a review of 47 articles, they mapped uses that cover the steps typically involved in educational assessments: from developing reference matrices, generating items, and designing tests to analyzing and interpreting results, including automatic grading, performance prediction, and plagiarism detection—tasks typically performed by teachers and assessment specialists. In addition to identifying challenges in the use of Big Data in education, such as biases, data protection breaches, and a lack of explainability in the models, they also emphasized the need to include human labor (educational assessment experts) in all stages of technology implementation, an approach known in the literature as "humans in the loop."

Still in the field of technologies that automate correction and assessment processes, Liu et al. (2025) conducted a comparative study involving the use of Automated Writing Evaluation (AWE). The study sought to investigate the differences between automated assessment and teacher feedback in terms of quantity, type, and level, and their impact on revisions, writing quality, and student motivation. To this end, a quasi-experimental design was developed with 28 7th-grade students in a school in China, based on an optional (extracurricular) writing course, in which the technology was used for six consecutive weeks. The students were randomly assigned to two groups: The treatment group received automatic assessments and suggestions for interventions on their writing, while the control group received comments and corrections from teachers.

Liu et al. (2025) identified improvements in the quality of students' writing in both groups, but considered the effects of AWE on the experimental group to be small and inferior to those on the control group. Regarding motivational aspects associated with the writing process, measured through questionnaires administered to students, the authors reported that members of the experimental group demonstrated significantly greater confidence and persistence in writing compared to the control group. However, there was no significant difference between the groups in interest and intrinsic motivation regarding writing.

A study by Kim et al. (2025), conducted in the United States (US), addressed the use of AI tools in automatic text correction from a different perspective. Writing correction tools are typically used for teaching writing; however, the authors investigated the correction of texts aimed at teaching science content to elementary education students. The research involved the use of a written content assessment tool, based on Natural Language Processing (NLP), applied to 307 7th-grade students in two schools. To this end, these authors began with a problem formulated regarding the use of formal language norms: For them, automatic correction should not penalize students for errors in the use of formal writing rules, since the objects of knowledge under focus were from another curricular component (the science component). The article reports that the students wrote essays covering previously studied physics content; however, it does not explicitly state whether the essays were part of the schools' curricular activities or were developed exclusively within the scope of the research.

The texts were subsequently corrected by both the NLP tool and Kim et al. (2025) to identify the scientific ideas present. They also observed whether the tool evaluated them independently of non-normative language. The study indicated that the tool was able to correct the essays without penalizing students for aspects of non-formal language outside the proposed target knowledge object, but it did not report any impact on student learning or motivation. Although this study focused more on the development of the tool, Kim et al. (2025) addressed the relevant issue of linguistic discrimination in the context of the use of NLP in education. Thus, the authors point out that it is necessary for the topic to be expanded to include language variations associated with distinct racial and ethnic groups, in order to contribute to the issue of discrimination and the reproduction of inequalities linked to the use of AI in education (Kim et al., 2025).

Finally, a study by Ferman et al. (2021), conducted in Brazil in 2019 with 178 public secondary education schools, used a randomized field experiment to evaluate the impact of an automated grading system for essays from the National High School Exam (Enem), also based on NLP. Two versions were tested: one based solely on AI and another that combined

AI with human graders. Both resulted in significant improvements in essay scores, demonstrating that the use of AI, even without additional human intervention, can improve student performance. The inclusion of human graders was not associated with an effect on grades, but, according to these authors, it contributed to students perceiving the feedback as more reliable and detailed. The study also showed that the technology freed teachers from repetitive and time-consuming tasks, allowing them to focus more time on activities of greater pedagogical value, without overloading their workload. Despite the positive results, these authors emphasized that the findings applied to a specific context—academic writing aimed at the Enem—without evaluating long-term impacts or possible differences in the quality of human feedback compared to automated feedback (Ferman et al., 2021).

EDUCATIONAL INSTITUTION-FOCUSED AIED

In educational management, AI is perceived as capable of refining data analysis relevant to administrative and educational decision-making and is often considered a useful tool in educational policy. Filgueiras (2024) linked the use of AI in education to the advancement of educational policies, stating that faster access to teaching and learning data enabled by the interconnection of school processes with platforms allows for objective monitoring and evaluation of policies in their short, medium, and long-term dimensions. According to this author, AI solutions applied to educational policies provide an experimental perspective on intervention design solutions, using simulations. However, Filgueiras (2024) also highlighted existing dilemmas: The use of Big Data and AI in educational systems involves privacy risks and increased surveillance, as in the use of facial recognition in schools, also reported by Tavares et al. (2023) in a study on the Brazilian context. From the perspective of educational inequalities, algorithmic biases can reproduce racial, gender, and regional disparities; digital literacy gaps among educational actors can lead to an inverse exclusion effect, limiting the beneficial reach of educational policies. Finally, this author also highlighted the dependence on large technology companies, a scenario amplified during the COVID-19 pandemic due to

the massive adoption of platforms that collect sensitive data (Filgueiras, 2024).

One of the areas considered most promising in school management and educational policies is the predictive analysis of low academic performance or dropout rates, anticipating recovery and retention actions for students in school systems (Holmes & Tuomi, 2022; UNESCO, 2021). From an empirical perspective, two studies on dropout prediction models using machine learning, referred to in the literature as Early Warning Systems (EWS), were analyzed. However, although they used administrative datasets from educational systems, the studies did not refer to specific cases of implementation of dropout prediction systems as educational policies, focusing primarily on the development and analysis of the predictive models' functioning. The general lines of these studies will be outlined below in order to identify aspects of their methodologies and results that may indicate potentialities and particularities for the implementation of similar systems in educational policies.

Hung et al. (2025) investigated data from 16,011 students in elementary schools in the United States during the COVID-19 pandemic to understand dropout and disengagement behavior in school activities, which were conducted online during that period. The main question to be answered by the study was the most appropriate time to intervene with students at risk of dropping out. To this end, the research used machine learning techniques to analyze a broad set of student data, including data on their interaction with proposed online activities, in order to relate them to three points in the academic semester. The analyses found that the second phase of the semester (the middle) was potentially more effective for interventions aimed at reducing dropout. Furthermore, student interactions were grouped into five risk profiles that require distinct intervention actions: (a) highly engaged: students with a high learning frequency; (b) poorly engaged: students who do not participate in any learning activities; (c) test-related risk: students who only participate in assessment activities; (d) low interaction: students who complete tasks but rarely participate in discussions in online forums; and (e) risk due to lack of persistence: students with inconsistent and discontinuous learning behaviors.

A study conducted in preparation for the implementation of a national government policy in Uruguay was conducted by Queiroga et al. (2022), a partnership between Uruguayan and Brazilian researchers. This policy aims to mitigate student dropout and increase retention in secondary school. To this end, the study methodology used data from 258,440 students, collected between 2015 and 2020, throughout elementary and upper secondary education, from various sources. The data used include demographic information and educational trajectories from the first year of elementary education to the second year of upper secondary education, such as: performance measured by assessments in different subjects during these years, number of absences, participation in social programs, and school location. Eight statistical models were tested using this information, and the main focus was to identify and compare their effectiveness. As relevant findings for the context of this review, these authors considered that the inclusion of elementary education data in conjunction with sociocultural information on students significantly contributes to the performance of the predictive models. Furthermore, as reported by the researchers, exploratory data analysis revealed an association between student participation in social assistance programs during elementary education and a lower probability of dropping out of school in upper secondary education (Queiroga et al., 2022).

In addition to studies focused on predicting school dropout, a study was analyzed that introduced the concept of unplugged AIED. Considering scenarios of structural inequalities in access to digital resources by Brazilian schools, Isotani et al. (2023) started from the premise that the use of AIED in educational systems in countries of the Global South can lead to the widening of digital inequalities. In dialogue with public policymakers from the Brazilian federal government, these authors proposed the development of AI-based educational technologies that do not require changes to school infrastructure or the qualifications of educational actors for their implementation.

According to Isotani et al. (2023), the fundamental characteristics of unplugged AIED are: (a) compliance: The AI-based solution must be developed considering the infrastructure, resources, and pedagogical practices available

in the school network; (b) disconnection: The AIED used must operate independently of the Internet most of the time; (c) intermediation (proxy): The technology must be usable by its users without requiring access to hardware or the necessary skills to use the tool (such as creating a login account); (d) multi-user: Solutions must dispense with login or registration of individual interactions, since, in general, users in the targeted school contexts share hardware and software; and (e) low digital skills requirement: AIED tools must have simple design and usability, so that specific digital skills, beyond those required for using a mobile phone, are not required.

The study reported that researchers developed an unplugged version of AIED for the automatic grading of essays written by Brazilian elementary education students, as part of a large-scale national assessment used as a data collection tool to inform public policy. During the writing process, teachers scan students' essays (written on sheets of paper and with a QR Code for identification) using a mobile application; the scanned essays then undergo an automated grading process using NLP techniques, guided by a rubric that expresses the writing assessment criteria. The graded essays, with feedback for the students and performance data organized on a digital dashboard, are returned to teachers and students within 72 hours. According to these authors, this tool has been implemented in public schools since 2022, having reached more than 500,000 elementary education students in approximately 7,000 schools. The study listed as the main results obtained with its implementation the possibility of using the pedagogical information obtained through correction in formative feedback for students, given the reduction in time of this process in relation to the traditional (non-automated) process (around 4 months); and the reduction of operational costs involved in the correction process. However, no data were presented on cost reductions or the effects on student learning (Isotani et al., 2023). Finally, we note that the technology analyzed in this study can be considered an automatic summative assessment system associated with teaching activities; however, we chose to locate the technology within the set of school-focused AIED because the study itself relates its findings to gains in educational provision by the education system.

DISCUSSION: AI FOR WHAT PURPOSE, WHY, AND HOW

Recalling the motivating questions of this literature review, we began the literature survey to identify three expectations regarding *the purposes for which* AI-based technologies are used: (a) to increase learning gains, in the case of intelligent tutors focused on students; (b) to automate the grading of schoolwork and assessments, in the case of technologies aimed at teachers; and (c) to predict and prevent school dropout, in the case of technologies focused on schools. The studies selected for this review illustrate how these applications are realized.

Regarding the articles addressing the uses of intelligent tutoring systems, we highlight the use of technologies that seek to generate learning gains in STEM curricular components, based on the premise of personalized teaching. The article by Lin et al. (2023) presents an additional unique feature: The use of AI tools to promote the learning of concepts related to the topic of sustainability.

Regarding studies on automated assessment, including writing assessment, the articles by Liu et al. (2025) and Ferman et al. (2021) described not only the perspective of optimizing teaching work involved in the use of AI, but also the effects of correction and assessment systems on student learning—an overlap of functions and effects predicted by Holmes and Tuomi (2022), as mentioned in the section "Fundamental concepts of educational AI." In the case of AI applied to institutions, in addition to the expected uses in relation to predicting school dropout, the concept of unplugged AIED presented by Isotani et al. (2023) introduced a support function for the educational offering of teaching systems that not only involves the aspect of school management, but also adds gains and effects on teaching activities and student learning.

However, when we consider *why* AI is used in education, we observe that not all of the studies analyzed explicitly addressed the educational challenges that foster the implementation of the solutions analyzed. Motivations were more explicitly reported in the set of studies on AI focused on educational institutions. The articles by Hung et al. (2025) and Queiroga et al. (2022) immediately presented the educational problem that drove the implementation of the technologies analyzed: preventing school dropout, which, in some of

the contexts reported, represented a significant challenge. Similarly, Isotani et al. (2023) outlined important structural and systemic issues in Brazilian educational systems, such as deficient school infrastructure, burdensome operating costs, and delays in the return of assessments for their proper pedagogical appropriation. These dilemmas motivate the development and implementation of disconnected AI systems, which seek to generate educational benefits without requiring the educational system to undertake great improvements in its infrastructure.

Studies on the use of intelligent tutoring systems sought to highlight the advantages of using tutoring systems in academic performance and in the time dedicated to activities by students, but failed to signal the broader educational meaning of these gains. It is not possible, based on the selected articles, to achieve a conclusive reading that indicates whether the technologies helped students in historically more fragile aspects, or even whether they supported the overcoming of learning challenges in a more systemic way in the schools and educational networks analyzed in these studies.

In the case of studies on automated summative assessment technologies focused on automating teacher activities, there are nuances, despite the similar scenario. The studies by Liu et al. (2025) and Kim et al. (2025) did not clarify the initial educational motivation for implementing the technologies analyzed. However, the article by Kim et al. (2025) addressed a relevant issue in the educational context: linguistic diversity and equity in student assessment. These authors discussed the ability of AI technologies to provide a fair assessment of the nature of the knowledge objects assessed, without prejudice to linguistic variations, and pointed to the need for more studies that consider linguistic variations associated with aspects such as gender and race. This approach speaks to a widely recognized educational problem: how social markers influence student assessment processes in schools (Carvalho, 2003). However, it is noteworthy that the study by Carvalho (2003) contextualized the research problem as a consequence of the biases of automated assessment technologies themselves, as it sought to present the development of alternatives capable of overcoming them.

In this sense, the problem addressed by Kim et al. (2025, p. 554) is characterized as "technologies that solve problems created by technologies," as Holmes and Tuomi (2022) pointed out. An exception to the scant characterization of the educational issues at stake among studies on automated assessment was the work of Ferman et al. (2021), for whom the objective of reducing learning gaps in writing between public and private school students was the initial motivation for implementing the technology analyzed.

Although the review of studies described in this chapter does not claim to represent all the educational motivations that inspire the use of educational AI, the lack of a connection between uses and their educational meanings is striking. Bartoletti (2022) argued that *why* the use of technologies in education is as relevant as *how* they are used, since, to a large extent, the two dimensions are inseparable. Ensuring the ethical and responsible use of AI in education requires clarity of purpose that allows for monitoring its effects, preventing and mitigating the risks involved in its implementation, and adapting procedures and practices to the educational objectives established in the first place.

The main global guidelines for implementing AIED and studies by leading researchers in the field indicate that there must be intentionality in the use of educational AI in two respects. First, undesirable outcomes must be avoided: widening preexisting educational inequalities, imposing embedded cultural biases in AI models and the design of educational solutions, low explainability of how technologies work, risks of data leaks and exposure of sensitive information about children and adolescents, and weakening human agency in educational processes (especially teachers), among others (Holmes et al., 2022; Holmes & Porayska-Pomsta, 2022; Miao & Holmes, 2023; UNESCO, 2019a, 2021). Second, it is necessary to implement AI in education in a way that guarantees the role of technologies in addressing structural educational challenges. To this end, it is necessary to ensure equitable access to infrastructure and technology, develop human capabilities through the continuous training of teachers and managers, formulate public policies and regulatory frameworks that promote

responsible and inclusive use of AI, create culturally and linguistically appropriate content, encourage research and innovation based on pedagogical and ethical principles, and implement mechanisms to monitor and evaluate the real impact of AI in education (Holmes, 2023; Holmes & Porayska-Pomsta, 2022; UNESCO, 2019a, 2023).

Careful consideration of *how* AI is implemented in education also involves analyzing the values embedded in the technology's architecture. Blikstein and Blikstein (2023) noted that educational technologies are not neutral, but rather embody values, assumptions, and power relations based on the social, economic, and political contexts in which they are developed. Based on a semiotic analysis of designers' and companies' discourses, these authors argued that design decisions—from interfaces to algorithms—carry normative views about efficiency, control, and personalization, which favor certain educational models over others. Maintaining this perspective is essential to sustaining an educational commitment to social justice and pedagogical diversity (Blikstein & Blikstein, 2023).

A similar argument was presented by Williamson et al. (2025), who analyzed institutional documents and data produced by a British consultancy specializing in educational technology markets. They argued that the meanings and demands regarding education and its relationship with AI and technologies in general have been shaped by actors more aligned with and interested in commercial logic than in educational interests. According to the study, these meanings often express logics of standardization, control, efficiency, and technological innovation. The study highlighted that these approaches can deepen educational inequalities by imposing uniform metrics and parameters, disregarding local contexts and needs, and argued that the regulation of AI in education should be constructed democratically, with transparency and social participation (Williamson et al., 2025).

Beyond criticism of the cultural and symbolic dimensions of the potentially deleterious effects of AI's educational uses, there are also perspectives that question the main promised benefits for educational practices, such as personalized learning and the optimization of teaching tasks. From the perspective of the potential support provided by AIED for student learning,

educational AI appears to be limited to learning perspectives aligned with cognitivism. Holmes and Tuomi (2022) pointed out that, for the most part, AIED applications are still flawed when they address other pedagogical perspectives, a view reiterated by Vicari (2021), who pointed out the inadequacy of AI for educational practices that require collaboration. Furthermore, as indicated in the section "Fundamental concepts of educational AI," there is consensus among the main authors in the field regarding the lack of evidence on the uses of educational AI in real school contexts, especially in basic education. In addition to being scarce and inconsistent, studies on learning gains are often produced or financed by the companies that develop solutions themselves (Holmes & Tuomi, 2022; UNESCO, 2023; West, 2023).

Regarding technologies that propose the automation of teaching activities, Selwyn (2022) argued that sometimes what is considered a meaningless activity (capable of being automated by AI) is actually part of school practices that carry educational meaning. This author analyzed the implementation of an "automated attendance" system, using facial recognition of students in an Australian school, which promised to simplify teachers' activities by eliminating the step of checking student attendance in the classroom. Although the stated objectives were to save teachers time and eliminate human error, the observed effect was the loss of a valuable step from a pedagogical perspective, as it allowed teachers to establish an initial connection with students. Furthermore, they also observed an increase in extra tasks related to the operation of the software itself.

Finally, one aspect of the risks inherent in the use of AI in education that has attracted attention from researchers relates to data governance and the resulting ethical issues. The work of Lupton and Williamson (2017), one of the first to raise this debate in education, consolidated concerns about consent, commercial use of student data, discriminatory profiling, and constant surveillance, a perspective reinforced by Andrejevic and Selwyn (2020) and Borenstein and Howard (2021). From a legal perspective, Weinstein (2020) focused specifically on the use of AI for school surveillance, based on a legal analysis and case studies in the United States,

comparing the way technologies such as facial recognition and behavioral monitoring systems operate with students' fundamental rights guaranteed by law. Although this author did not approach the issue from a pedagogical or learning perspective, he argued that, while the use of such tools can be justified from a security and management perspective, they can also generate negative effects, such as the intensification of excessive control practices and the creation of environments of distrust in schools, especially in contexts where there is a lack of specific regulation for AI technologies.

CONCLUSION

The increased use of AI in basic education has gained attention from school stakeholders, policymakers, families, students, and researchers. However, it is not uncommon to encounter discourses that associate, in a shallow or insufficiently critical manner, the use of AI technologies with the solution of educational problems that are often systemic and structural in nature. With this in mind, this literature review aimed to gather information and research evidence that contribute to more balanced and well-founded analyses of the real possibilities and stage of technical development of AI, considering the concrete challenges and dilemmas of contemporary educational systems.

Without intending to exhaust the discussions or comprehensively cover all the possible uses of AI in education, we gathered studies that provide empirical evidence of educational uses of tools with embedded AI. We organized the literature review around three guiding questions: "AI: What for?" (in which school activities AI technologies are commonly used); "Why AI?" (what educational challenges technologies can help overcome); and "AI: How?" (what are the challenges and conditions necessary for its implementation). We focused our research on the types of AIED most implemented in school contexts and with basic education students, prioritizing more documented and analyzed use cases over technological applications still in the research and development phase. Likewise, we chose to gather studies that could provide input for discussions related to the formulation of public education policies.

After outlining the origins of the relationship between AI and education, and the learning and educational premises upon which this relationship is built, we sought to clarify the basic operating principles of AI solutions in education, in addition to presenting a possible typology of technologies validated by specialized literature. Next, we analyzed a set of review studies and empirical articles that gathered evidence on the most common types of uses, focusing on three users: students, teachers, and institutions. Regarding *the purpose* of AI technologies in education, the studies analyzed objectively highlight the main activities and dimensions of school activities covered by AI: personalization of teaching, automation and optimization of teaching activities considered burdensome to the teaching and learning process, and preventive measures regarding school dropout.

Regarding the *why* of using AI in education, we found that studies did not always clearly connect applications with significant educational challenges and problems within educational systems. They sometimes prioritized analyses of results not always produced in genuine school contexts, such as experimental situations or case studies. In general, two aspects of the studies caught our attention: the relatively low incidence of studies on AIED implementation in real school contexts, often conducted with a small number of participants, which makes generalization difficult; and the difficulty in comparing study findings due to their methodological diversity.

Finally, we drew on the main guidelines on the ethical and responsible use of AI in education, and the literature with a critical perspective on AIED, to highlight some important aspects of *how* AI should be approached in relation to education. Its adoption requires care to prevent undesirable results that can exacerbate existing problems. Furthermore, its use must be aligned with addressing structural educational challenges.

In summary, understanding AI in education requires not only measuring its immediate results, but also situating its applications, motivations, and modes of implementation in dialogue with the values, challenges, and purposes that guide contemporary educational systems.

REFERENCES

Adiguzel, T., Kaya, M. H., & Cansu, F. K. (2023). Revolutionizing education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology, 15*(3), ep429, 1-13. https://doi.org/10.30935/cedtech/13152

Andrejevic, M., & Selwyn, N. (2020). Facial recognition technology in schools: Critical questions and concerns. *Learning, Media and Technology, 45*(2), 115-128. https://doi.org/10.1080/17439884.2020.1686014

Baker, T. (2019). *Educ-AI-tion rebooted? Exploring the future of Artificial Intelligence in schools and colleges*. Nesta. https://www.nesta.org.uk/report/education-rebooted/

Bartoletti, I. (2022). AI in Education. An opportunity riddled with challenges. In W. Holmes, & K. Porayska-Pompsta (Eds.), *The ethics of Artificial Intelligence in education: Practices, challenges, and debates*. Routledge.

Bloom, B. S. (1984). The 2-Sigma problem: The search for methods of group instruction as effective as one-to-one tutoring. *Educational Researcher, 13*(6), 4-16. https://doi.org/10.2307/1175554

Borenstein, J., & Howard, A. (2021). Emerging challenges in AI and the need for AI ethics education. *AI and Ethics, 1*, 61-65. https://doi.org/10.1007/s43681-020-00002-7

Carvalho, M. P. (2003). Sucesso e fracasso escolar: uma questão de gênero. *Educação e Pesquisa*, *29*(1), 185-193. https://doi.org/10.1590/S1517-97022003000100013

Chounta, I.-A., Bardone, E., Raudsep, A., & Pedaste, M. (2022). Exploring teachers' perceptions of Artificial Intelligence as a tool to support their practice in Estonian K-12 Education. *International Journal of Artificial Intelligence in Education, 32*, 725-755. https://doi.org/10.1007/s40593-021-00243-5

Deng, R., Jiang, M., Yu, X., Lu, Y., & Liu, S. (2025). Does ChatGPT enhance student learning? A systematic review and meta-analysis of experimental studies. *Computers & Education, 227*, 105224. https://doi.org/10.1016/j.compedu.2024.105224

Dillenbourg, P. (2016). The evolution of research on digital education. *International Journal of Artificial Intelligence in Education, 26*, 544-560. https://doi.org/10.1007/s40593-016-0106-z

Doroudi, S. (2023). The intertwined histories of Artificial Intelligence and education. *International Journal of Artificial Intelligence in Education, 33*, 885-928. https://doi.org/10.1007/s40593-022-00313-2

Ferman, B., Lima, L., & Riva, F. (2021). Artificial Intelligence, teacher tasks and individualized pedagogy. *SocArXiv*, 1-55. https://doi.org/10.31235/osf.io/qw249

Filgueiras, F. (2024). Artificial Intelligence and education governance. *Education, Citizenship and Social Justice, 19*(3), 349-361. https://doi.org/10.1177/17461979231160674

Holmes, W. (2023). *The unintended consequences of Artificial Intelligence and education* [Research Report]. Education International. https://www.ei-ie.org/en/item/28115:the-unintended--consequences-of-artificial--intelligence-and-education

Holmes, W., & Porayska-Pomsta, K. (2022). *The ethics of Artificial Intelligence in education: Practices, challenges, and debates*. Routledge. https://doi.org/10.4324/9780429329067

Holmes, W., & Tuomi, I. (2022). State of the art and practice in AI in education. *European Journal of Education, 57*(4), 542-570. https://doi.org/10.1111/ejed.12533

Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S. B., Santos, O. C., Rodrigo, M. T., Cukurova, M., Bittencourt, I. I., & Koedinger, K. R. (2022). Ethics of AI in education: Towards a community-wide framework. *International Journal of Artificial Intelligence in Education*, *32*, 504-526. https://doi.org/10.1007/s40593-021-00239-1

Hung, J-L., Rice, K., & Zhang, M. (2025). Interpretable AI techniques uncover the factors and types of at-risk early warning: A case study in K-12 online learning. *Data Technologies and Applications*. https://doi.org/10.1108/DTA-11-2023-0795

Isotani, S., Bittencourt, I. I., Challco, G. C., Dermeval, D., & Mello, R. F. (2023). AIED unplugged: Leapfrogging the digital divide to reach the underserved. In N. Wang, G. Rebolledo-Mendez, V. Dimitrova, N. Matsuda, & O. C. Santos (Orgs.), *Artificial Intelligence in education. Posters and late breaking results, workshops and tutorials, industry and innovation tracks, practitioners, doctoral consortium and Blue Sky* (Vol. 1831, p. 772-779). Springer Nature. https://doi.org/10.1007/978-3-031-36336-8_118

Kim, C., Passonneau, R. J., Lee, E., Sheikhi Karizaki, M., Gnesdilow, D., & Puntambekar, S. (2025). NLP-enabled automated assessment of scientific explanations: Towards eliminating linguistic discrimination. *British Journal of Educational Technology, 33*. https://doi.org/10.1111/bjet.13596

Kim, N. J., & Kim, M. K. (2022). Teacher's perceptions of using an Artificial Intelligence-based educational tool for scientific writing. *Frontiers in Education, 7,* 755914. https://doi.org/10.3389/feduc.2022.755914

Latour, B. (2012). *Reagregando o social: uma introdução à teoria do Ator-Rede*. Edufba.

Létourneau, A., Deslandes Martineau, M., Charland, P., Karran, J. A., Boasen, J., & Léger, P. M. (2025). A systematic review of AI-driven intelligent tutoring systems (ITS) in K-12 education. *Npj Science of Learning, 10*(1), 29. https://doi.org/10.1038/s41539-025-00320-7

Lin, C.-C., Huang, A. Y. Q., & Lu, O. H. T. (2023). Artificial Intelligence in intelligent tutoring systems toward sustainable education: A systematic review. *Smart Learning Environments, 10*(1), 41. https://doi.org/10.1186/s40561-023-00260-y

Liu, S., Boudouaia, A., Chen, X., & Li, Y. (2025). Comparative study about the impacts of Chinese Automated Writing Evaluation (AWE) feedback and teacher feedback on middle school students' writing practice. *The Asia-Pacific Education Researcher, 34*(2), 859-869. https://doi.org/10.1007/s40299-024-00903-9

Luckin, R., & Holmes, W. (2016). *Intelligence unleashed: An argument for AI in education*. UCL Knowledge Lab.

Miao, F., & Curukova, M. (2025). *AI competency framework for teachers*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000391104

Miao, F., & Holmes, W. (2023). *Guidance for generative AI in education and research*. UNESCO.

Mitchell, M. (2019). *Artificial Intelligence: A guide for thinking humans*. Pelican Books.

Queiroga, E. M., Machado, M. F. B., Paragarino, V. R., Primo, T. T., & Cechinel, C. (2022). Early prediction of At-risk students in secondary education: A countrywide K-12 learning analytics initiative in Uruguay. *Information, 13*(9), 401. https://doi.org/10.3390/info13090401

Roll, I., & Wylie, R. (2016). Evolution and revolution in Artificial Intelligence in education. *International Journal of Artificial Intelligence in Education, 26*(2), 582-599. https://doi.org/10.1007/s40593-016-0110-3

Selwyn, N. (2019). *Should robots replace teachers? AI and the future of education*. Polity Press.

Selwyn, N. (2022). The future of AI and education: Some cautionary notes. *European Journal of Education, 57*(4), 620-631. https://doi.org/10.1111/ejed.12532

Sperling, K., Stenliden, L., Nissen, J., & Heintz, F. (2022). Still w(AI)ting for the automation of teaching: An exploration of machine learning in Swedish primary education using Actor - Network theory. *European Journal of Education, 57*(4), 584-600. https://doi.org/10.1111/ejed.12526

Tavares, C., Simão, B., Martins, F., Santos, B., & Araújo, A. (2023). *Tecnologias de vigilância e educação: um mapeamento das políticas de reconhecimento facial em escolas públicas brasileiras*. InternetLab.

United Nations Educational, Scientific and Cultural Organization. (2019a). Artificial Intelligence in education. Challenges and opportunities for sustainable development. https://unesdoc.unesco.org/ark:/48223/pf0000366994

United Nations Educational, Scientific and Cultural Organization. (2019b). *Beijing consensus on Artificial Intelligence and education*. https://unesdoc.unesco.org/ark:/48223/pf0000368303

United Nations Educational, Scientific and Cultural Organization. (2021). AI and education: Guidance for policy-makers. https://doi.org/10.54675/pcsp7350

United Nations Educational, Scientific and Cultural Organization. (2023). Global education monitoring report summary, 2023: technology in education: a tool on whose terms? *Global Education Monitoring Report Team*. https://doi.org/10.54676/cuyc7902

Valente, J. A. (2006). *A gênese do NIED*. NIED. https://www.nied.unicamp.br/genese/

Vicari, R. M. (2021). Influências das tecnologias da Inteligência Artificial no ensino. *Estudos Avançados, 35*(101), 73-84. https://doi.org/10.1590/s0103-4014.2021.35101.006

Williamson, B., Celis, C. V., Sriprakash, A., Pykett, J., & Facer, K. (2025). Algorithmic futuring: Predictive infrastructures of valuation and investment in the assetization of edtech. *Learning, Media and Technology, 50*(1), 87-101. https://doi.org/10.1080/17439884.2024.2435820

CHAPTER 3

Benefits, risks, and purposes of using Artificial Intelligence in education: The Brazilian scenario

Graziela Castello,[1] Rodrigo Brandão,[2] Priscila Vieira,[3] Monise Picanço,[4] Florbela Ribeiro,[5] and Gabriela Trindade[6]

1 A social scientist, she is the coordinator of Qualitative Methods and Sectoral Studies at the Regional Center for Studies on the Development of the Information Society (Cetic.br), a department of the Brazilian Network Information Center (NIC.br)

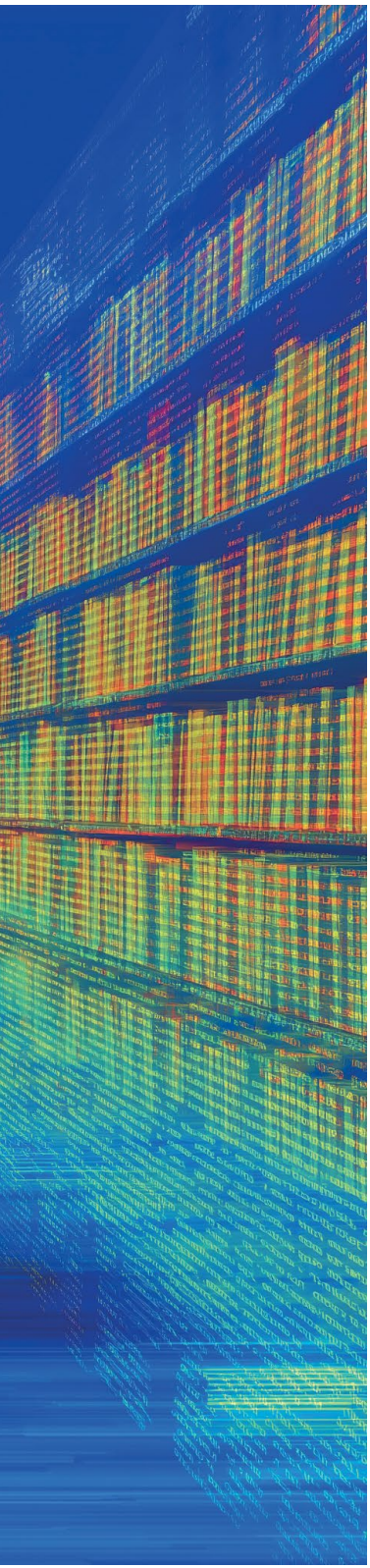
2 PhD in Sociology from the University of São Paulo (USP) and is a researcher under the Coordination of Qualitative Methods and Sectoral Studies at Cetic.br|NIC.br.

3 PhD in Sociology from USP, researcher and coordinator of the Development Center of the Brazilian Center for Analysis and Planning (Cebrap).

4 PhD in Sociology from USP and coordinator of the Development Center and cebrap.lab of Cebrap.

5 PhD in Social Anthropology from USP and researcher at the Development Center of Cebrap.

6 Master's degree in Public Policy from the Federal University of ABC and researcher at the Development Center of Cebrap.



PRESENTATION

The present chapter analyzes the current scenario of Artificial Intelligence (AI) in the Brazilian educational context, exploring the perceptions of various strategic actors, including representatives from academia, public administration, the market, school management, and civil society. The main objectives are mapping the stage of development of AI in Brazilian education, identifying the potential benefits, associated risks, and challenges, and proposing alternatives for its ethical and effective implementation.

The analysis presented here was based on 27 in-depth interviews conducted between June and August 2025 with representatives from several segments of the education sector who are deeply involved with the AI agenda in education, as detailed in Chapter 1 ("General introduction to the study and methodological notes") of this publication, in the "Methodological notes" section.

The results of the study are presented in five sections in this chapter. The first section, "Perceptions on the use of AI in Brazilian education," shows the participants' views on the benefits and risks of AI in education, the forms of application ("AI: What for?"), the motivations for its adoption ("Why AI?"), the strategies for its implementation ("AI: How?"), as well as the challenges and barriers faced. Throughout the presentation of these points, it will be possible to notice some theme repetition or overlapping, because, for many of the people interviewed, benefits can be mistaken for motivations, just as risks can be mistaken for challenges, depending on the purposes of AI use and the forms of mediation applied in the envisaged solutions. The strategy adopted in this analysis was prioritizing the reflections collected in the interviews, which made evident the difficulty of segmenting the themes. Therefore, the diffuse ways in which the issue has been perceived exposes the complexity of the theme, as well as the incipient nature of the agenda.

The second section, entitled "The Brazilian scenario of AI in education," presents the country's current status regarding the implementation of AI in the education sector. To this end, comparisons with the international context are made, and the degree of preparedness of the school community was assessed

based on the perceptions of the participants. The third section, "AI initiatives in education under development," describes pedagogical applications of AI known and cited by the participants, such as teacher training activities, uses in educational management, initiatives to institutionalize the agenda for the topic, and pedagogical applications. The fourth section, "The future of AI in Education," is based on an analysis of an exercise proposed to the participants, in which they were asked to reflect on what they thought ideal AI in education would look like: its purpose, its potential beneficiaries, the ways it could be implemented, and the agents responsible for putting it into practice. Last, the chapter concludes with the section "Final considerations," which summarizes the most important findings of this analysis, highlighting the convergences and divergences in the perceptions of the different interviewed segments.

PERCEPTIONS ON THE USE OF AI IN BRAZILIAN EDUCATION

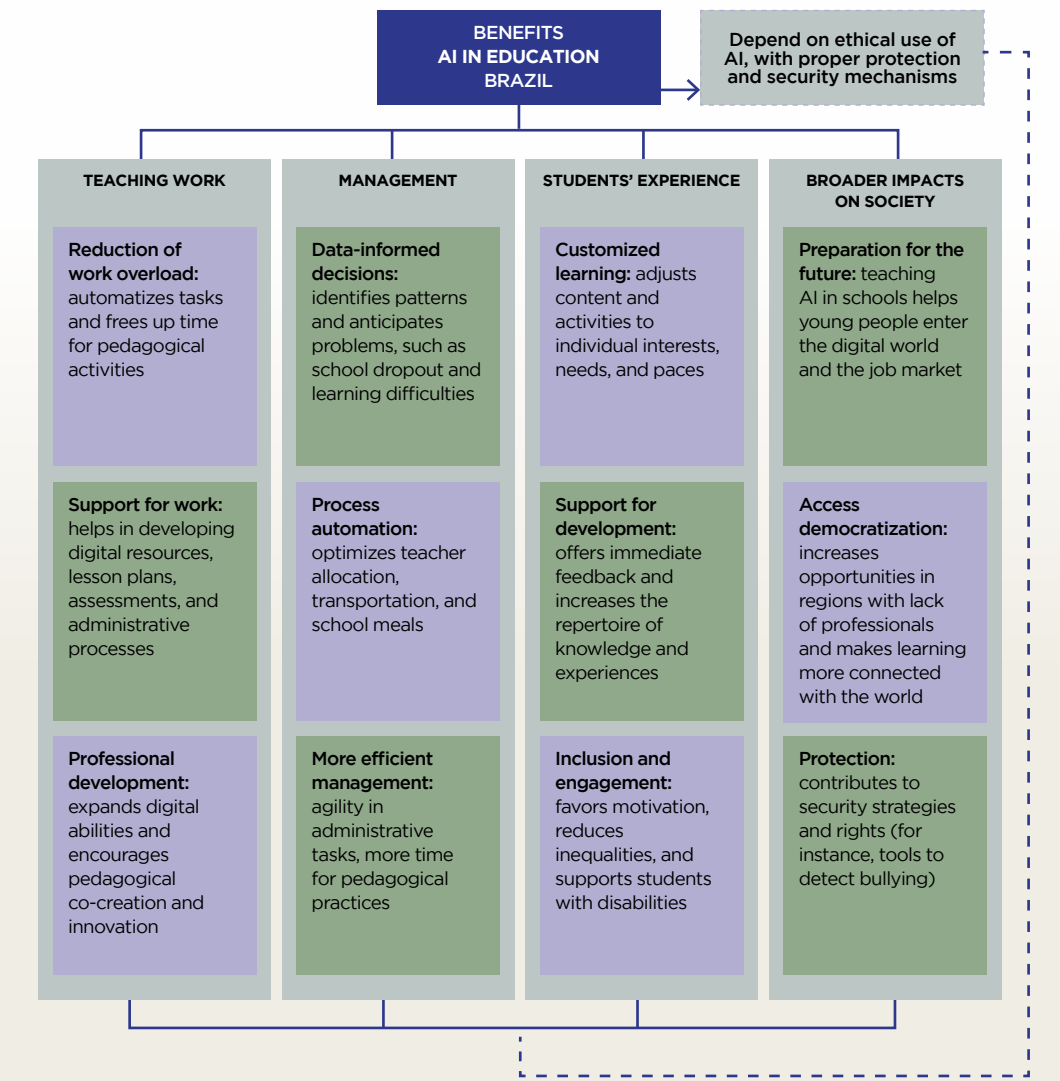
This section presents the results of the study, which aimed to describe the participants' perceptions on the use of AI in education, addressing its potential benefits and risks, as well as the challenges and barriers related to this technology. The section also examines the motivations for using AI in education ("Why AI?"), its purposes and forms of application ("AI: What for?"), and strategies to enable its use ("AI: How?"). The answers to these questions were not always formulated separately by the participants, even though their reflections could be presented in an articulated manner; thus, an analytical exercise was carried out to group them into each axis, as a way of better understanding these three dimensions that guided the study. However, theme repetition was kept to some degree; for example, when the same theme arose several times as a risk and as a challenge, the emphasis in each case varied, so it was highlighted in the two related subtopics.

Critical issues, such as security, data privacy, social inequalities, ethics, and responsibility, were understood as cross-cutting themes and, therefore, addressed in the subtopics of benefits, risks, and challenges, to which they were spontaneously associated in the interviews.

POTENTIAL BENEFITS OF USING AI IN EDUCATION

The participants mentioned different potential benefits of using AI in education, divided into four areas: (a) teaching; (b) management; (c) students' experience; and (d) broader impacts on society. Figure 1 summarizes the main results regarding perceived benefits.

FIGURE 1 – MAIN PERCEIVED BENEFITS OF USING AI IN EDUCATION



SOURCE: PREPARED BY THE AUTHORS.

Regarding teachers' work, AI emerged as a tool that can reduce overload and optimize tasks, freeing up time for pedagogical activities. This would include everything from creating digital resources and supporting the development of lesson plans and assessments to reducing the time spent on administrative processes. Many participants highlighted the possibility of expanding teaching skills, not only in the digital field but also in pedagogical co-creation and innovation activities, which allow professionals to favor special practices in the classroom.

The first one, and I think it is very important to say this right away, is that we have to understand AI not from the perspective of automating educational activities. It is exactly the opposite. We have to see AI as a tool available to teachers that helps improve the quality of education, [...] transforming students' experiences as it is gradually made available to teachers. I think this is a great opportunity, so to speak.

(PUBLIC MANAGEMENT STAKEHOLDER)

I wonder if a fraction of teachers' time can be optimized. [...] Time devoted to bureaucratic stuff, which reduces time to do other things. They can use this time for something that really matters. This is a benefit, it has pedagogical importance, it is a potential, an advantage that AI can bring.

(ACADEMIA STAKEHOLDER)

In the field of school management, AI is expected to enable more effective analysis of educational data, supporting diagnostics, identifying patterns, and offering predictive models for recurring problems, such as school dropout and learning difficulties. The potential for automating processes, including teacher allocation and management of transportation and school meals, was highlighted. Implementing these strategies could make educational policies more effective and free up time for schools to focus on their pedagogical goals.

Improving educational management processes, being able to carry out data analysis, to contribute to digital transformation, establishing better communication with citizens, with students' relatives—all these are resources made possible by AI, which will improve the management of educational policies.

(PUBLIC MANAGEMENT STAKEHOLDER)

An AI that helps me understand what is happening. In other words: Are my students learning? Is learning equitable? Are students in urban and rural schools experiencing different realities or different difficulties? So it can help understand the phenomenon by gathering the data, analyzing them, and presenting the results to the manager.

(ACADEMIA STAKEHOLDER)

Regarding students' experience, the most frequently mentioned benefits related mainly to learning customization. AI was considered a resource with the potential to adjust content and activities to individual interests, needs, and paces, offer immediate feedback, and expand the repertoire of diverse knowledge, going beyond what the teacher alone can offer each student. Its potential to increase student motivation and engagement, reduce learning inequalities, and support inclusion (for instance, of students with disabilities) was also mentioned.

> The student is facing a difficulty "X," then you go to them and you can, very quickly, provide them with content that meets their learning challenge. I think that this content processing and targeting is, for sure, another great advantage of AI.
>
> (MARKET STAKEHOLDER)

> From my point of view, AI has, in many ways, the potential to make things widespread, democratic. To reach everyone. This is one of the great virtues that I see when this technology is applied to favor student learning. You can reach many places that cannot be reached today.
>
> (CIVIL SOCIETY STAKEHOLDER)

Regarding broader social impacts, the possibility of teaching AI in schools also stood out as a benefit, as this learning tends to help young people enter the digital world and the contemporary job market. In this sense, by incorporating AI into everyday school life, educational institutions strengthen their primary role of preparing young people for the world and its challenges.

More broadly, AI is perceived by stakeholders as a means of democratizing learning, since it allows reaching regions where there is a lack of professionals and infrastructure, and bringing schools closer to everyday life, making learning more dynamic and connected to the world.

This technology, in the participants' view, can also contribute to the development of strategies to ensure the safety and protection of the rights of children and adolescents, by means of tools for early detection of bullying, for example. It is also believed that AI has the potential to increase students' individual autonomy, which facilitates creative processes and the study of complex topics.

Despite the mentioned potential, the participants emphasized that these benefits can be fully realized only

if AI use is guided by ethical principles and supported by appropriate protection and security mechanisms. Therefore, the enthusiasm for the possibilities was accompanied by concerns about implementation challenges and risks of misuse.

Most of the benefits of AI in education listed above were cross-cutting themes in the perceptions of the stakeholders from different segments analyzed in the study. However, there were variations in terms of emphasis, that is, of what the participants considered most positive among the potential benefits (Box 1).

BOX 1 – BENEFITS OF AI IN EDUCATION, EMPHASES OF INTERVIEWED SECTORS

SECTOR	MAIN PERCEPTIONS AND EMPHASES
PUBLIC MANAGEMENT	Focus on optimizing administrative processes and using data to predict and fight school dropouts. The importance of continuing education of teachers also stood out.
SCHOOL MANAGEMENT	Reduction of teachers' work overload, creation of innovative materials, and improvement of the relationship between teachers and students by means of informed feedback were stressed as important points. AI was considered a "copilot" of pedagogical work.
ACADEMIA REPRESENTATIVES	Adoption of a critical and conceptual approach, which questioned "which AI" was in use, with emphasis on ethics, awareness, and the development of human abilities that AI does not have.
MARKET REPRESENTATIVES	AI is a solution for large-scale challenges. Focus on learning customization, optimization of bureaucratic tasks, and management of educational data.
CIVIL SOCIETY	Focus on the potential of AI to democratize access to learning, promote inclusion, and reduce inequalities. However, there is some skepticism in the face of the lack of concrete evidence of benefits.

SOURCE: PREPARED BY THE AUTHORS.

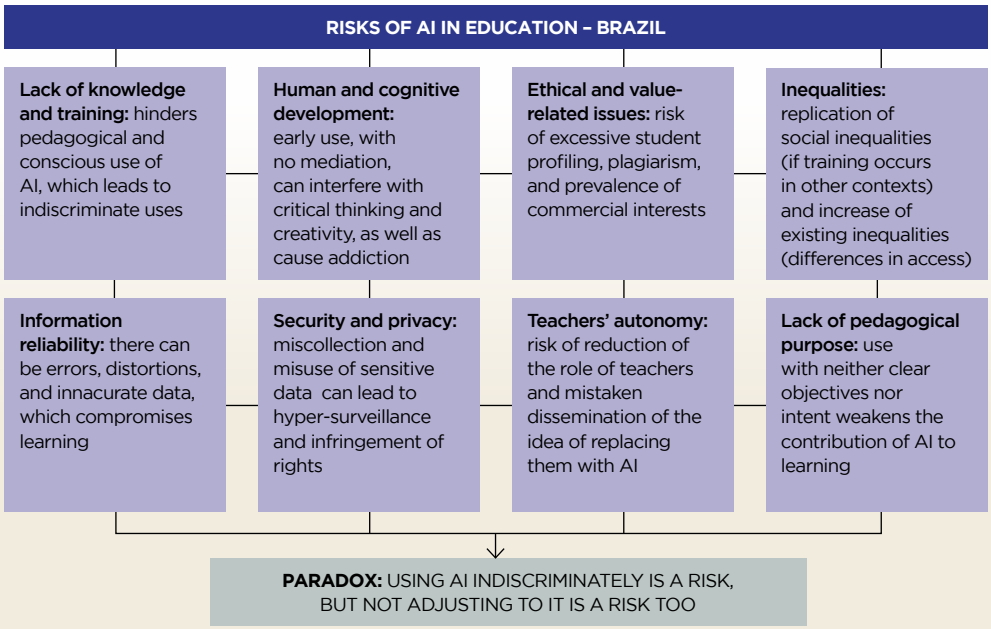
In summary, although learning customization, optimization of administrative processes, and support for teaching work were identified as cross-cutting themes, each segment emphasized the benefits most aligned with its specific priorities and challenges. As detailed below, representatives from academia and civil society also offered a more critical and cautious perspective on the risks of AI and the need for its ethical and conscious use.

POSSIBLE RISKS OF USING AI IN EDUCATION

> I am especially worried that people will start using tools with embedded AI without prior training for teachers and students, so they can understand what they are using and what is happening there.
>
> (PUBLIC MANAGEMENT STAKEHOLDER)

According to the stakeholders, the risks of using AI in education fell into different dimensions (Figure 2).

FIGURE 2 – MAIN PERCEIVED RISKS OF USING AI IN EDUCATION



SOURCE: PREPARED BY THE AUTHORS.

One of the points most emphasized by participants was the perceived lack of knowledge and training regarding this technology. Participants noted that many teachers and students resort to these tools without understanding how they work, their implications, or their limitations. The absence of specific training and dialogue between institutions (such as universities, enterprises, and schools) hinders the pedagogical and conscious use of technology, leading to indiscriminate use,

marked by a lack of digital skills to deal with the challenges brought about by AI.

Another set of concerns is related to human and cognitive development. According to participants, the early use of AI by students without adequate mediation can interfere with the development of critical thinking and creativity, in addition to generating technological dependence and the outsourcing of learning. Furthermore, participants noted that because AI operates based on past patterns and data, it can limit innovation, reduce analytical skills, and make it difficult to distinguish between fact and fiction. There were also warnings about impacts on social relationships, such as the risk of weakening face-to-face interactions and strengthening opinion bubbles.

> I do not think the risk here is plagiarism or cheating. The risk here is a very deep effect on cognitive development. It has been proven that, if you stop writing your e-mails because you use ChatGPT to do it, the time will come when you will not be able to write your e-mails by yourself.
>
> (MARKET STAKEHOLDER)

> We think about, for instance, what is being left out in the cognitive domain when we consider learning. [...] what I am leaving aside when I use AI. Language? Well, this is another factor. There is this guy who discusses anchoring, or cognitive bias. When we start producing something by asking AI to do it, it gets difficult to break out this structure created by the tool. We keep fighting this structure, and we could have created it in another way, one that made more sense for the creation.
>
> (SCHOOL MANAGEMENT STAKEHOLDER)

Ethical and value-related issues also gave rise to apprehension. Academia and public management stakeholders expressed concern that the commercial interests of companies developing these technologies will prevail over educational objectives, potentially leading to the dehumanization of education. In addition, profiling students using predictive systems may foster stigmatized views of them, leading teachers to avoid investing in certain students rather than encouraging their development. Furthermore, concerns about unethical uses, such as plagiarism and information manipulation, add to fears that schools will begin to ignore fundamental humanistic values, such as dialogue, respect, and dignity. Therefore, the ethical dimension must be considered from the development of the tools to the stages of dissemination and implementation, so they do not deviate from the pedagogical objectives that guide them.

Student profiling can be used in very positive ways, but it can begin to be used in a negative way, almost like a prophecy, you know? From the moment I mapped that this student has relevant family issues, that he has an engagement issue which is reflected in his school attendance, and that he got bad grades, and I put it on record in a report [...] to what extent we can get a bit lost in this profiling process and start using these data to give up. [...] I think it is because of the hierarchization, the ranking of students, which somehow results, in part, from profiling them. To what extent will this lead to bad results in education and make us behave like the characters from *Minority Report*? Make us give up on people even before they commit a crime?

(PUBLIC MANAGEMENT STAKEHOLDER)

The risk of spreading biased content and widening inequalities was a recurring theme in the interviews: AI can have the negative potential to replicate racial, gender, and cultural injustices, especially when trained in contexts distant from the Brazilian reality. This mismatch can result in cultural erasure and symbolic and social exclusion, affecting groups that do not recognize themselves in the results generated by the tool. In addition, unequal access to technological devices, connectivity, and digital literacy impacts access to AI tools, widening the digital and social disparities that exist in the country.

We always warn our students that AI is a generic summary of the world. And it has great difficulty addressing specific subjects.

(SCHOOL MANAGEMENT STAKEHOLDER)

On the Internet, 56% of the content is written in English, whereas only 5% of the world population is native English speakers. So obviously, there is a bias. There are two things that are probably happening: Number one, people who speak English produce more content on the Internet; and number two, people who do not speak English but use it as a second language are producing content for the Internet (these people are probably from higher social classes, since they have access to learning a second language). This, obviously, results in a series of biases in the database that trains AI models and, therefore, these models replicate worldviews and ways of life that do not necessarily match the local ones, which alone can result in the risk of erasure of the local culture.

(MARKET STAKEHOLDER)

[...] from the moment you have very unequal environments in the country, using AI with only certain nuclei or groups can increase the gaps caused by inequalities that are already known to exist.

(CIVIL SOCIETY STAKEHOLDER)

Another point highlighted as a risk was the reliability of the information presented by AI. Generative models can produce errors and "hallucinations," as well as generate inaccurate and unreliable data. If users do not have the necessary skills to identify these flaws, the consequence may be the proliferation of false information, including in audiovisual formats, such as videos and synthetic images (deepfakes).

Data security and privacy were also mentioned as risks of using AI in education. The storage and circulation of sensitive information about students and teachers raise concerns about improper data collection, commercial use of private data, and hyper-surveillance mechanisms. Facial recognition technologies in schools, for example, were cited for their potential for data leaks, the normalization of surveillance they are associated with, and the loss of privacy.

> This awareness of how the solutions are, what security is, what privacy is, we have to really work on discussing and clarifying these concepts, ok? With everyone, with students, teachers, and institutions as a whole. So, yes, awareness of privacy risks, security, not just privacy risks, but also concepts of security, what is safe, right? A lot of clarity about using safe models. This awareness is the basis.
>
> (MARKET STAKEHOLDER)

After analyzing the potential influence of AI on the role of teachers and schools, the participants warned about the weakening of teacher autonomy and the misguided dissemination of the idea that AI will play, even if only partially, the role of teachers. This trend was identified as a significant risk, since it threatens the relational dimension of education, reducing it to instrumental and automated processes.

Last, some participants pointed out the risk of using AI in education without a clear and defined pedagogical purpose, which can reduce the relevance and educational value of this technology in school practices.

The analysis of the interviews indicated a paradox: While there are risks in indiscriminate use, failing to adapt to this new scenario and ignoring the transformations brought about by AI also pose risks to education, potentially widening the gap between schools and society.

The presented risks formed a predominant view among the different participant profiles, although the emphasis and depth of their concerns varied (Box 2).

BOX 2 – RISKS OF AI IN EDUCATION, EMPHASES OF INTERVIEWED SECTORS

SECTOR	MAIN PERCEPTIONS AND EMPHASES
PUBLIC MANAGEMENT	Lack of preparation and knowledge to use AI, prevalence of commercial interests over pedagogical ones, possible losses in cognitive development, excessive learning customization, risks to data security, risk of cultural erasure.
ACADEMIA REPRESENTATIVES	Theoretical and critical approach of the risks, with emphasis on threats to privacy, biases, algorithmic discrimination, misinformation and "hallucinations," weakening of the role of teachers and schools, technological addiction, and deviation from the humanistic values of education.
CIVIL SOCIETY	Need for teacher training and data protection, fear of commodification of education, concerns about the environmental impact of AI, and inequalities in access to technological infrastructure.
MARKET REPRESENTATIVES	Misinformation-related risks, algorithmic biases, and the use of facial recognition tools in schools.
SCHOOL MANAGEMENT	Practical challenges in the implementation of AI tools in everyday school life, need for professional training, possible negative impacts on learning, and difficulties in student assessment.

SOURCE: PREPARED BY THE AUTHORS.

In summary, although most segments shared concerns about lack of preparation, ethics, biases, reliability, and privacy, each group's specific perspective influenced their analysis and prioritization of these risks, as a consequence of their experiences and responsibilities in the field of education.

The following section presents perceptions regarding the three guiding questions of the study: "Why AI?," "AI: What for?," and "AI: How?." Many participants had difficulty reflecting on these questions in isolation and, therefore, presented an integrated response to the questions. An analytic exercise to systematize the main arguments related to these points is shown below.

WHY AI?

Schools are a privileged space for us to qualify the use of AI and discuss this use.
(SCHOOL MANAGEMENT STAKEHOLDER)

The empirical research encouraged stakeholders to answer the question "why AI in education?," fostering reflection on the main reasons for adopting this technology in teaching.

The most frequent reaction to this question was a perception of inevitability: The presence of AI in education was described as "inevitable," "urgent," and "a path of no return." The prevailing perception was that AI has imposed itself on society and that, consequently, Brazilian education needs to face this novelty, appropriate this technology, and make it a subject of teaching.

The main reason for introducing AI into education is the need to adapt to ongoing social and technological changes. According to most of the people interviewed, ignoring its incorporation into the school environment could lead to a loss of educational relevance in the geopolitical scenario, in addition to compromising the strengthening of democracy and critical thinking in Brazil.

The adoption of AI in education is considered a means of aligning schools with contemporary reality, fostering dialogue with social change, and preparing Brazilian students for a world in constant transformation.

Education has to do with current social practices. So it must keep an eye on what is happening in the world these days. If we have to keep an eye on what is happening, we have to turn our attention to AI.
(SCHOOL MANAGEMENT STAKEHOLDER)

The first thing we have to think about is that AI, just like any other disruptive technology, will affect the way we interact with people, the way we learn, the way we teach, and the way our society organizes itself.
(ACADEMIA STAKEHOLDER)

Adoption of AI in education was justified for various reasons, usually related to its potential benefits. The main reasons cited included improved learning, the possibility of new experiences in teaching and educational content production, support for pedagogical activities, and teaching customization.

Another cited reason was AI's ability to reduce costs and increase efficiency in assessment and management processes,

while expanding access to information and enhancing practices recognized by pedagogy. In addition, participants mentioned another justification: the expectation that AI will help reduce educational inequalities. When combined with digital inclusion policies, adequate infrastructure, and training, it can promote student inclusion and expand learning opportunities.

Even the interviews that did not present such an optimistic view about AI in education recognized the need to understand how it works and promote critical debates about its meanings and implications in the school community.

> If we do not prepare our students to perceive how this has affected reality, we will begin to face challenges regarding democracy and dumbing down. In general, we may deviate from the idea of what science is, what facts and the truth are.
>
> (PUBLIC MANAGEMENT STAKEHOLDER)

In general, the stakeholders understood that teaching about AI is increasingly necessary, as this technology is present in everyone's daily lives, in different tools and activities. Therefore, conscious use of AI was recognized as a condition for teachers, students, parents, and managers to anticipate risks and make responsible choices. In other words, understanding AI is an integral part of an education oriented towards citizenship, just as schools, by definition, are the social institutions responsible for educating critical citizens.

> Schools must be a reflection of the society in which these students will live, grow up, develop, and work, right? So they cannot stay distant from a reality that is so present in society.
>
> (CIVIL SOCIETY STAKEHOLDER)

After the discussion above about the main motivations for adopting AI in education, we will move on to the purposes and forms of application of these tools, that is, the answers to the question: "AI: What for?."

AI: WHAT FOR?

The study sought to investigate the objectives of adopting AI in education. During the interviews, the participants were encouraged to reflect on the following question: "What is AI in education for?." The stakeholders emphasized that AI should be

used primarily to enhance learning, support teaching practices, and prepare students for a constantly changing world.

Regarding support for teaching practices and enhanced learning, a representative from civil society stated:

> Helping the teacher plan their classes and make them much more attractive, interesting to young people, in a customized way, following assessment in real time (which helps the teacher make decisions much more quickly). A tool that provides the teacher with feedback so they can be more assertive in the classes and in students' learning.
>
> (CIVIL SOCIETY STAKEHOLDER)

The perspective summarized in the previous account was particularly emphasized by school management professionals, who considered AI to be a tool for expanding and enhancing classroom debate and individual learning. One of the participants from this segment described how AI can act as a "magnifying glass" on a topic, allowing students to explore different views and deepen their understanding of the content:

> AI is used this way to broaden the debate, the discussion. So we use it as an enhancer, an expansion tool, as if it were a magnifying glass over that subject. With this and our students' previous knowledge as starting points, we can bring other perspectives, other views to the center of the debate.
>
> (SCHOOL MANAGEMENT STAKEHOLDER)

Another representative from this segment complemented this perspective. In their account, the participant declared that AI should not be considered an end product, but rather a tool, a means to an end.

In addition, AI was perceived as a resource for individualizing study plans and assessments, bringing teaching closer to the individual needs of each student. Some participants pondered the possibilities that technology offers for generating personalized study plans and adaptive assessments in order to promote a better fit between the teaching process and the student's learning pace:

> AI helps automate and speed up several processes. Sometimes, you can do in one day things that it would take two, three weeks to complete in the past. If you want to formulate personalized study plans for a student, it is more feasible to do it by using AI, because it can detect the student's flaws [...] when the teacher has a class with 30, 40 students.
>
> (SCHOOL MANAGEMENT STAKEHOLDER)

Another point that stood out in the participants' accounts was that AI inclusion in education should aim to prepare students for life in a society marked by rapid social and

technological transformation. In this context, schools should promote the responsible use of this technology and help the students develop critical and reflective skills, connecting learning to the outside world and to major contemporary issues, with the aim of educating qualified citizens:

> Turning attention to AI is part of the digital inclusion of children and teenagers [...] schools are the place where they are going to learn how to use this tool responsibly, reflect on it, understand the effects, for example, of disseminating fake messages, of reading unreliable sources, of seeking better results.
>
> (CIVIL SOCIETY STAKEHOLDER)

> Nowadays, the world is surrounded by AI. And if we prepare—if education says that it prepares people for the world, this world has to be closely connected with pedagogical activities [...] in this scenario of uncertainty [...] it is necessary to include minimally what the world is experiencing and incorporate that into an education that establishes a dialogue, even if very incipient, with what the students will face outside the school.
>
> (SCHOOL MANAGEMENT STAKEHOLDER)

According to the participants, optimizing time and resources is another important goal of using AI in education, especially when it comes to administrative processes and operational tasks, and handling data for decision-making.

The analysis of the views of the different actors showed clear agreement regarding the purposes of adopting AI in education. In summary, the prevailing perception was that this technology should be a support for teaching, a tool to enhance pedagogical processes and prepare students for the world, as well as to organize and analyze complex data and information.

AI: HOW?

After answering the questions about the reasons for adopting AI in education, its purposes, and its priority modes of application in the educational environment, the participants explored how this incorporation should be carried out. The researchers asked the question: "AI in education: How?" to gather perceptions about paths, strategies, and means to put into practice the scenario the participants had envisaged.

According to participants' views, to enable the adoption of AI in education, it is essential to promote strategies for teacher education and training. In their opinion, education professionals need to be prepared to integrate this technology into their teaching practices to ensure that its adoption is productive, ethical, and consistent with educational objectives.

Some managers expressed their views that, in the face of the dissemination of this technology and its inevitable presence in schools and students' lives, it is necessary to promote a transformation in the role of teachers. They must be more than mere transmitters of knowledge: they must also serve as mediators of learning and support students in developing critical and reflective thinking.

> First, we have to train teachers to carry out content curation. Encyclopedic teachers no longer make sense. They may still have a certain charm—we still enjoy encyclopedic classes, at least in the expository bits, but they are not the central figure in teaching activities anymore. These days, teachers must be able to help students ask questions.
> (PUBLIC MANAGEMENT STAKEHOLDER)

Deepening the reflection on pathways for incorporating AI into education in a beneficial way, stakeholders emphasize that professionals' training must be continuous and accompanied by consistent policies that involve the entire education network and ensure the planned and systematic incorporation of technology. Therefore, the use of AI must be intentional, ethical, and oriented toward supporting clear pedagogical objectives, functioning as a tool to support educational decision-making, without losing sight of the focus on students and their learning. Consequently, the interviews indicated that continuous professional training is the main way to leverage the potential benefits and mitigate potential risks.

The participants also mentioned that strategies for introducing this technology into school life should consider aspects such as age groups and the needs of each student's profile. They declared, for example, that young children should learn about AI through offline activities, while older students can explore this technology in research projects, problem-solving, and personalized learning.

> AI should be used with intent and awareness. With young children, we cannot use it under any circumstances. We have to talk about it. There is talking about AI, and there is talking to AI.
> (SCHOOL MANAGEMENT STAKEHOLDER)

> It must be done so that AI contributes to activities in the classroom and to students' lives. It is not just that we are going to teach that AI exists, that they can do anything with it—we have to give a reason for them to use it, to improve their grades, to increase their knowledge, to make them move forward.
> (SCHOOL MANAGEMENT STAKEHOLDER)

Another important point stressed by the participants in their reflections on ways to efficiently adopt AI in education is its integration into the curriculum and teaching methodologies. This incorporation can occur in the computer science and digital technologies curriculum, but also across the board in the teaching of different areas of knowledge, as a pedagogical support tool aligned with educational principles and existing methodologies.

> AI is an enhancer, since it makes students able to find other ways to learn. Always keeping in mind that it must happen in safe environments, mediated by teachers, and never fully independently, but, of course, ensuring that the student can be at the center of their learning.
> (SCHOOL MANAGEMENT STAKEHOLDER)

Additionally, there was a clear perception that the path to effective AI implementation in education also depends on investments in infrastructure, connectivity, and digital resources. Some participants pointed out that the National Strategy for Connected Schools (Enec),[7] which aims to provide quality Internet access and technological infrastructure for educational use in all basic education schools by 2026, could be a good way to achieve this goal.

In summary, the successful implementation of AI in education would require the mobilization of several complementary strategies. The initial and indispensable step is investing in the continuous training of teachers and administrators so they can act as critical and ethical mediators of technologies. It is also essential that AI be integrated into educational curricula in order to serve pedagogical principles, ensuring intentional and ethical use that respects the needs of different age groups of students.

Last, for these steps to be effective, investments are needed in infrastructure, connectivity, and digital resources capable of ensuring equitable access to technology and its potential benefits.

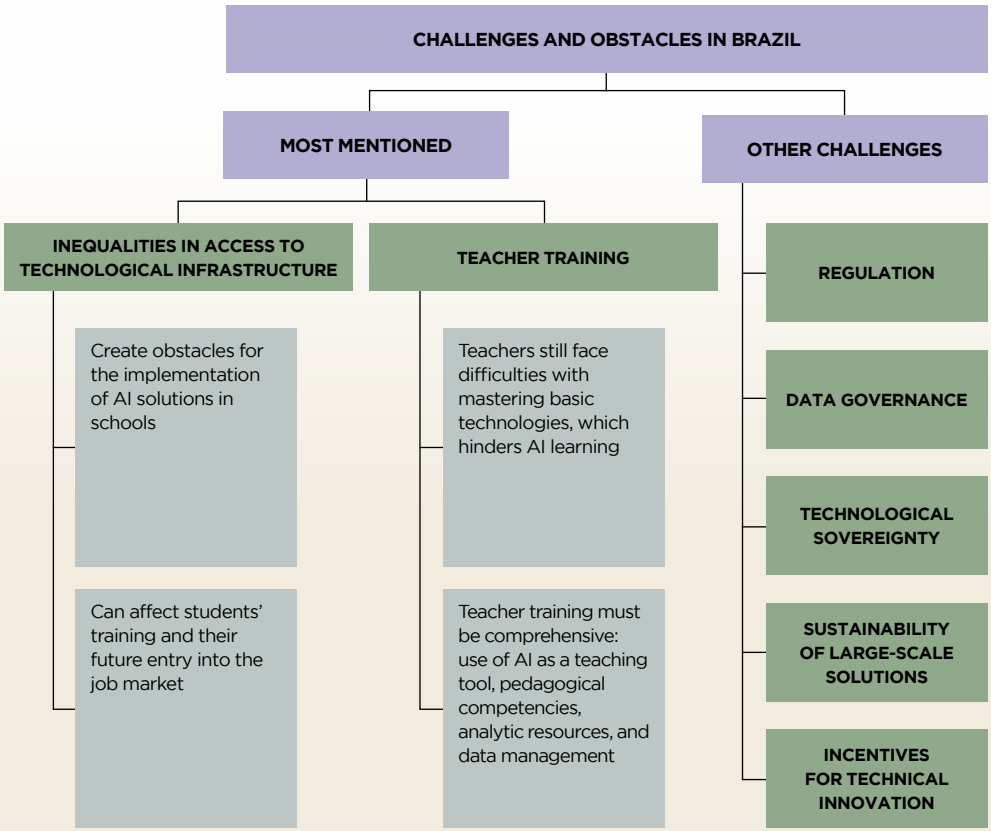
CHALLENGES AND OBSTACLES TO THE ADOPTION OF AI IN EDUCATION

The present study mapped the participants' perceptions about the main challenges and obstacles to the appropriation

7 Find out more: https://www.gov.br/mec/pt-br/escolas-conectadas

of AI by Brazilian education. Figure 3 shows a cross-cutting summary of the items mentioned by the stakeholders.

FIGURE 3 – MAIN CHALLENGES AND OBSTACLES TO THE ADOPTION OF AI IN EDUCATION



SOURCE: PREPARED BY THE AUTHORS.

The most frequent answers from the participants regarding challenges and barriers to adopting AI in education focused on two areas: teacher training and technological infrastructure. It is worth noting that these points converged with those perceived as means and conditions for the positive incorporation of this technology in education, as presented in

the previous section. In addition to these aspects, challenges related to regulation, data governance, technical limitations (with consequences for technological sovereignty), and institutional barriers (which reduce incentives for technical innovation) were mentioned.

Moreover, the issue of technological infrastructure and unequal access to it was identified as one of the main challenges in the Brazilian context. The participants stressed that access to basic technology, such as computers, laptops, and high-quality Internet, is uneven across the country, creating significant obstacles to the implementation of AI solutions in public and private schools. This unequal access to technological infrastructure and, consequently, to the potential benefits of AI in education can affect the quality of students' education and their future entry into the job market, since it widens social and educational gaps.

I think that we can only start talking about AI in Brazil after technology improves a lot, right? We always mention the small minorities. In public schools, not everyone has access to it. The students have access to it here at school. But in the world, in their homes, there is a need for access to technology. Even Wi-Fi, mobile phones, computers... So I believe that this is a difficulty in our country.

(SCHOOL MANAGEMENT STAKEHOLDER)

The fact that you do not have access to Internet devices will cause you to not know the tools, and this will make it harder for you to enter the job market or stay in it.

(PUBLIC MANAGEMENT STAKEHOLDER)

Teacher training was also perceived as a major challenge in the Brazilian context. It is observed that most teachers still face difficulties with mastering basic technological tools, which makes the learning process regarding AI-based resources more complex for these professionals. The participants who pointed out this challenge also argued that such training should cover the use of AI as a tool for teaching and developing pedagogical skills, as well as application in analytical and data management resources.

We had not been able to properly train (so to speak) all our teachers to use technology at more basic levels, and now there is the challenge of AI. So the challenge of training teachers is really, really huge.

(PUBLIC MANAGEMENT STAKEHOLDER)

It is a great challenge for Brazil to carry out large-scale, high-quality teacher training, guaranteeing that teachers have access to this training, not just as a standard practice or because it is mandatory, but making sure that they receive training compatible with their everyday lives in the classroom. I think that, when they feel safe to use it, we will be able to effectively use AI in favor of learning.

(SCHOOL MANAGEMENT STAKEHOLDER)

Another point considered critical by some participants from all segments related to the regulation of platforms and the establishment of legal standards for the use of AI, as well as the formulation of pedagogical guidelines for using this technology in education, an aspect highlighted mainly by actors from academia. The stakeholders interviewed recognized the need to improve AI-related regulations in Brazil and to clarify ethical limits, legal provisions, and data protection mechanisms. Without clear rules or defined regulatory frameworks, students and teachers may be exposed to ethical, legal, security, and privacy risks.

But I think that, without regulation, we cannot keep thinking that old way—that digital technology is just another tool. We can reflect on this use and use the tool, but it also uses us all the time. This relationship has not been considered.

(ACADEMIA STAKEHOLDER)

The themes of governance and data protection were mentioned as challenging by some participants. One stakeholder drew attention to the importance of good, qualified data collection so that teaching customization, one of the potential benefits of using AI in education, can be effective. However, he noted that strict governance rules must guide data collection and use in order to prevent leaks and inappropriate sharing.

What governments, education secretariats, etc. must do, generally speaking, is to improve data collection: educational data, assessments, student data, and student profiling data. The quality has to be really improved in a very strict governance regime, which does not allow leaks or inappropriate sharing of this data.

(PUBLIC MANAGEMENT STAKEHOLDER)

The interviews also addressed technical challenges, including the need to develop solutions compatible with the limited technological infrastructure in some regions of the country and to promote the improvement of offline tools and models adapted to Portuguese. Innovative initiatives that seek to circumvent connectivity restrictions, such as AI systems that dispense with the Internet (unplugged AI), capable of offering educational experiences in contexts of scarce resources, were mentioned.

The participants pointed out that dependence on foreign technologies, combined with a lack of investment in research and development in the country, raises concerns about technological sovereignty and national autonomy in the field of AI. In addition, challenges related to the sustainability of this technology's solutions implemented in large-scale education networks: Equipment deteriorates and service subscriptions undergo constant changes, aspects that can extensively compromise the continuity of projects. Discontinuity, therefore, becomes even more critical when changes in public administration and suspension of programs and solutions of previous administrations are considered.

Representatives from the private sector highlighted political, bureaucratic, and corporatist barriers that hinder the adoption of AI in Brazilian education. According to this perception, the complexity of educational governance in Brazil, together with the rigidity of public contracts, tends to delay the implementation of innovative solutions, discourage investment, and hinder the scaling of successful experiences.

> Governmental hiring mechanisms in the area of educational innovation are, these days, the great barrier that prevents adoption of educational technologies. Governments do not have legal mechanisms to adopt educational innovation.
>
> (MARKET STAKEHOLDER)

In summary, adoption of AI in Brazilian education faces a series of structural challenges and depends on integrated solutions that include improvement of technological infrastructure, robust and continuous teacher training, regulation of platforms, and improvement of data governance, as well as incentives for technical innovation and technological sovereignty.

THE BRAZILIAN SCENARIO OF AI IN EDUCATION

> Artificial Intelligence is still under development, still in its infancy. It is a subject that is very poorly understood by most people who deal with it. Both here in Brazil and abroad, there is still a lot of conflicting information about what AI can contribute to in education, and there is no sort of consensus about it yet.
>
> (PUBLIC MANAGEMENT STAKEHOLDER)

This section describes the scenario of AI development in Brazilian education, based on the perceptions of the different actors who participated in the study. The focus was on the current stage of adoption of this technology, structural gaps,

challenges faced, identified resistance, and factors favoring AI adoption in the Brazilian context. The analysis compared Brazil with other countries, assessed the preparedness of the school community, and stressed the differences between public and private networks in terms of infrastructure, teacher training, and student skills. The goal was to understand how these elements interact and influence the country's ability to integrate AI into the education system effectively.

CURRENT STAGE OF BRAZIL IN THE FIELD OF AI IN EDUCATION

According to the people interviewed, Brazil's current stage regarding the adoption and implementation of digital technologies in education, especially in the field of AI, is marked by sporadic advances and significant structural gaps. The prevailing view is that many basic conditions for the effective implementation of AI in Brazilian schools have not yet been consolidated. The responses to the question about the current stage of AI in national education brought images and representations of an initial moment: "In its infancy" was the most recurring expression used by the participants to describe the scenario.

The current stage of AI in Brazilian education was described, in general, as incipient and marked by experimentation. In the different segments examined, the predominant idea was that, although AI is socially widespread, its effective use in education still lacks structure, training, and clarity of objectives.

Among public management representatives, for example, there was consensus that the country has good connectivity, especially via mobile phones, which opens a window of opportunity. However, this potential has not yet been fully explored, since access to technology does not always translate into qualified and conscious use, as summarized by a public manager: "I think that its use is widespread, but there is still very little preparation for good use."

Among representatives from academia, there was consensus that there has been significant progress in recognizing the potential benefits of AI and that more significant resistance to the technologies observed in the recent past has been overcome. Even so, these participants maintained their

criticism that the Brazilian debate on AI needs to mature, since it is restricted to specific technologies and does not move forward to broader discussions on digital transformation and its social impacts. This perception of immaturity also appeared in academic analyses of the market, given that experimental initiatives still predominate, with no consolidated cases of large-scale use of AI in education.

The diagnosis of school management professionals and civil society organizations converged on the perception that the stage of AI adoption is initial and that the impact of this technology has little significance in school practices. These stakeholders reiterated that, in general, teachers do not yet use AI regularly in their teaching practice, as a consequence of a lack of specific training and infrastructure. In addition, they warned that introducing new technologies without overcoming structural problems, such as poor connectivity in schools and limited access to equipment, tends to widen existing inequalities. One of the participants mentioned:

> Having a very clear notion that, in a network without quality Internet for students, without devices [...] the AI available in this place will widen inequalities.
>
> (CIVIL SOCIETY STAKEHOLDER)

Despite the general perception that AI in Brazilian education is still incipient and characterized by limitations, some participants mentioned its potential. It is believed that Brazil has the potential to develop this technology in the near future, given the existence of important private sector innovation hubs and many ongoing debates and initiatives.

There is also growing curiosity about this topic, as well as commitment by research groups, social organizations, and some educational networks to forge paths for responsible adoption of this technology. Therefore, the current scenario can be described as a period of consolidation of the first experiences, which are still fragmented and uneven, but allow us to glimpse both the risks and possibilities involved in the transformation of Brazilian education.

In order to better determine the current status of AI in Brazilian education, the interviews explored the participants' perceptions of factors that favor its adoption in the country. A recurring theme was the understanding that Brazil has

widespread connectivity and access to the digital world by means of mobile phones, even in regions with poor infrastructure. This scenario was perceived as an advantage in comparison with other developing countries, because of the openness to the use of AI-based digital platforms.

Another factor identified as favorable was the cultural nature. The participants considered that the Brazilian population demonstrated openness and a particular interest in new technologies, evidenced by the rapid and massive adoption of social networks and communication applications in the country. Therefore, this disposition may facilitate the introduction of AI tools into everyday school life.

The school infrastructure of some education networks was also identified as a favorable element for the incorporation of AI, especially in cases when there are robust investments in digital technology. Although inequalities between Brazilian municipalities and states are significant, managers recognized a significant advance in access to the Internet and digital devices in schools in recent years, which creates better conditions for the adoption of new technologies.

The participants were asked about the differences between public and private education networks in Brazil regarding the adoption of AI. They identified clear structural differences, which are mainly evident in access to technological infrastructure.

According to the participants, private schools usually have more material and institutional resources, such as equipment, laboratories, and quality connectivity, as well as administrative autonomy to implement technological solutions, which facilitates the adoption of AI tools and the development of diverse and innovative pedagogical activities. On the other hand, the public education system faces significant limitations: Many schools still lack stable electricity, adequate connectivity, or enough computers for all students, a situation that compromises the incorporation of new technologies. However, many stakeholders stressed that there are positive experiences in these schools, which are making rapid progress in this area. Some examples can be seen in the public school systems in the states of Piauí and Paraná, mentioned in several interviews, because of the recent adoption of AI in education, in both teaching practices and school management. These school

systems came up during the interviews as good examples of strategic investments, innovation projects, or public policies that favor digitization and teacher training.

A noteworthy aspect was teacher training in both public and private education systems. It was the participants' opinion that, although access to resources is greater in private education, teacher training is not always systematic or high-quality, since it often depends on individual initiatives or actions promoted by the education systems themselves. In the public system, this shortcoming is even more evident, marked by the difficulty with continuous updating and a scarcity of structured training programs.

In addition to mentioning structural and formative differences, the participants emphasized that students' socioeconomic conditions influence the learning and use of technologies. They pointed out that, in the public school system, there are many students in socially vulnerable situations, which compromises the educational experience in general.

Regarding the adoption of technologies and innovation, there was a consensus that private schools tend to advance more quickly, motivated by administrative autonomy, budget flexibility, and competition between institutions. In some private networks, there are advanced AI systems that monitor attendance and performance, predict school dropouts, issue alerts to families, and personalize learning trajectories. In contrast, the public network relies heavily on public policies, structured projects, and systemic support to advance AI integration, although there are some examples of innovation in robotics, research, and digital assessment projects.

Another point highlighted by the participants was how the focus of the two administrative jurisdiction differs. While the public school system prioritizes the results of national assessments such as the National High School Exam (Enem)[8] and the National Basic Education Assessment System (Saeb)[9], which guide policies and investments, the private school system focuses its efforts on attracting and retaining students, using technologies to create competitive advantages and improve the

8 Find out more: https://www.gov.br/inep/pt-br/areas-de-atuacao/avaliacao-e-exames-educacionais/enem
9 Find out more: https://www.gov.br/inep/pt-br/areas-de-atuacao/avaliacao-e-exames-educacionais/saeb

educational experience. This distinction directly influences how technology is implemented and applied, which affects pedagogical priorities and investments.

Moreover, representatives from all the segments recognized that the adoption of AI and educational technologies can widen inequalities if attention is not paid to access conditions, infrastructure, and socioeconomic context. Private schools with resources can innovate and offer sophisticated learning experiences, while public schools, in many cases, are limited to implementing solutions defined by public administration, with no flexibility for local creations and adaptations.

The accounts suggested that, in order to minimize the risks of widening inequalities among Brazilian students, it is essential to invest in equitable educational and technological policies based on principles of open technologies that consider the insertion contexts, without neglecting the systemic and integrated coordination of the educational process.

In summary, the participants agreed that the differences between public and private networks, despite involving structural, economic, technological, and social factors, are not definitive. Strategic investments, consistent public policies, teacher training and support, and attention to inequalities can enable the public education system to advance and reduce historical gaps with the private education system, especially regarding the use of technologies and AI aimed at enhancing learning.

Last, we investigated whether the participants perceived any resistance to the adoption of AI in education. In general, they identified only isolated and indirect resistance, rather than an organized or widespread movement against its use in education. According to the stakeholders, the most recurrent resistance showed in subtle ways and related more to concerns about fads, ethical risks, and lack of reliability than to an ideological or systematic rejection of AI. This resistance manifested mainly as an initial concern among teachers and family members about the replacement of teaching work by AI tools or their negative impact on learning:

> Resistance? Well... There are some teachers... I have not talked to them directly. Instead, I have read some reactions of teachers questioning if they are going to be replaced [...] it has become increasingly clear that they will not, that it is a support rather than a replacement.
>
> (CIVIL SOCIETY STAKEHOLDER)

Public managers and academia representatives explained that resistance is not systematic opposition, but caution due to the need for evidence on the effectiveness, costs, and real impacts of AI implementation:

> Forbid? I would not say so. I think forbidding would still be the result of the public managers' common sense. All these things have costs, have not matured, have not been proven.
> (PUBLIC MANAGEMENT STAKEHOLDER)

The interviews sought to capture the participants' perceptions about the Brazilian school community's level of preparedness for incorporating this technology. Most believed that the community is not ready for this integration and understands that the readiness of the Brazilian school community for the use of AI in education is still limited, encompassing students, teachers, management, and families.

Although students show familiarity with digital tools and use AI in schoolwork and school activities, their use of this technology is superficial, usually without ethical, critical, or moral reflection, while teachers face significant challenges. The participants mentioned that many teachers have not yet fully mastered basic digital skills and do not yet fully understand the risks and potential of AI.

Some of the interviews indicated that, to overcome this challenge, more comprehensive training in digital skills needs to be reinforced, addressing not only the technical use of these technologies, but also the purposes and pedagogical foundations that justify their use in education. Therefore, the prevailing perception was that public education management is not sufficiently prepared to deal with rapid technological evolution.

In summary, the participants did not identify a structured movement of resistance to AI in education; what they reported were isolated and localized instances of resistance, motivated by ethical, pedagogical, cultural, and infrastructure concerns. There was a consensus that the adoption of AI is increasingly perceived as inevitable.

INTERNATIONAL CONTEXT AND COMPARISON WITH BRAZIL

According to the participants, the Brazilian reality strongly contrasts with the international context in terms of the development of technologies, pedagogical practices,

and public policies. Most existing AI solutions, especially advanced language models (Large Language Models [LLM]),[10] are developed by big tech companies based in the United States and China. This concentration of production and technical expertise creates technological power inequality and dependence in countries that do not master these tools. In addition, as most of the databases used are in English, many participants mentioned that this technology tends to reproduce linguistic and cultural biases of English-speaking countries and insufficiently reflect the cultures and traditions of countries such as Brazil, whose information and contexts are not yet widely represented.

The general perception is that, in other countries, the debate is more mature, with an emphasis on the pedagogical and regulatory integration of AI in education. The participants also highlighted that the structure of educational policies in each context directly influences the process of introducing this technology into the classroom.

Regarding the scenario in the United States, the perception of the stakeholders was that the decentralized format of education and the competitive market favor free competition. However, in Europe, there seems to be greater concern with public values and data protection. The participants cited the case of Finland, which began incorporating AI into the school curriculum only after the European Union enacted regulations, demonstrating a more cautious, normative stance toward the adoption of these technologies.

On the other hand, countries such as China and South Korea were recognized as leaders in the development and implementation of AI in the classroom, with the former standing out as an example of nationwide AI implementation across all schools since 2024. Elsewhere in Asia, Indonesia was remembered for developing teacher support solutions. These tools, currently in a pilot phase, helped reduce the amount of time teachers spend on administrative and planning tasks, allowing them to focus more on lesson planning and management. Digital inequality helps explain

10 LLM are language models based on generative AI, trained with vast amounts of textual data so they can understand and create texts in a way that resembles the way a human being would do it (IBM, n.d.).

the differences: Countries with limited resources face a range of challenges, including insufficient Internet access, poor connection quality, few devices per student, and lack of teachers' pedagogical skills at using technology.

According to the participants, education management and governance models directly influence the risks and possibilities of AI. In places with more centralized systems for funding and curricula, such as some Nordic countries and Brazil, there is a greater capacity for monitoring and control of educational data. The stakeholders pointed out that the discussion about the regulation of AI use in Brazilian education has advanced, with models from the European legislation serving as its starting point.

However, the professionals also indicated that the country faces challenges to implementing national AI solutions, such as a lack of adequate teacher training and social and regional inequalities. Furthermore, in the participants' perceptions, the solutions offered by multinational companies were not designed for the reality of Brazilian education, and investment in applied scientific research on AI remains low. Nevertheless, the country's federal structure provides national monitoring tools, such as the School Census[11] and Saeb, which can be used for policy coordination, as highlighted by a participant from civil society.

In summary, the stakeholders believe that Brazil has the opportunity to leap in the development of AI in education by learning from international experiences and adapting them to the country's reality. Nevertheless, for this to occur, they considered it necessary that the debate be qualified to ensure that regulations and public policies support conscious and effective adoption of AI in Brazilian schools. They also advocated for the development of digital competencies among teachers and students, combined with critical and reflective thinking about the impacts and implications of AI in school life and society.

11 Find out more: https://www.gov.br/inep/pt-br/areas-de-atuacao/pesquisas-estatisticas-e-indicadores/censo-escolar

AI INITIATIVES IN EDUCATION UNDER DEVELOPMENT

The present section discusses the uses of AI systems in Brazilian education, as well as initiatives aimed at developing this technology. The analysis considered both projects organized by the participants themselves and examples observed in different regions of the country. Additionally, it explores positive and negative evaluations of these initiatives, highlighting how these experiences have been implemented and what results have been observed so far, with particular attention to differences across education segments.

The identified initiatives were grouped into four main categories, based on their characteristics and uses: (a) pedagogical applications of AI; (b) AI training programs; (c) applications of AI in educational management; and (d) institutionalization of the AI agenda. The analysis sought to emphasize both the initiatives mentioned and the themes and issues that occurred most frequently in the interviews. Figure 4 summarizes the applications cited in the four main types of initiatives.

FIGURE 4 – AI INITIATIVES MENTIONED IN BRAZILIAN EDUCATION, BY TYPE

PEDAGOGICAL APPLICATIONS OF AI
(most mentioned)

Automated text correction: evaluation and instant feedback for essays

Evaluation of reading fluency: analysis of reading aloud sessions to assess fluency

Diagnostic and formative assessments: performance monitoring and support for learning recovery

Customized pedagogical planning: development of adapted plans and activities based on data about the class

Support for learning and digital tutorship: voice assistants and platforms that guide learning in real time

Inclusion and accessibility: content adaptation, translation, and customization for different profiles

Unplugged AI solutions: applications to contexts with little connectivity and limited resources

Engagement monitoring: analysis of videos to identify inattention and support teachers' work

TRAINING IN AI

Teacher-oriented training: the main focus of the initiatives under development in the country.

Actions carried out by public networks: training promoted by state and municipal secretariats, often in partnership with public universities.

Various formats: training, workshops, interactive activities, and use of digital platforms to standardize and structure content.

Emblematic case – Piauí: training covered technical, ethical, and critical aspects of AI, which promoted responsible use and conceptual reflection.

APPLICATIONS OF AI IN EDUCATIONAL MANAGEMENT

Support for management and administration: planning, data analysis, and task automation, including grade and attendance recording.

Logistic predictive models: optimization of book distribution, resulting in quantity prediction and waste reduction.

School dropout prediction: identification of students at risk of dropping out, which allows implementation of preventive actions.

Integration into management systems: use of LLM and API to process administrative and pedagogical data in school offices.

Automated control of attendance and behavior: use of facial recognition to record student attendance and monitor student behavior.

INSTITUTIONALIZATION OF THE AI AGENDA

Pioneering state regulation: approval, in 2025, of a supplementary law in Goiás that fosters innovation and sustainable use of AI.

AI teaching in K-12 education: the case of Piauí, the first Brazilian state to offer a specific subject on AI, supported by a digital platform and an unplugged version.

Extended curriculum in the private education system: schools with subjects focused on digital culture, computational thinking, and AI.

Public hubs of educational innovation: the case of Pará, with equipment that offers AI learning tracks and support for technological projects in the public education system.

SOURCE: PREPARED BY THE AUTHORS.

PEDAGOGICAL APPLICATIONS OF AI

The pedagogical uses of AI tools emerged across all segments of interviewed stakeholders as the most frequently mentioned, especially among representatives from school management and civil society. Various resources were identified as applicable to both teaching processes—related to teachers' methods of mediating and transmitting knowledge—and learning processes—associated with the assimilation of new information and expansion of students' cognitive repertoire (Lisbôa & Moreira, 2023).

The participants highlighted the use of AI-based platforms as assessment tools, mainly for the automatic correction of students' essays. EdTechs[12] and research centers affiliated with public universities have applied AI to the evaluation of students' written productions, both handwritten and typed. Depending on the platform, students either type their text on different devices or submit images of handwritten versions to be processed by the tool. These systems automatically analyze and provide feedback on students' writing, taking into account linguistic and discursive aspects such as proper grammar use, textual coherence, and cohesion, in line with the criteria used by Enem essay exam evaluators.

Representatives from academia and the market mentioned the development of AI tools to assess students' reading fluency—a core skill in the literacy process and one that is closely linked to text comprehension.[13] To use such tools, students read a text out loud; the audio is captured by a device and then analyzed by AI on a platform, which identifies and classifies students' fluency level.

Still regarding educational assessment processes, participants from all stakeholder segments mentioned the use of AI tools to support diagnostic, formative, and summative assessments, enabling continuous monitoring of student performance

12 EdTechs (or EduTechs, short for *Education Technology Companies*) are startups or enterprises that develop technology-based education solutions. They use technology to improve, innovate, or transform educational processes—whether in formal education (schools and universities) or in corporate and individual learning contexts.

13 Find out more: https://www1.folha.uol.com.br/educacao/2024/04/escolas-de-sp-terao-fluencimetro-com-ia-para-avaliar-leitura-dos-alunos.shtml

and the identification of learning needs.[14] In some cases, the platform itself provides data on students' performance—such as dashboards with their results, in the case of essay correction tools[15]—while in others, use of AI occurs by means of creation of prompts in generative AI chatbots to design activities based on diverse assessment methods.[16] These resources are also considered relevant for learning recovery assessment,[17] used to identify and address students' learning gaps, which were exacerbated during the COVID-19 pandemic.

The AI has also been applied to the development of personalized lesson planning. A representative from the market mentioned that the company where they work developed a tool based on an LLM capable of assisting teachers in planning learning activities better suited to each student or subgroup of students by using previously collected data on the class. Moreover, in the institution for which one of the civil society representatives works, AI has been used to adapt lesson plans to the specific needs of each teacher. By drawing on a repository of class plans that covers the entire National Common Curricular Base (BNCC),[18] generative AI solutions enable content customization and provide more tailored support for teachers' demands. According to a school management professional, using AI fosters creativity and streamlines lesson planning.

> It really helped teachers with lesson planning, creativity, the need to have more ideas, to avoid that pattern of a more traditional planning. So it helped teachers decrease the time spent on planning. They can do it more quickly, and also in a more contemporary way, with more playful, creative activities.
>
> (SCHOOL MANAGEMENT STAKEHOLDER)

14 Diagnostic (or prognostic) assessment is carried out at the beginning of a school year or thematic unit to map students' prior knowledge and difficulties, serving as the basis for structuring the next steps of the educational process. In formative assessment, teachers continuously monitor learning in the classroom to identify whether students are learning and the factors involved in this process. Based on this information, subsequent activities are redesigned to address the identified needs. Summative assessment, in turn, is conducted at the end of a cycle to verify whether the learning objectives have been achieved, identifying students' final performance and ensuring that they have an opportunity to demonstrate what they have learned (Yurie, 2022).

15 Find out more: https://www.nees.ufal.br/plataforma-que-usa-inteligencia-artificial-auxilia-professores-na-correcao-de-redacoes/

16 Find out more: https://iaedu.nees.ufal.br/wp-content/uploads/2025/04/NT-1-Inteligencia-Artificial-Generativa-na-Educacao.pdf

17 Find out more: https://www.gov.br/mec/pt-br/recomposicao-aprendizagens

18 Find out more: https://basenacionalcomum.mec.gov.br/

Regarding classroom support for teachers and the teaching of specific subjects, several AI-based resources were cited. School management professionals from private schools mentioned investments in voice-activated AI devices used as teaching assistants. In these institutions, such devices allow teachers to interact verbally with the system—to search for information and request support from other school departments when needed. Participants from all stakeholder segments reported the use of AI platforms to support the teaching of specific subjects. In particular, it was highlighted that, in the state of Paraná, the public school system has begun using an AI platform designed to help with teaching mathematics, functioning as a digital tutoring system (Paraná State Education Secretariat, 2024). This tool guides students through problem-solving processes, answering questions in real time—not by providing ready-made answers, but by encouraging reasoning and student autonomy.

Among public sector and civil society representatives, another use of AI that came up frequently during the interviews was its role in promoting the inclusion of students with disabilities, advanced abilities, and even foreign students. One cited example was the use of a learning platform that offers accessibility features, such as adjustable font size and color and brightness settings, which allows its use by people with low vision, color blindness, and other conditions. Additionally, AI platforms have also been employed to help teachers adapt their teaching strategies to diverse learning profiles, including students with intellectual disabilities and advanced abilities. These tools make it possible to adjust the complexity of exercises according to individual needs, following each student's learning pace. Moreover, in regions with a large number of immigrant students, the language-switching feature supports students' adaptation to a new context, as in the state of Mato Grosso do Sul, where AI-powered automatic translation is provided to Spanish-speaking immigrant students. The mentioned applications show that these systems help students progress together, even if in different ways.

Therefore, the emergence of innovative applications based on AI resources has been recognized as strategic for the education sector. The initiative most frequently mentioned by

participants from all the analyzed segments was unplugged AI (Dermeval et al., 2025; Portela et al., 2025), an approach that proposes the use of AI solutions adapted to contexts with little or no Internet connection and limited technological resources. Focused on digital inclusion, this proposal aims to bring AI-related content and practices to schools and communities in vulnerable situations, without relying on complex or high-cost technologies. One cited example was an offline solution, currently implemented in the state of Alagoas, for the automatic evaluation of students' compositions.[19]

Last, a market representative mentioned a tool that uses classroom cameras integrated with a video analysis system to monitor student disengagement. This system processes the captured images and identifies moments when students are not actively participating in class (for example, when they show low attention or limited interaction with activities) or when teachers have difficulty maintaining discipline. Based on this information, human supervision is activated, which enables feedback on teachers' performance.

TRAINING IN AI

The fieldwork of the present study indicated that promotion of AI training programs for teachers stands out among the AI initiatives under development in Brazilian education. This topic was mentioned by participants from all segments, with less emphasis among market stakeholders.

Several initiatives carried out by state and municipal departments of education were described, many of them in partnership with research centers at public universities. These actions include training sessions, workshops, interactive activities, and the use of digital platforms to deliver such training, allowing content to be organized in a structured manner and helping standardize teachers' training levels.

---

19 The solution works as follows: Students produce handwritten texts in the classroom, and teachers capture images of these compositions by using a mobile device. The data are stored locally on the device and transmitted to a server only when an Internet connection becomes available. On the server, the data are processed by computer vision and natural language processing algorithms. The system then generates printed dashboards with feedback on the writing. This feedback supports students and standardizes the assessment process without overburdening teachers (Ness, 2025).

According to a state public manager, partnerships with local institutions (such as universities or secretariats focused on technological innovation management) contribute to greater sustainability in the development of AI-related resources and favor knowledge internalization and professional development of educators within the state, while reducing dependence on external researchers.

Overall, public education in Piauí emerged as the most emblematic case among the described experiences. In this state, training programs are not limited to technical aspects: They also cover ethical issues related to the responsible use of AI in the educational environment, as well as the development of the technology itself and a critical understanding of the meaning of the term "Artificial Intelligence," acknowledging the diversity of interpretations associated with it.

> There is a lot of in-person training, biannual training, online and live training, and we monitor these teachers. We get weekly feedback sessions with them. All of this allowed us to work, and we managed to make it slightly sustainable: We established a partnership with [a federal university] and with [the state Secretariat], [...] they took over the activities during this second year of teacher training.
>
> (PUBLIC MANAGEMENT STAKEHOLDER)

According to a public administrator involved in the implementation of this initiative, the training process was oriented toward teachers of all subjects who showed interest in the topic of AI. These training sessions occur within the teachers' regular working hours and are organized to combine annual in-person meetings—which promote debates with specialists and exchanges of experiences among schools—with ongoing support throughout the year, by means of tutoring sessions aimed at clarifying questions and helping the professionals apply the discussed content.

APPLICATIONS OF AI TO EDUCATIONAL MANAGEMENT

The interviews showed that AI tools have been used in both activities of educational management professionals (pedagogical coordinators, principals, and education system managers) and teachers' administrative tasks. Their use in educational management encompasses intellectual work—such as planning, analyzing information, monitoring data, and

coordinating broader actions—and administrative-operational work, such as recording grades, tracking attendance, and organizing daily procedures.

These technologies have been applied in different areas. Academia and civil society representatives highlighted the use of predictive models based on AI. These models involved the application of predictive logistics models to optimize the delivery of books within a national textbook distribution program. This initiative, especially relevant for education network administrators who work for education departments, has been developed through a partnership between the federal government—via the Ministry of Education (MEC)—and a research center affiliated with a public university. Using AI-based predictive models allows for faster and more accurate assessments of textbooks, as well as predicting the quantity of materials needed for each school, consequently reducing waste and contributing to proper delivery to students.

Still in this area, participants from the academia and civil society sectors mentioned the development of school dropout prediction solutions capable of identifying students at higher risk of abandoning school and providing information to help teachers and school administrators take preventive action.

Some public management stakeholders noted that the use of AI contributes to improving the management processes of education networks. One of these participants mentioned the use of LLM models accessed through an application programming interface (API), in order to integrate the tools into the departments' internal systems and automatically process administrative and pedagogical data.

Another participant from this segment mentioned investments in the implementation of an educational data laboratory, conceived as a platform that uses AI to cross-reference state information and generate projections on various topics. These initiatives have the potential to enable analyses that can be used in management and provide feedback on pedagogical practices in the classroom.

In the teaching domain, participants from academia, public management, and civil society described the use of AI to automate student attendance tracking by setting up facial recognition devices. They also emphasized a public education

experience in the South region of Brazil, where the system was used to identify facial expressions, allowing monitoring of students' behavior and emotions in the classroom.[20]

INSTITUTIONALIZATION OF THE AI AGENDA

The participants' accounts stressed that the institutionalization of the AI agenda is regarded as a particularly relevant topic in the educational context. Public management and academia stakeholders pointed out the approval, in 2025, of a complementary law that establishes a state policy in Goiás aimed at promoting innovation in AI (Complementary Law No. 205/2025). This measure seeks to foster sustainable technological development, competitiveness, research, technical training, and the use of open AI solutions. It is the first state-level initiative to regulate this technology in Brazil, even though it is not specifically oriented toward the educational area.

Representatives from civil society and public management highlighted the importance of effectively implementing the BNCC for Computing,[21] which already provides for the development of skills and competencies oriented toward technology and computing. Although its implementation was expected to begin in 2023, a participant from civil society explained that the organization for which they work conducted some studies and found out that few education systems had started the process. This situation motivated the creation of a technical assistance project to support state and municipal education departments in developing their computing curricula. In this process, the team sought to clarify how AI could be addressed by means of the BNCC for Computing. According to the civil society and public management representatives, the current curriculum provides a relevant foundation for AI learning, although they noted that it will likely be necessary to

20 Find out more: https://revistagalileu.globo.com/tecnologia/noticia/2023/10/reconhecimento-facial-no-parana-impoe-monitoramento-de-emocoes-em-escolas.ghtml

21 The BNCC for Computing is a complement to the BNCC that defines essential technology skills for K-12 education. It was officially established in 2022. It is structured around three main pillars: computational thinking, which involves logical reasoning and problem-solving; digital world, which focuses on understanding how the Internet, networks, and cloud systems work; and digital culture, which addresses the social, ethical, and political implications of technology. Its goal is to educate critical and creative citizens capable of acting in an increasingly digital world. Available at: https://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=236791-anexo-ao-parecer-cneceb-n-2-2022-bncc-computacao&Itemid=30192

revisit the national frameworks in the future, given the ongoing transformations in the field of digital education.

In the curricular scope, as part of the process of institutionalizing the AI agenda, Piauí became the first state to implement the teaching of AI in K-12 education. The subject, which treats AI as an object of learning, is offered with the support of a digital platform made available by means of a partnership with a major technology company. Taught from an interdisciplinary perspective, it integrates AI concepts with various fields (such as biology) and offers adaptations for contexts with limited connectivity, enabling the teaching of AI in offline environments and conventional classrooms.

In the context of the private education curriculum, in turn, a school management professional mentioned that the institution for which they work, in addition to maintaining an active and well-integrated educational technology department, offers a subject that addresses AI as an object of learning. Since the implementation of the BNCC, the school has been teaching computational thinking and, more recently, it included a subject called STEAM,[22] which complements the curriculum and supports pedagogical practices in digital culture, computational thinking, and AI.

Last, another aspect related to the institutionalization of AI mentioned by participants from the academia, public management, school management, and civil society sectors concerns the implementation of public facilities to support educational projects. These accounts referred to the experience of the state of Pará, which uses these facilities to provide practical support for the development of innovative and technological projects within its public education system. The operation of these centers is structured around learning tracks that cover various areas, including AI; schools participate voluntarily, depending on each facility's operational capacity.

22 STEAM is an acronym for Science, Technology, Engineering, Arts, and Mathematics. The term refers to an interdisciplinary educational approach that integrates these five areas of knowledge with the goal of promoting more practical, creative teaching that is connected to real-world problem-solving. By combining scientific, technological, and artistic knowledge, this approach fosters critical thinking, innovation, and collaborative work, contributing to students' holistic development and the cultivation of essential 21st century skills.

EVALUATIONS OF EXISTING INITIATIVES

When asked about AI initiatives in education in Brazil, the participants in this study pointed to both experiences they considered positive and those that raised concerns or criticisms. Table 3 summarizes these evaluations.

CHART 3 – SUMMARY OF POSITIVE AND NEGATIVE EVALUATIONS OF MENTIONED INITIATIVES TO IMPLEMENT AI IN BRAZILIAN EDUCATION

POSITIVE EVALUATIONS	NEGATIVE EVALUATIONS/CONCERNS
Composition correction tools: appreciated for providing detailed feedback, which helps improve students' writing and reduce time spent by teachers to correct the pieces.	**Composition correction tools:** criticized for ignoring students' individuality and not adjusting to schools' reality, which can result in negative pedagogical effects.
Unplugged AI initiatives: praised for increasing access to AI and reducing digital inequalities, it enables the use of AI in places with little or no connectivity.	**Lack of critical training in AI:** concerns about limiting skills to technical use of the tools, ignoring pedagogical contextualization, or ethical reflection.
Training in AI: appreciated for promoting teacher development and increasing digital literacy among teachers.	**School dropout predictive models:** risk of counterproductive reactions by teachers, who can give up on keeping track of students labeled "hopeless."
Institutionalization of the AI agenda: well-regarded; led to the formulation of public legislation and policies, such as Goiás state law and actions in Piauí to include AI in the curriculum.	**Facial recognition and surveillance:** warnings about privacy violations, hyper-surveillance, and possible leaks of children's and students' sensitive data.
The case of Piauí: emphasized for integrating teacher training with AI teaching, which strengthened the insertion of the subject into the public network in a structured way.	

SOURCE: PREPARED BY THE AUTHORS.

Overall, the strategic actors assessed several ongoing initiatives positively. They highlighted the pedagogical applications of AI, which were mentioned especially by participants from the market, school management, and civil

society sectors. Within this group, one of the most frequently cited AI tools was the essay correction system, particularly stressed by representatives from civil society. The positive assessment occurred mainly due to the detailed feedback these tools provide, which can contribute to the future improvement of students' writing, as well as reduce teachers' correction time—they can then focus on validating and reviewing analyses generated by this technology.

Cited mainly by professionals from school management and civil society, unplugged AI initiatives were also positively evaluated for helping reduce digital inequality, since they make AI accessible in areas with limited connectivity.

Another aspect that stood out was AI training programs, mentioned by representatives from academia, public management, and school management, who recognized the importance of these initiatives for strengthening digital competencies and promoting ethical use of technology in the educational environment.

In addition, initiatives oriented toward institutionalizing the topic were also seen as relevant—particularly the development of legislative frameworks about AI and the experience of the public school system in Piauí, which has promoted teacher training and inclusion of AI in the curriculum—both emphasized by representatives from public management.

Despite these positive evaluations, the interviews also pointed out several uses of AI in education that, rather than sparking enthusiasm, raised criticisms and concerns among strategic actors. Regarding pedagogical applications of AI, essay correction tools stood out once again. They were mentioned especially by participants from the market and school management sectors, who argued that this technology may overlook students' individual complexity and, consequently, become more harmful than beneficial. Moreover, they expressed their concern that, although technically sophisticated, these solutions are often poorly adjusted to the realities and needs of Brazilian education, given that many do not reflect the country's diversity or are developed based on data from other locations or specific contexts.

The participants' accounts, especially by academia, the market, and school management stakeholders, also stressed

the scarcity of training and AI literacy initiatives. One representative from academia emphasized that AI training cannot be merely instrumental, arguing that teaching how to use the tool without a pedagogical context undermines both student and teacher learning and critical reflection.

Regarding applications of AI in educational management, school dropout predictive models were highlighted by representatives from public management and civil society. The main concern was that the identification of students at high risk of dropping out could have the potential for counterproductive reactions from teachers—for example, giving up on supporting these students rather than reinforcing assistance and educational intervention.

Another issue frequently raised by the participants was data protection and ethical use of AI. Concerns about the installation of facial recognition devices in schools were most common among representatives from public management and civil society. The participants noted that these technologies can originate forms of hyper-surveillance, creating overly monitored school environments that can compromise students' privacy and increase the risk of leaks involving images or other sensitive data of children and adolescents.

Last, still regarding data protection and ethical use of AI, there were negative evaluations of AI tools that can pose risks to students' mental health. School management professionals mentioned applications with emotional support features and reported potentially toxic interactions between students and generative AI chatbots. According to the participants, if these systems are not properly regulated and continuously monitored, they may negatively influence and manipulate students, leading them to distorted judgments or inappropriate decisions.

FUTURE OF AI IN EDUCATION

This section addresses perceptions about the future of AI in education. In the final stage of the interviews, the participants were invited to engage in a critical and imaginative reflection exercise aimed at envisioning the development of a better society, based on a few guiding questions: What would the ideal form of AI to be adopted in education be? Whom would

it benefit? Where would it come from? This exercise sought to gather perspectives on how AI in education could contribute to the positive transformation of society.

The prevailing perception of the participants when they considered this future scenario was that the ideal AI should, first of all, serve the development of human abilities:

> Technology, including AI, must value human beings. The reason for its existence is human beings, the human presence, the expansion of human beings' reach.
>
> (MARKET STAKEHOLDER)

After pondering more specifically the educational context, stakeholders from different sectors agreed that the AI of the future should function as a tool to support and enhance learning, rather than as a replacement for teachers or students' intellectual effort. This technology is understood as a resource with the potential to transform society by improving the quality of education and expanding digital inclusion.

From this perspective, the ideal AI should enable personalized teaching, support teachers' work, assist formative assessments, and provide richer and more diverse learning experiences, mediated by human presence and guided by pedagogical and ethical values. Therefore, the AI of the future should be applied to education with the purpose of strengthening students' roles as protagonists of their own learning, always with teacher mediation. Students should always be the main beneficiaries of this technology:

> In my opinion, an AI that benefits students, that is designed to be an instrument to help education, an instrument available to teachers in several situations. So I think that this would be the ideal world. To whom? Students, above all.
>
> (PUBLIC MANAGEMENT STAKEHOLDER)

The interviews showed that teachers can also benefit from the ideal AI, as long as it does not threaten their role in education and instead facilitates their work by optimizing administrative tasks, providing data and analyses about student progress, and enabling more precise pedagogical interventions. Furthermore, as noted by a researcher from the academic field, the AI of the future should promote cultural and regional diversity rather than serve the interests of large corporations:

Free-code AI, distant from big techs. An AI designed according to regionalisms, an AI that respects our diversity, including cultural, economic, and educational diversity.
(ACADEMIA STAKEHOLDER)

This account highlighted the importance of developing technologies that value Brazil's linguistic, social, and pedagogical plurality, ensuring that technological innovation aligns with principles of equity and representativeness. According to the reflections of the interviewed participants, AI should be designed in a collaborative, gradual, and ethical way, taking into account infrastructure, teacher training, and regulation. Education professionals emphasized that they should take part in the process of its design because they recognize the importance of their engagement in this technological chain.

When we keep our distance and do not engage in this process, we end up colluding with atrocities that happen throughout this production chain, from the extraction of mineral resources, through the use of water and of everything else, up to the end of this production and the disposal process, including equipment, and the entire operation of the Internet.
(SCHOOL MANAGEMENT STAKEHOLDER)

Therefore, the development of this ideal AI must take into account social, environmental, and pedagogical impacts. In the opinion of the participants, the agents responsible for the development and implementation of AI include:

- The public sector, which should act as regulator and coordinator, ensuring equity in access and quality;
- The private sector and technology companies, which can develop solutions adapted to the national context;
- Academia, whose role is to contribute to research, open-source development, and teacher training; and
- Civil society, which plays a role in overseeing and monitoring the use of AI, as well as in promoting initiatives to guarantee that it is ethical.

As a representative from civil society noted:

We could think of a decentralized "who." A scattered "who," given the size of Brazil, in all of its diversity. It could be something that connects universities with social organizations, such as co-ops, which quite often deal with the issue of technologies for the common good, open technologies, and then we could add research initiatives, with public schools as study locations for applied research. But listening would be crucial.
(CIVIL SOCIETY STAKEHOLDER)

In summary, achieving this ideal AI in Brazilian education would require a systemic and collaborative effort between different sectors of society. In the pursued scenario, this technology should be used to develop human abilities, improve learning, promote inclusion, and support teachers' work, with gradual implementation, adequate training, and ethical oversight. The joint participation of all actors—the public and private sectors, companies, academia, and civil society—is essential to ensure that AI is consolidated as an effective and safe pedagogical tool, aligned with local needs and contexts.

FINAL CONSIDERATIONS

The objective of the present study was to outline the current scenario of AI in Brazilian education, based on the perceptions of various strategic actors: representatives from academia, public management, the market, school management, and civil society. The in-depth interviews conducted with these stakeholders showed a panorama marked by transformative potentialities as well as significant challenges.

Overall, the participants agreed that AI should be used as a tool to support education, in order to enhance learning, optimize teaching and administrative tasks, and personalize instruction, without replacing the role of teachers or students' intellectual effort. This technology was perceived as a resource capable of improving the quality of education, expanding inclusion, and addressing the specific needs of the Brazilian context.

There was also a consensus that adopting AI in the educational context is both inevitable and urgent—that we're past the point of no return. Ignoring its incorporation may compromise the relevance of educational institutions on the global stage, as well as weaken critical thinking in the country.

The potential benefits of AI were identified across multiple dimensions of education. Regarding teachers' work, it can reduce overload and expand pedagogical competencies. In the management sphere, it can contribute to data analysis and the prediction of problems and trends (such as school dropout). The participants indicated that for students, it can be a source of personalized learning, immediate feedback, increased motivation and engagement, and also promotes inclusion. Therefore, on a broader social scale, it can generate

more comprehensive social impacts, given that it democratizes access to education and fosters individual autonomy.

However, concerns about potential risks were also widely shared. Among the identified risks, lack of knowledge and adequate training, negative impacts on cognitive development and cultivation of critical thinking, ethical issues, biases, and replication of inequalities, information reliability, data security and privacy, and weakening of teacher agency stood out.

The present study also identified specific challenges to implementing AI in the Brazilian educational context, such as limitations on technological infrastructure, gaps in teacher training, lack of regulation and data governance, regional inequalities, institutional barriers, and technical restrictions. Insufficient availability of basic technology and lack of teacher training emerged as the main obstacles, because they reflect the current lack of preparation of the Brazilian school community to use AI steadily, critically, and ethically.

Analysis carried out in the present study resulted in the following synthesis, based on the perceptions of the different profiles of interviewed stakeholders:

- **Why AI?** Because it is already part of society; consequently, schools, as spaces for social and civic formation, cannot remain oblivious to this reality.
- **AI: What for?** To support teachers' work (in everyday administrative tasks and as a tool for developing pedagogical content), to customize learning (adapting content to the reality and needs of each student), and to prepare students for a changing world (developing the competencies needed to participate in an increasingly digital society).
- **AI: How?** Ethically and with planning, trained teachers, an integrated curriculum, and proper, accessible technological infrastructure for all students.

The view of the participants was that Brazil is at an early and still experimental stage of incorporation of AI into its educational reality, with isolated advances and persistent structural gaps. Despite this scenario, they believe there is potential to reverse the situation due to widespread mobile

connectivity and the population's cultural openness to technological innovation.

The present study considered perspectives from different sectors of Brazilian education, each with distinct emphases. Public managers highlighted the use of AI to optimize administrative processes, analyze data in order to fight school dropout, and complement teacher training, as well as the need to uphold pedagogical principles over commercial interests. School management professionals emphasized the reduction of teachers' workload, the development of innovative materials, and the improvement of the relationship between teachers and students, as well as the practical challenges of implementing these technologies in Brazil's unequal reality. Academics adopted a conceptual and critical perspective, questioning the type of AI being used, algorithmic biases, ethics, and critical awareness in the use of this technology. Market representatives viewed AI as a solution to large-scale challenges and focused on personalization, optimization of bureaucratic tasks, and data interpretation, but also warned about risks of misinformation and cultural erasure. Last, civil society stakeholders concentrated on democratization of learning, reduction of inequalities, inclusion, data protection, and prevention of the commodification of education.

The international scenario was also considered. It was stressed that Brazil is still in an incipient stage when compared to countries such as China, South Korea, and Finland, where educational AI is implemented in a more structured manner. Although dependence on foreign solutions, lack of investment in research and development, and replication of cultural biases are important challenges, there are concrete opportunities for learning from international experiences, provided that they are adapted to the national context and accompanied by a qualified, plural, and less polarized public debate.

A recurring point in the interviews, regardless of segment, was the distinction between predictive and generative AI. Predictive AI was associated with data analysis to identify patterns, predict school dropout, and optimize logistic processes. Generative AI, in turn, was linked to the creation of personalized lesson plans, the provision of feedback on written assignments, and the broadening of classroom discussions.

However, the participants expressed their concerns about possible "hallucinations," plagiarism, and negative impacts on cognitive development. Many participants noted that, in several situations, benefits and risks overlap:

- Although customized learning is seen as positive, if applied excessively, it can lead to harmful student profiling;
- Although innovation is desirable, it becomes a risk when implemented without a clear pedagogical purpose or adequate infrastructure;
- Although AI-assisted assessment can be helpful, it can also rank students or reduce interpretive nuances.
- Therefore, both predictive and generative AI can offer benefits or pose risks, depending on how they are applied to education.

Another relevant aspect was the difficulty participants had in pointing out benefits without mentioning risks or describing challenges without simultaneously addressing potentialities. Representations of positive and negative aspects of this technology came up during the interviews in a way that made evident the connection and contrast between them, like two sides of the same coin.

The interviews showed that potential benefits are often also perceived, in the same situations, as possible risks. For instance, AI can help reduce inequalities by personalizing content and supporting students in different learning conditions; on the other hand, extreme profiling can foster stigma or lead students in more vulnerable situations to drop out.

Similarly, pedagogical innovation is a desirable benefit, but it can also become a risk to the learning process when incorporated without a clear pedagogical purpose or without proper mediation. In other words, the way it is used and the rules that govern it will determine whether a given aspect becomes a benefit or a risk.

In conclusion, successful implementation of AI in Brazilian education requires collaborative and systemic efforts involving government, schools, civil society, academia, and the market. This technology must be used with intentionality, ethics, and curricular integration, while respecting the specificities of each

age group and individual needs. For this to occur, investments in infrastructure, connectivity, consistent teacher training, clear regulation, and data governance are necessary. Only then will AI fulfill its pedagogical potential and promote inclusion, equity, and meaningful advancements in Brazilian education.

REFERENCES

Dermeval, D., Rodrigues, L., Isotani, S., & Bittencourt, I. I. (2025). *Inteligência Artificial Desplugada na Educação*. Ed. dos Autores. https://iaedu.nees.ufal.br/wp-content/uploads/2025/08/NT-3-Inteligencia-Artificial-Desplugada-na-Educacao.pdf

Complementary Law no. 205, of May 19, 2025. (2025). Establishes the State Policy for Promotion of Innovation in Artificial Intelligence in the State of Goiás. Official Gazette of the State of Goiás, Goiânia, May 19, 2025. https://goias.gov.br/governo/go-ia/politica-estadual-de-fomento-a-inovacao-em-inteligencia-artificial/

IBM. (n. d.). *What are large language models (LLMs)?* https://www.ibm.com/think/topics/large-language-models

Lisbôa, C. C. A., & Moreira, M. C. A. (2023). *Glossário Pedagógico-científico de significados relacionados à avaliação da aprendizagem*. Ed. das Autoras. https://educapes.capes.gov.br/bitstream/capes/740843/2/Produto%20Educacional_C%C3%A1ssia%20Lisb%C3%B4a%2021-12-23.pdf

Portela, C., Palomino, P., Challco, G., Sobrinho, A., Cordeiro, T., Mello, R., Dermeval, D., Bittencourt, I., & Isotani, S. (2025). AI in education unplugged support equity between rural and urban areas in Brazil. In ICD: Proceedings of the 13th International Conference on Information & Communication Technologies and Development, 24. *Association for Computing Machinery*, 143–154. https://doi.org/10.1145/3700794.3700810

Secretaria de Estado de Educação do Paraná. (2024). *Paraná adota IA para aprimorar ensino de matemática nas escolas da rede estadual*. Governo do Estado do Paraná. https://www.educacao.pr.gov.br/Noticia/Parana-adota-IA-para-aprimorar-ensino-de-matematica-nas-escolas-da-rede-estadual

Yurie, I. (2022). *Avaliação Formativa: corrigindo rotas para avançar na aprendizagem*. NOVA ESCOLA. https://novaescola.org.br/conteudo/20862/avaliacao-formativa-corrigindo-rotas-para-avancar-na-aprendizagem

CHAPTER 4

Competences and uses of Artificial Intelligence in education: A qualitative study with upper secondary students and teachers in Brazil

Graziela Castello,[1] *Rodrigo Brandão,*[2] *Priscila Vieira,*[3] *Monise Picanço,*[4] *and Florbela Ribeiro*[5]

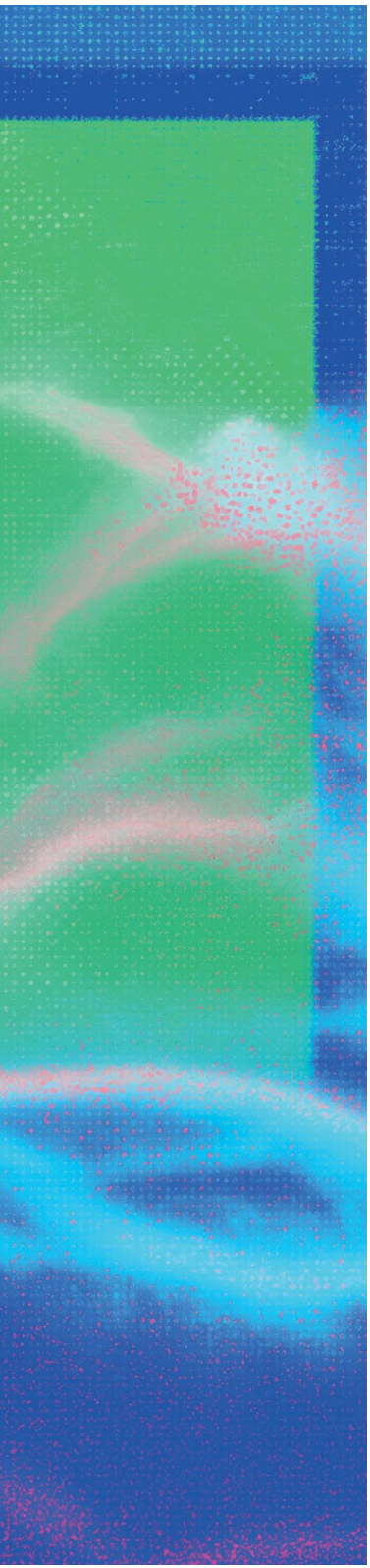
1 A social scientist, she is the coordinator of Qualitative Methods and Sectoral Studies at the Regional Center for Studies on the Development of the Information Society (Cetic.br), a department of the Brazilian Network Information Center (NIC.br).

2 PhD in Sociology from the University of São Paulo (USP) and is a researcher under the Coordination of Qualitative Methods and Sectoral Studies at Cetic.br|NIC.br.

3 PhD in Sociology from USP, researcher and coordinator of the Development Center of the Brazilian Center for Analysis and Planning (Cebrap).

4 PhD in Sociology from USP and coordinator of the Development Center and cebrap.lab of Cebrap.

5 PhD in Social Anthropology from USP and researcher at the Development Center of Cebrap.



INTRODUCTION

This chapter presents the results of the second stage of the qualitative research on the use of Artificial Intelligence (AI) in education developed for this publication. This line of research focused on understanding the skills with and uses of these technologies among upper secondary students and teachers in Brazil. The aim was to explore how AI is used, the reasons for its use and non-use, the level of knowledge that these players have about the tools and their functioning, and their perceptions about the opportunities, challenges, and risks associated with the application of AI in education. Their expectations about the future in the face of these technologies' advancements were also analyzed.

The results presented in this chapter are based on eight focus groups conducted with public and private upper secondary school teachers and students in São Paulo and Recife, Brazil, between May and June 2025. The criteria for selecting the participants, the scripts applied, and the procedures for coding and analysis are described in Chapter 1 ("General introduction to the study and methodological notes") of this publication, in the "Methodological notes" section.

The present chapter is organized into two main parts. The first, divided into five sections, systematizes the results of the focus groups carried out with students on: (a) daily use of digital technologies; (b) knowledge and insights about AI; (c) uses and non-uses of AI; (d) critical topics related to AI; and (e) the future with AI. The second part presents the results of the focus groups with teachers (structured in the same sections), but from the teaching perspective, in addition to including a section dedicated to the teachers' views of the uses that students make of AI. The chapter closes with final considerations that summarize the main convergences and contrasts observed between the two audiences.

UPPER SECONDARY EDUCATION STUDENTS: SKILLS, USES, AND EXPECTATIONS FOR THE FUTURE

EVERYDAY USE OF DIGITAL TECHNOLOGIES

This section discusses the results of the first set of questions presented to the groups, whose objective was to spontaneously contextualize the presence of technologies in students' daily lives, inside and outside schools, at this initial stage of the study.

Students, in general, reported the use of digital technologies in their daily lives mostly for entertainment purposes, through social networks and apps, to watch series and movies, as well as use for research and school assignments. Mobile phones were the most used equipment for both leisure and pedagogical activities; few students reported frequent computer use.

Differences were identified between public and private school students regarding access to technological infrastructure (devices and Internet connection) within schools. Students in private schools reported access to different technological resources at school, such as individual Chromebooks, notebooks, TV, and tablets, used by teachers. On the other hand, among public school students, access to this equipment was more limited and unequal: Some units had TV and computers in the classroom or in a specific computer room, while others only had projectors for teachers to present content.

In early 2025, Law No. 15.100/2025 was enacted, restricting the use of mobile phones in schools throughout the country. Although the prohibition is only related to the recreational use of these devices by students in the units, release for pedagogical purposes varied from school to school, in both São Paulo and Recife. In some schools, mobile phones were authorized in the classroom to carry out research or monitored activities, while in others, the devices had to be locked in a closet and returned at the end of the period.

The use of AI emerged spontaneously in answers to questions about more general uses of technologies, reflecting the integration of these tools into students' daily routines. Mentions to ChatGPT as a search and research resource, in parallel with Google, were recurrent, both at home and at school. Students in private schools in Recife spontaneously

reported that ChatGPT was used in the classroom under teacher guidance, while among students in private schools in São Paulo, the use of AI was mentioned for school research purposes on their own initiative.

> Some teachers ask you to do assignments, to give presentations. They even ask you to search in ChatGPT, to search for topics, and to write by means of pedagogical use.
> (STUDENT, PRIVATE SCHOOL, RECIFE)

Students in the public school system in Recife mentioned using AI tools spontaneously without supervision, when looking for quick answers, because "the answer is already there." In this early stage of the discussion, they already demonstrated concern about the impact on learning, aware that the ease of use of the tool can reduce the ability to reflect and write. On the other hand, students in public schools in São Paulo said they used ChatGPT to summarize texts and write essays, and they did not evaluate the impact of this use in this first phase of the conversation, as did the students in Recife. Insights into the impact of the use of AI in education were a topic explored elsewhere in the focus group and will be presented in detail below. It is important to note here that students brought the issue to the debate even before being asked about it, which already suggests the importance of this technology in their lives.

Students reported how technology was used in the classroom: notebooks and projectors for presenting content, and the Internet for research and mandatory pedagogical platforms. This topic generated debate: Some students problematized the pros and cons of the use of technology in the classroom, stating that, as a complementary resource to the teacher's explanations, it is a positive use. However, if it is to replace such explanations, the use of technology becomes inappropriate.

> The teacher replacing their class with a video lesson really ends up getting in the way [...] it becomes a monologue that does not improve on anything. It's the digital monologue of the in-person teacher, it makes no difference. So, teachers need to know how to use it.
> (STUDENT, PRIVATE SCHOOL, SÃO PAULO)

When talking about technology in schools, students in public schools in São Paulo spontaneously addressed the topic of mandatory teaching platforms, tools that were

implemented in 2023 in state schools in São Paulo. It is a set of digital resources and platforms used in the curricular activities of schools in the network (including assessment activities), whose educational content is associated with the state curriculum. This, in turn, is presented to students through standardized slides prepared by the Secretariat of Education of the state of São Paulo (SEDUC-SP), and they must be used by teachers during classes.

As we will see in the second section of this chapter, teachers felt that this method limits their autonomy. The students' view was also critical: Most said they did not like the resource, as they perceived an effect of "robotization of teaching," which made classes "boring," "tedious," and "dull." These perceptions revealed an effect inverse to what is expected from AI technologies applied to teaching: personalization, adaptability to individual needs, and increased interest and engagement of students in activities, as presented in Chapters 2 ("Artificial Intelligence and education: History, fundamental concepts, and literature review on uses") and 3 ("Benefits, risks, and purposes of using Artificial Intelligence in education: The Brazilian scenario") of this publication.

> [...] before, when there was no such thing as a thousand platforms, I had teachers who used video classes, who helped to pass on content, used technology, in their favor, but now, literally, the teacher enters the room and they need to robotize teaching for all people, all teachers end up having the same teaching method, because they need to pass on the content. It's not something that the teacher can use, he must use it.
>
> (STUDENT, PUBLIC SCHOOL, SÃO PAULO)

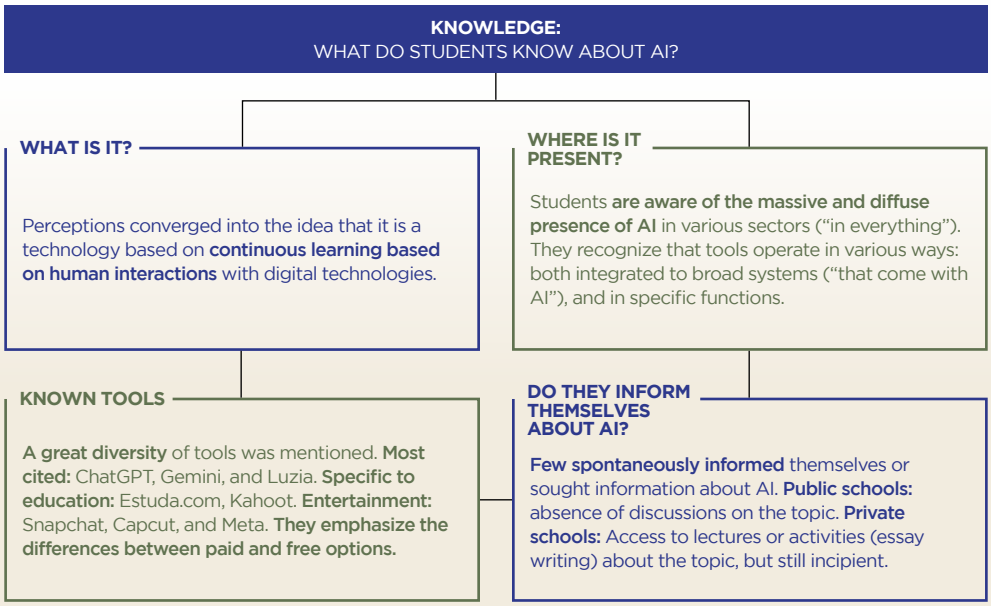
These initial data revealed that AI is already inserted in students' daily lives and provided clues about the possible paths for its integration into education. Technology can be used in a guided or spontaneous way that generates positive impacts on learning, or be perceived as a resource that replaces essential experiences in the educational process. Thus, the way it is incorporated depends on both school policies and the attitudes of teachers and students.

KNOWLEDGE: WHAT DO STUDENTS KNOW ABOUT AI?

This topic presents students' perceptions on what they understand AI to be: what it is in their view, where it is present, what tools they know, and how they learn about it.

Figure 1 summarizes the main results in relation to students' knowledge about AI.

FIGURE 1 – STUDENTS' KNOWLEDGE ABOUT AI



SOURCE: PREPARED BY THE AUTHORS.

What is it?

The students were asked about what they knew and understood AI to be: "What do you think AI is?." Overall, they understood that AI is a technology based on continuous learning from human interactions with digital technologies. Among students in public schools in Recife, this concept came up with the idea that AI learns as humans ask, revealing the perception that the system depends directly on user contributions to improve itself.

> AI, in short, is a robotic mind that learns as humans ask. So, it learns and adapts as you ask questions, like GPT itself. I believe that everyone here uses it. We were talking about GPT. If I ask a question on GPT and she asks the same question, it will probably give the same answer. However, if she or I makes a different answer than that, we add some things and the site learns from that. The answers are becoming more and more elaborate.
>
> (STUDENT, PUBLIC SCHOOL, RECIFE)

The statements suggest that students understood that there is a progressive evolution of technology as the use intensifies. Students in the public education system in São Paulo defined AI as a "robotic simulation of human thought," created from a large database, while those in private schools (in Recife and São Paulo) often described AI in technical terms, such as "a computer system," "a database," or "a highly specialized algorithm." These formulations indicate contact with more formal definitions and approximations of academic or media discourse on technology, without further depth. Also, for private school students in São Paulo, the idea arose that AI is a tool that "compiles everything on the Internet," suggesting the view that it operates by synthesizing and organizing the available information.

> It's a tool that compiles everything on the Internet, makes a summary and sends it to you. You want to know about birds, it'll look up everything on the Internet about birds, it'll offer you the answer, which would be most of the data, or a summary of the data.
> (STUDENT, PRIVATE SCHOOL, SÃO PAULO)

Where is it present?

After the students in the focus groups discussed what they knew about AI, they were asked where this technology is today. The most recurrent answer to this question was "in everything," which demonstrated an awareness of the massive and diffuse presence of AI in various sectors.

By exploring this answer, a variety of examples were brought up by students: from applications in health, education, law, and design to more everyday uses and support in schoolwork. This repertoire indicated that they were not only aware of the presence of AI in different sectors, but also experimented with various ways of incorporating this tool into their own routines, that is, they realized that all areas have been using AI, from work to study, from scientific research to emotional support.

Another important aspect is the understanding that different AI tools operate in distinct ways. Students recognized that some tools are integrated with broad systems, such as Google, whose operational search "comes with AI;" and that others are specific AI tools (non-embedded), which take on very particular functions, such as "Tia Bete," used by diabetic people to make glucose calculations, or "Duda," which organizes studies according to errors and correct answers.

Known tools

Still in discussions about what they know about AI, the students' responses revealed their own experiences with the use of these technologies, showing that they are widely incorporated into their routines. They claim that they resorted to these resources almost automatically when faced with different demands (academic, personal, or leisure), as discussed in the next section.

The habit of using different tools according to need or availability shows familiarity with multiple resources and flexibility in transit between platforms. In addition, a wide diversity of AI tools mentioned was observed. Although the most cited were ChatGPT, Gemini, and Luzia, specific platforms related to studies also appeared, such as Estuda.com, linked to a private school, and Kahoot, used in different institutions. In addition to these, applications aimed at entertainment, video and photo production, and communication, such as Snapchat, CapCut, and Meta tools, were mentioned. This variety of tools pointed out by the young people reflected a continuous process of experimentation and circulation among technological innovations, in which they explored and tested different alternatives in their various spheres of life.

In addition, the students highlighted differences between paid and free tools: They emphasized the variation in the quality of services and recognized that access to more complete versions depends on material conditions. Their remarks reflected a critical position on inequalities in access to the most advanced technologies: The cost of use appeared as a significant barrier for many, which, according to them, had important implications for both the possibilities of using these tools and the development they could achieve from them.

Are students informed about AI? How?

Students were also asked if and where they usually did research about AI. The answers revealed different levels of interest and engagement in the search for information on the subject.

Among students in public schools in Recife, there was both curiosity and a desire to deepen their knowledge, and manifestations of explicit disinterest, whereas in the focus group formed by young people in private schools in the same

city, the prevailing perception was that there was no need to seek additional information. Some reported that they initially researched AI for fear of risk or exposure, but abandoned the practice because they considered the technology reliable and practical. In general, the surveys mentioned were carried out through Google and were one-off, motivated more by initial curiosity or concern with safety than by continuous interest in deepening the theme.

Students in São Paulo, in turn, did not report having sought information about AI on their own. In general, the reports observed show that the young people recognized the importance of AI and were assiduous users of tools based on this technology for practical tasks (context explored in more detail in the next section), but an interest in understanding the topic in a deeper way was still incipient, manifesting itself mainly in moments of curiosity or occasional concern.

When asked if they had ever had any content as a class or course on AI at school, most students in public schools, in both Recife and São Paulo, stated that they had little content (some teachers addressed the topic in the classroom, commented on it, but in a one-off way): Only one public school student mentioned an activity conducted by a teacher with the aim of promoting debate about AI. Some students in private schools reported that they attended lectures on AI at school, while others stated that they wrote essays on this topic, at the request of teachers, but still consider these initiatives to be quite incipient and limited.

My Philosophy and Geopolitics teacher, he used it, today, even, and there were a few times when some teachers brought it up, asked about our opinion and explained a little about it. Today my teacher gave me an assignment on this, as if it were an activity, as if it were a test, for us to conduct research, without Artificial Intelligence, for us to see the risks, the benefits of Artificial Intelligence.

(STUDENT, PUBLIC SCHOOL, SÃO PAULO)

In my school, the most that happened was the teacher assigning us an essay with a topic about Artificial Intelligence, how it would affect the future.

(STUDENT, PRIVATE SCHOOL, RECIFE)

"I had to write an essay on AI." "Writing too." "Writing too." "For me too." "I think it would be interesting for us to know how to use it, because there are a lot of things, it's very comprehensive."

(STUDENTS, PRIVATE SCHOOLS, SÃO PAULO)

These aspects refer to the question of understanding AI technologies. Several authors of the literature specializing in AI and education discuss the need to critically approach technology with students, which involves, among other initiatives, the development of knowledge about how AI works, biases linked to training data, and risks to data privacy (Selwyn, 2019, 2022). The approach to these topics is also related to competencies and skills provided by the complement of the BNCC of Computing,[6] a guideline for the teaching of computing in Brazilian basic education (Ministry of Education [MEC], 2022).

USES AND NON-USES OF AI BY STUDENTS

When the uses of AI reported by students during the focus groups were discussed in more depth, both its personal uses and those for school activities were explored. Fundamentally, we sought to identify purposes for and ways of using AI tools (how, when, and for what), in addition to eliciting students' perceptions about the ease, challenges, and risks they perceived in the uses made, including dealing with situations in which they preferred not to use AI or believed that its use is arbitrary.

The narratives, as observed, showed that students experienced varied and highly intensive forms of incorporating AI into their routines. As mentioned by a public school student in São Paulo: "I use it all the time. All the time for anything."

In addition, the research sought to understand the students' views of the question "AI: What for?," to investigate the purposes and objectives for the use of this technology. At this point, there were no significant differences in the responses of students in Recife and São Paulo, nor between those in public and private schools. The main purpose for students is time optimization: AI has been used by young people and

6 The BNCC of Computing is a complement to the National Common Curricular Base (BNCC) that defines essential skills in technology for basic education; it was made official in 2022. It is based on three main axes: computational thinking, which involves logical reasoning and problem solving; digital world, which focuses on understanding the functioning of the Internet, networks and the cloud; and digital culture, which discusses the social, ethical, and political implications of technology. The goal is to train critical, creative citizens capable of acting in an increasingly digital world. Available at: https://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=236791-anexo-ao-parecer-cneceb-n-2-2022-bncc-computacao&Itemid=30192

those they know to gain agility in everyday activities and to avoid repetitive tasks.

I think I use it in all activities where it can optimize time, which is a matter of practicality too, because most people have a lot to do all the time, and AI optimizes any information you need. You can use it for various contexts as well, school, various environments. "I need restaurants near such and such street," you can optimize your time, it's a matter of agility.
(STUDENT, PRIVATE SCHOOL, SÃO PAULO)

Personal uses of AI

The most recurrent use of AI pointed out among the young participants was in search and research activities. They said they used it to search for "anything": from the meaning of words to symptoms and pain they were experiencing. There were also those who used it to find out how to repair and assemble objects. Another function mentioned had to do with problem-solving: Students reported using AI tools to assist in games, for example, in order to improve their performance. Others said it is good for "picking up ideas."

Among the uses of this technology in personal life, practices related to the organization of routine, health, and leisure stood out. The study collected reports of the use of AI for reminders of daily tasks, preparation of recipes, organization of diets, and even for requesting advice. A student in a private school in São Paulo reported that some classmates used it as if it were a "psychologist, or sometimes tarot," taking advantage of the voice conversation feature. Some participants mentioned that they used it as emotional support, even claiming to use AI as a "friend" and/or confidant, even referring to ChatGPT in these terms.

Chat knows absolutely everything about me. If I come in and say, "Chat, I'm sad," it already knows. It asks me: "Why? Did something happen at school? Did something happen with your boyfriend?" It knows my boyfriend's name. My Chat knows everything. I use it for life, for anything.
(STUDENT, PUBLIC SCHOOL, SÃO PAULO)

The use of generative AI as a source of emotional support by children (especially the use of ChatGPT, as it is the most popular tool of this type) has recently been addressed by the media (Goulart, 2025; McBain, 2025; Pinotti, 2025). Although there are still a few studies on this phenomenon in the specialized literature, it is certainly a topic that deserves attention from schools and families as well as from mental

health professionals. In Brazil, the ICT Kids Online 2025 survey revealed that 10% of children who were Internet users used generative AI to talk about personal problems or their emotions (Brazilian Network Information Center [NIC.br], 2025a).

Uses of AI for studies

In the context of school tasks, students distinguished different ways of using AI, which varied between what they called one-off support and uses that, in their perception, could generate dependence. In the first group (one-off support), they reported the use of AI for extensive or repetitive tasks, such as the preparation of text summaries for study, organization of class notes, or generation of ideas and repertoire for the preparation of essays. Among the uses considered by them to be potentially addictive, they mentioned using AI tools to solve exercises in tests and complete assessment activities.

Among students in public and private schools in São Paulo, very diverse experiences in the use of AI for school tasks emerged. Some reported using AI tools for different purposes: Gemini for quick searches, Character AI for creating characters, Leonardo AI for image creation, and ChatGPT for school activities. There were also those who used AI to filter information, which is useful for browsing through long articles, selecting relevant passages, and then deepening the reading. Others highlighted functions linked to learning outside of schools, such as asking ChatGPT to organize and correct class notes, or turning summaries into flashcards for study. In these situations, AI emerged as a tool to support study at home, complementing teachers' explanations and teaching materials:

> It's not my main source of study, I much prefer to go to a teacher, to the than relying entirely on ChatGPT for my exam, which is worth a full ten points.
>
> (STUDENT, PRIVATE SCHOOL, SÃO PAULO)

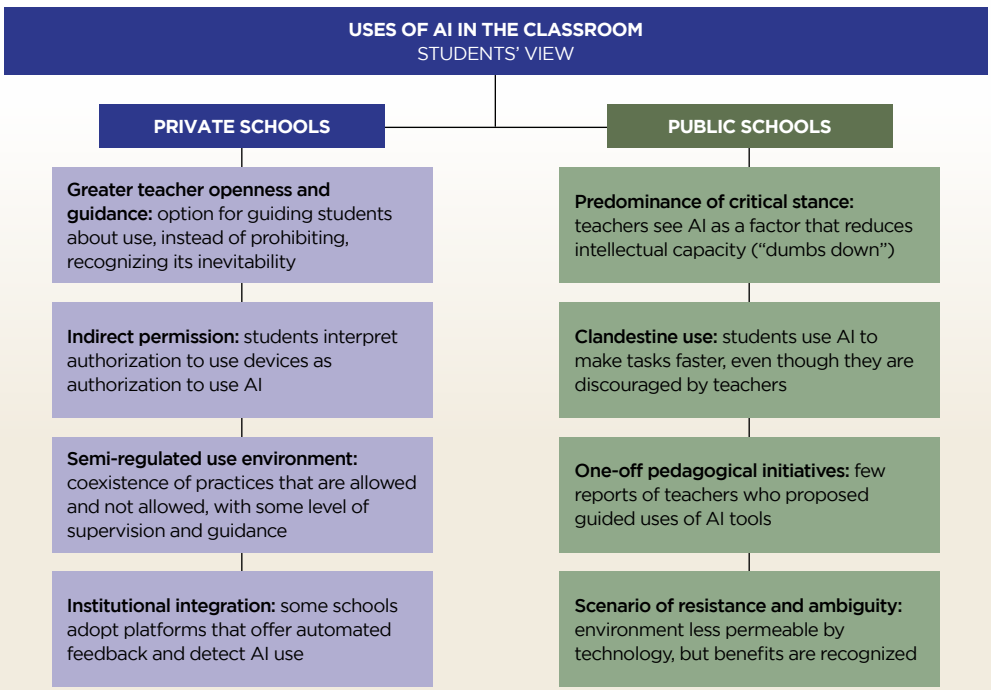
According to students, there is a "silent pact" in schools between them and teachers: the latter pretend that they do not know about the use of AI by students, while the former pretend that they do not use it. This environment of use of and experimentation with tools for school activities is permeated by both mistrust and strategies for adapting content prepared

with AI, such as the use of tools to "humanize" texts before submitting, preventing the use of this technology from being identified. In public schools in Recife, students said that teachers know the patterns of ChatGPT answers, while in private schools, students reported training the tools so that they respond more reliably and coherently. In addition, they thought that by acting in this way, they were learning the content as well.

Uses of AI in the classroom

The last topic addressed in this section is the use of AI in the classroom. In this case, the results revealed a marked distinction between private and public schools. Figure 2 summarizes the main differences observed between students in public and private schools regarding the use of AI in the classroom.

FIGURE 2 – STUDENTS' PERSPECTIVES ON THE USE OF AI IN THE CLASSROOM



SOURCE: PREPARED BY THE AUTHORS.

In private schools, students reported a diverse scenario that is more open to the use of these tools. They reported that some teachers preferred to teach how to use them instead of prohibiting them, based on the idea that the tools are present in the students' daily lives, so it is better to guide them: "so that we can use them in the right way, correctly, in a way that helps us," as a participant in Recife said. In São Paulo, they reported situations in which teachers allowed the use of mobile phones or Chromebooks for research, which they interpreted as permission to also use AI. In summary, in private schools, the use of AI moved between authorized and unauthorized practices, with some guidance and supervision from teachers. Some schools have even institutionalized the use of platforms for pedagogical support, especially for writing correction. An example was the "Redação Nota 1000[7]," which offers revisions and suggestions for improvement and even gives estimates on the probability that the text was produced by AI.

On the other hand, in public schools, students described a more restricted scenario, marked by teachers' criticism of the use of AI. Teachers tended to associate technology with a loss of intellectual capacity, even stating that excessive use "dumbs you down." In this sense, students said that teachers recognized the students' use of AI tools to solve exercises quickly, despite being against the guidelines. Thus, a few teachers guided more productive forms of interaction, such as a math teacher who was quoted for suggesting that they ask not only for the result, but also for "the step-by-step calculation, so that we can understand how this works." However, even less frequently, some teachers also proposed activities that directly involved AI, such as the elaboration of a song, promoting space to experiment with creative and pedagogical uses. In public schools, therefore, although the context is less permeable to this type of technology, critical discourse coexists with the perception that AI can offer benefits, as long as it does not fully replace the intellectual effort and the learning process of students.

7 Find out more: https://www.redacaonota1000.com.br/

In general, these observations by students reinforced the lack of teacher mediation in the use of AI by students in schools, as evidenced by the ICT in Education 2024 survey, carried out by Cetic.br. The survey data pointed out that most upper secondary school students (70%) used AI tools in research and school activities, but that only 32% of upper secondary education students in the country said they had received some guidance from their teachers on how to use generative AI apps, such as ChatGPT, Copilot, or Gemini, in school activities (NIC.br, 2025b).

Perceived non-uses and limits

Beyond the use of AI tools integrated into students' daily lives, the discussions revealed, in both Recife and São Paulo, that there were situations in which students avoided using AI, usually in preferred subjects or in those that they understood required greater critical analysis. In these cases, they resorted to books and produced their own reflections, as the use of AI could limit their intellectual exercise and the authorship of their productions.

> [...] the activities that need to discuss more things, such as History, Geography, Biology. I don't like to use [AI] a lot, I prefer to look things up in books, at school, that kind of thing.
> (STUDENT, PRIVATE SCHOOL, RECIFE)

> I don't use Artificial Intelligence when it's the humanities subjects, because I'm specializing in humanities. Sociology, when the teacher assigns the work, I try to do it in my own head, precisely because these are subjects to exercise our critical sense. So, I try to do things more with my head.
> (STUDENT, PUBLIC SCHOOL, SÃO PAULO)

Despite the intense use of AI in school tasks, it was possible to identify reflections on limits and on contexts in which it would not be appropriate to use it. These limits arose especially in activities that required critical thinking, creativity, or personal expression: "I have seen classmates using it to write a self-assessment text, which I thought was quite wrong," reported a public school student in São Paulo. For some, delegating tasks of this type to AI compromised authenticity, being interpreted as "being too lazy even to have a personality" and as a way of forgetting "who the person is."

There was also a recurring perception that one should not resort to AI when there was no previous knowledge about the

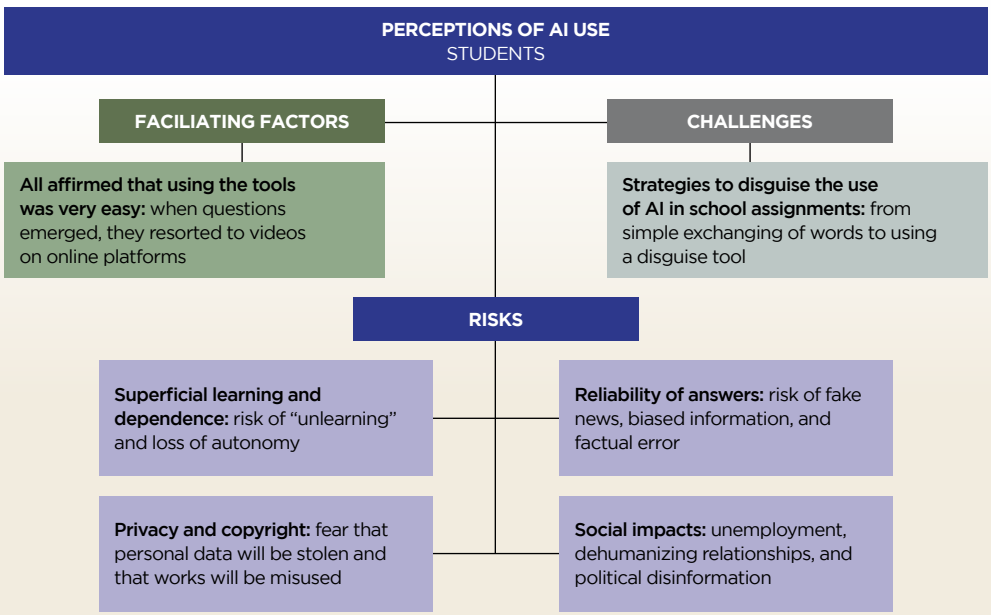
researched topic, since there would be no minimum judgment or repertoire to evaluate the content produced by the tool.

> I think that if you don't know anything about the subject, it's not cool to use it, because it's flawed. If you don't have the slightest understanding and you copy anyway, you'll only write down what you've read.
>
> (STUDENT, PRIVATE SCHOOL, RECIFE)

Perceives facilitating factors, challenges, and risks in use

Students were asked about the facilitating factors, challenges, and risks in using AI. Figure 3 summarizes the main results, based on students' perceptions of the use of AI.

FIGURE 3 – STUDENTS' PERCEPTIONS OF AI USES: FACILITATING FACTORS, CHALLENGES, AND RISKS



SOURCE: PREPARED BY THE AUTHORS.

All students stated that they found it very easy to use the tools mentioned. When doubts arose, they reported turning

to platforms, such as TikTok, where there are tutorial videos that teach various ways of using AI tools.

When addressing the challenges in the use of AI, students mentioned strategies to disguise the technology used in school tasks. The methods reported ranged from simple adaptations (changing a few words in artificially generated texts) to the use of other tools that mask artificial authorship. One of the students created his own method of "humanizing" his texts. First, he asked for the content to be generated by AI, then summarized it, translated it into other languages, and finally translate the text back into Portuguese, which, according to him, made it seem that the result was not produced by AI. In general, however, the participants did not know how to deepen the discussion about challenges in the use of AI, focusing more on practical strategies of use than on their ethical or pedagogical implications.

With regard to risks, one of the points mentioned with the greatest recurrence was the risk of lag in the learning process. The constant use of this technology to solve school activities was associated with the loss of intellectual autonomy and the "unlearning" of basic content. The perception that the excessive use of AI can hinder cognitive formation was predominant in all groups, especially emphasized by students in private schools in São Paulo and public schools in Recife.

[...] Everyone gets a ready-made answer [...] when you get further ahead and take a test or the university entrance exam, how will you know how to do it?

(STUDENT, PUBLIC SCHOOL, RECIFE)

In addition, many young people problematized the quality and reliability of the answers produced by AI tools, pointing out the risk of access to biased or incorrect information. One student commented:

Chat can't verify if it's fake news or not. If, for example, there is an article saying that a headache is brain cancer, if it is the first link it finds, it will send it to you.

(STUDENT, PUBLIC SCHOOL, SÃO PAULO)

Risks that go beyond the use restricted to the study were also mentioned, such as concern about privacy and digital security, especially the fear that AI could "steal data." Copyright concerns also emerged as a risk: Some students criticized

the possibility of AI producing content from existing works, without acknowledging sources.

Another risk that was highlighted was the replacement of jobs by automation via AI. One student expressed the fear of unemployment:

> In any area now, AI is managing to replace most people. People are becoming unemployed because of this.
>
> (STUDENT, PUBLIC SCHOOL, SÃO PAULO)

The risk that the use of AI will lead to the dehumanization of social relationships was also pointed out, as young people recognized that the automation of communication can result in a loss of authenticity in human interactions. In addition, the ability to manipulate images and generate false content generated concern among students. Students in a public school in São Paulo cited the example of creating pornographic images from photos of real faces, highlighting the potential for damage to people's reputation and integrity. Finally, the students pointed to the use of AI in the production of political disinformation, especially during election periods, since the difficulty of distinguishing real content from fabricated content was described as a direct risk to democracy.

The students' answers showed that, in addition to using AI in a variety of ways, students reflected on risks and limits, developing their own criteria for when and how its use is acceptable. On the one hand, there was an understanding of AI as a support tool capable of streamlining tasks and supporting learning; on the other, they recognized that certain practices can impair learning, lead to a kind of "self-sabotage" or dependency, and compromise personal expression and authenticity. It is important to note that these boundaries are not, in the students' view, imposed solely by teachers, but are also articulated by the students themselves, who associate the legitimate use of AI with support for learning and illegitimate use with laziness, fraud, or loss of identity.

At the same time, the strategies for "humanizing" texts and circumventing detectors showed that the boundaries between right and wrong and what is allowed and what is forbidden were still fluid and constantly (re)negotiated in the daily life of students. The fact that many teachers "pretend they do

not know" and students "pretend they do not use it" suggests that AI is normalized in school practice, despite still lacking a consensus on its legitimacy. Therefore, the analysis of the uses and non-uses of AI revealed a process of experimentation, in which young people tested the reliability of the tools, explored their limits, and delimited their own ethical boundaries by deciding what is considered learning and what is perceived as a shortcut, risk, or even moral deviation.

CRITICAL AI TOPICS (BEHIND THE TOOLS)

The purpose of this topic is to present students' understanding of critical topics related to AI by exploring what they understood about what is "behind these tools." Some perceptions are discussed, such as reliability, privacy, and use of personal data, issues of ethics, responsibility, and algorithmic biases. In addition, this section addresses students' interest in discussing these topics at school, which shows their understanding of the social, political, and moral implications of AI use.

Regarding the reliability of the responses generated by AI, most students pointed out that it was not possible to fully trust the information provided. They recognized that these technologies operate from databases, continuous learning, and algorithms that personalize responses, but they also highlighted limitations in responses, which require critical evaluation. Reports of the identification of contradictory or inaccurate answers reinforced the importance of using AI with caution, including adopting verification strategies. In these situations, students turned to other sources, such as Google, specialized websites, or books, to confirm or complement the content accessed:

> I think you always have to have some degree of distrust. [...] Read and reread it, twice, to be sure.
> (STUDENT, PUBLIC SCHOOL, SÃO PAULO)

Another topic addressed was the issue of privacy and the use of personal data, with perceptions of insecurity and distrust arising in relation to AI technologies. Students in public schools in Recife reported feeling invaded and lacking control over the information shared. Many stated that they provided their data "automatically," without reflecting on the consequences, and expressed disbelief in the existence of effective protection mechanisms. The prevailing perception

among young people was that enterprises and developers of AI platforms hold the power over personal data, and not users. Among students in private schools in Recife, fear appeared mainly in the form of possible invasions and virtual attacks. Many expressed fear of being hacked and recognized that lack of technical information on the subject further accentuates insecurity. Although they knew about the existence of data protection laws, they did not understand how they work. Thus, they accepted the terms of use without prior reading, which revealed a combination of ignorance, naturalization, and resignation in the face of the practice of giving up personal information in exchange for access to digital tools.

In public schools in São Paulo, students were more explicit in pointing out the risks related to the collection and storage of information by AI. They said that these technologies "store information" and there is no real security in this process, since the data can be used both to manipulate users and to favor enterprises and governments. Although they considered the protection necessary, they believed that only people with technical knowledge, such as information technology (IT) professionals, really know how to protect themselves. This perception revealed a critical view of the lack of digital security, as they saw structural problems, but did not master practical protection strategies, which naturalizes the risks involved in the use of these technologies.

When prompted to debate ethics in the use of AI, the responses revealed both a lack of understanding of the concept and pragmatic perceptions based on experience of use. Students in public schools in Recife said they had never heard of the term, associating the notion of "ethics" with the fact that ChatGPT refuses to answer inappropriate questions. For them, ethics was perceived as a protection mechanism incorporated into the tool, that is, as a virtue of technology, and not a human principle that can guide its responsible use.

Everything you ask ChatGPT, it will teach you how to do it. Just don't ask the wrong things, like how to rob a bank, it won't answer, because it has ethics.

(STUDENT, PUBLIC SCHOOL, RECIFE)

Some students in private schools in Recife said they "had heard about" ethics in the context of the use of AI. For them, it

was not ethical to use AI in jokes and memes that could deceive more vulnerable people, such as the elderly:

> Facebook is now full of AI photo posts. For example, my grandmother believes everything she sees, everything. A child builds an airplane with a plastic bottle, that's clearly an AI-generated image.
>
> (STUDENT, PRIVATE SCHOOL, RECIFE)

Regarding responsibility for the misuse of AI technology, opinions were divided. Some of the students said that "no one" would be responsible, since it is not possible to identify who produces the misleading content. Others argued that it would be up to the "creator" of the AI to take responsibility, even though they recognized that systems "learn by themselves," which makes it difficult to establish a direct "cause and effect" relationship (like a child who acquires habits outside the control of parents). Students from private schools in Recife pointed to a double responsibility: both that of the enterprises that make the tools available and that of the people who use them improperly. They also emphasized the role of those who share disinformation, stating that those who disseminate misleading content condone the action, that is, they also become responsible.

In the group of public schools in São Paulo, the students highlighted the need for regulation and inspection. Although some had not formally heard of ethics and responsibility in the use of AI, they recognized the importance of developing "critical thinking" and having laws that curb abuses in the use of these technologies. For them, responsibility is shared between different actors: users, who produce and disseminate fake news; governments, which fail to regulate; and enterprises, which develop and maintain the tools. The perception of the power of Big Tech companies was also present in the answers, suggesting that "people much more powerful than we imagine" would be behind the development and maintenance of AI, motivated mainly by economic interests. In general, the students' perceptions were diffuse, but they understood that, in some way, the responsibility would fall on three entities: (a) individuals, who deceive; (b) creators, who design the tool; and (c) the State, which fails to regulate it.

Still on critical topics related to the use of AI, students were encouraged to think about inequalities associated with the use

of AI. In public schools of Recife, many defended the idea that the tools do not distinguish people, since they are programmed only to execute commands. However, a student in a private school in Recife brought a more critical perception:

> When you have to pay to have a service, it becomes unfair. You're already excluding a niche that can't afford it, people who can't afford it. There was another issue, I think years ago, which has been discussed a lot, an issue, since in digital media appearance is so important, the issue of White people, and it always associated its constructions with White people, because it didn't have a good basis, or it was less represented in the data it used. This can be a problem too.
>
> (STUDENT, PRIVATE SCHOOL, RECIFE)

This statement highlights the debate on inequality in access, especially due to charges for paid versions, which exclude those who cannot afford the cost. The student from Recife also highlighted the issue of representativeness in the data: Tools would tend to reproduce white and Eurocentric patterns due to the basis of their training, which could generate distortions and injustices. Among students in São Paulo's public schools, inequality was also associated with paying for premium versions, which expand access to resources or increase usage limits.

The themes mentioned and discussed by students returned to the issue of the critical approach to the use of AI, pointed out in the section "Perceptions and general knowledge about AI." In addition to the need to develop knowledge about the modes of operation and limitations of AI, authors such as Selwyn (2022), Holmes et al. (2022), and Bartoletti (2022) emphasized the relevance of the ethical debate on AI in the educational context. The term "ethics," although it takes on different meanings according to the author or the line of investigation, generally crosses concerns mentioned by the students: risks to privacy in the use of data, the possibility of reinforcing social inequalities, and the reliability of the responses generated by technology. On the last item, the Referential Framework for AI Skills for Students, published by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2025, emphasized the principle of promoting a critical approach to AI among students, since identifying the reliability and proportionality of AI tools is a fundamental skill for the ethical and critical use of technologies (Miao et al., 2025).

Finally, the students also highlighted the role that, in their view, schools should have in training students in relation to the knowledge necessary for the beneficial use of AI tools. In the four focus groups, students stated that topics such as critical, safe, and ethical use of AI tools should be addressed at school. After all, according to them, most students already use these tools and, so far, in their perceptions, schools are not talking about it.

The students said that they would like to learn more about the subject, and learn to use it correctly, for both personal purposes and pedagogical uses, and attributed this role to the school. They report wanting to know more about the use of data, about how to be ethical in use, preserve individuality, and avoid dependence on the tool. "Denying is negligence" in the view of one of the participants from a private school in Recife.

Moderator: What would you like the school to address? What would you like to learn about AI?

[...] about ethics when using the tool in a way that does not harm everyone and that does not take away each person's individuality, in a way that people are not totally dependent on the tool, that it is something that helps, and you don't get totally dependent on it.
(STUDENT, PUBLIC SCHOOL, SÃO PAULO)

Knowing how to use it and the right formula, because since it is very fast, sometimes the answers are not always correct, so you have to know how to use it.
(STUDENT, PRIVATE SCHOOL, SÃO PAULO)

The issue of ascertaining facts. Often when you search for something you don't know, you can't be sure if the answer is true or not.
(STUDENT, PRIVATE SCHOOL, SÃO PAULO)

I think the issue of data, what they do with our data, is a good thing.
(STUDENT, PRIVATE SCHOOL, RECIFE)

How it was made. New ways to use it.
(STUDENT, PUBLIC SCHOOL, RECIFE)

THE FUTURE OF AI

This topic aims to present students' feelings and perceptions about their perspectives on the future of schools and their professional life, in a context marked by the dissemination of AI. These reflections were discussed at the end of the focus groups, at which time they were also encouraged to discuss what they considered to be an ideal use of AI.

In general, students mostly expressed negative feelings, fears, and uncertainties, but with some degree of ambiguity,

since sometimes there were also mentions with some enthusiasm in the face of technological possibilities.

Among students from schools in São Paulo, both public and private, a critical and pessimistic view predominated, associated with the idea of loss, understood both as a replacement of services and professions and as a threat to humanity itself. The expectation that AI may reduce people's autonomy in accessing information reinforces, among young people, a perception of an uncertain and potentially unequal future.

Moderator: In one word, what do you feel when you think about your future with AI?

"Fear." "Chaos." "Danger." "Exchange."

(STUDENTS, PUBLIC SCHOOL, SÃO PAULO)

"Domination." "Evolution." "Substitution." "Undefined." "Danger." "Fear."

(STUDENTS, PRIVATE SCHOOL, SÃO PAULO)

In Recife, more contrasting visions appeared. Among young people in public schools, there were those who believed in the positive impact in creative and artistic areas, highlighting that AI can be an ally in technical and ideas development. On the other hand, these students also recognized important dilemmas, such as the difficulty of differentiating creative references from plagiarism, while others projected broader negative consequences, such as decreased professional opportunities, unemployment, and economic inequality resulting from the replacement of human labor by machines.

Negative [impact], because they will go to some college, they will not have a profession, and will not get a job. There are several enterprises that use more robots than humans. It generates a big hole in the economy.

(STUDENT, PUBLIC SCHOOL, RECIFE)

These statements revealed that, even among students, both hopeful views about the creative potential of AI and structural concerns about the future of work and the economy coexist, expressing the ambiguous and multifaceted character of expectations around the technology.

Young people in private schools in Recife thought that some professions would disappear, but new ones may emerge, as long as society knows how to "control" the use of technology. In São Paulo, students in private schools also showed concern

about the extinction of professions, but stressed that the field of Humanities, such as Law, could hardly be fully assumed by machines, as it depends on contextual judgment and sensitivity to avoid injustices, attributes understood as essentially human.

Reflections on the future of schools with the use of AI also revealed similar tensions. In São Paulo, public school students expressed fear that the institution would become a space of alienation, in which "it will no longer be a place of learning, but a place of dumbing down." This criticism suggests the concern that the introduction of technologies may widen inequalities and consolidate existing power relations, instead of democratizing access to knowledge. In Recife, students in private schools also pointed out that the massive introduction of technology could lead to overdependence, highlighting that its use could weaken students' cognitive capacity, making them unable to cope with situations in the absence of devices. At the same time, they warned of the risk of deepening inequalities present in Brazilian society, since access to technology tends to remain restricted to those who already have better material and educational conditions.

I think that in addition to public school, in teaching, but social disparities in general. They can increase a lot. We already have very strong social inequality here in our country, and when you are giving even greater technological power to a small part of the population, which already has greater access to education, wealth, technology, it will further aggravate this problem. It can get worse if you don't use it correctly, and if it stays in exclusive niches.

(STUDENT, PRIVATE SCHOOL, RECIFE)

Despite the fears, many recognized positive potentials for the integration of AI into schools, as long as it is a support (and not a replacement). In São Paulo, students in the private network reinforced the importance of teachers being central mediators of the educational process; that is, they should not be replaced; for them, AI should be incorporated as a support tool to prepare students for future life. In Recife, proposals for ideal uses have emerged, such as tools that help in the organization of studies, work as counselors, or even offer psychological support, showing that young people projected monitoring functions in AI that go beyond pedagogical tasks.

Perhaps it could provide guidance on the organization of studies, because many people have difficulty organizing their studies and are ashamed or shy about even talking to the teacher, seeking out the teacher, asking for help. Maybe with this tool it would become easier.
(STUDENT, PRIVATE SCHOOL, RECIFE)

Kind of being a best friend, for the person to come in, talk to that person, give advice.
(STUDENT, PUBLIC SCHOOL, RECIFE)

In summary, expectations regarding the future of AI oscillated between promises of facilitating life and work and concerns about dependency, unemployment, dehumanization, and widening inequalities. In this scenario, schools appear as strategic spaces in this debate that are essential to the critical, ethical, and conscious integration of technology.

UPPER SECONDARY EDUCATION TEACHERS: SKILLS, USES, AND EXPECTATIONS FOR THE FUTURE

USE OF DIGITAL TECHNOLOGIES IN TEACHING LIFE AND PRACTICE

The first questions presented to teachers, as well as in the focus groups with students, aimed to understand the use of digital technologies in their daily lives, emphasizing, in this case, use by teachers in the school environment and in the integration of resources.

Among teachers, there was a tendency to address technology by articulating recognition of its benefits for the pedagogical process alongside criticism of its risks, including excessive use and inequalities of access. The reports showed familiarity and frequent use of technology by teachers, but were accompanied by a certain fear, especially regarding the use made by young people. Some teachers felt that students become too dependent on digital resources and end up not recognizing the role of the teacher:

You become so accustomed to projectors and programs that the student does not recognize you as the holder of knowledge. "If the power goes out, the projector burns out, there is no class." Technology should be your support. And not replace you.
(TEACHER, PRIVATE SCHOOL, RECIFE)

In general, teachers showed familiarity with various electronic equipment (mobile phones, computers, projectors) and used them all to prepare and teach classes. However,

the reports revealed disparities in access to technological infrastructure between schools, which implies inequalities that directly affect teaching practice. Teachers in the public school system in Recife reported, for example, that they needed to improvise and even buy equipment with their own resources.

> I have 100% of the subject in digital media, I use a projector, the computer every day [...] so much so that I bought a projector for myself. I won't depend on it. The computer is mine and is at school all the time.
>
> (TEACHER, PUBLIC SCHOOL, RECIFE)

However, in private schools in the same city, the scenario was different: There was more support from management and more equipment available. In these contexts, teachers reported greater autonomy in integrating digital technologies into classes, while respecting legal restrictions on the use of mobile phones:

> We give the kids their mobile phones to play Kahoot. [...] You have to notify the management, because the mobile phone is locked away, because of the law that prohibits the use of mobile phones, then we let them know and make the phones available to them at that time. They love it.
>
> (TEACHER, PRIVATE SCHOOL, RECIFE)

The digital platforms adopted by schools for different teaching activities were another important point of criticism. Among teachers in Recife, the Education Information System of Pernambuco (SIEPE)[8] was mentioned as a bureaucratic burden that takes time and energy. In São Paulo, although complaints about digital platforms were similar, they were more related to the excess of activities that these tools bring to classroom dynamics. Even in private schools, where there were more resources, teachers reported institutional pressure linked to the mandatory use of platforms, which contributed to the feeling of overload and loss of autonomy.

> SIEPE is a sore point for every teacher in the state. [...] It's never-ending work. There is always something to fill out. [...] It is a bureaucratic activity, which in the past was not ours. And it shouldn't be.
>
> (TEACHER, PUBLIC SCHOOL, RECIFE)

8 SIEPE is a computerized system of the state education network of Pernambuco, which allows access to and sharing of educational information in real time, in addition to providing pedagogical and management resources, promoting interaction between the Secretariat of Education, Regional Education Managements, schools, and the school community (Silva et al., 2017).

> Since the school implemented the platforms, there is no escape. [...] It is very rich material, you have to admit that it's good, but it is a very large amount for the class demand. [...] It takes away teacher autonomy.
>
> (TEACHER, PUBLIC SCHOOL, SÃO PAULO)

The use of mobile phones in the classroom is a topic that appeared spontaneously and elicited conflicting opinions. By Law No. 15.100/2025, the use of mobile phones for pedagogical purposes is restricted. However, reports show that the application of this rule varies widely between institutions and education networks. In Recife, public school teachers said that, despite the prohibition by law, students used their mobile phones constantly to play games, film something, or access social networks. In private schools in the same city, teachers reported a different scenario: Students can use the devices as a pedagogical resource, but under constant institutional surveillance, by both the school coordination and the students themselves, who question and supervise its use.

In São Paulo, public school teachers said that the ban clashes with the reality of young people:

> [...] the law exists, but it seems to me that it is something that goes against the use of technology. Whether you like it or not, for young people today, mobile phones are aggregating, they are a part of their body. It is an extension of the body.
>
> (TEACHER, PUBLIC SCHOOL, SÃO PAULO)

The discussion on the use of technologies in schools also highlighted infrastructure disparities between public and private schools, including in the education systems themselves. In general, private institutions have better structural conditions, such as a more stable Internet connection and higher-quality equipment. In addition, access to devices varies significantly according to the internal policy and the degree of incentives for pedagogical innovation in each school.

In São Paulo, for example, public school teachers reported very different situations: While in some schools, the use of digital technologies was intense and well incorporated into pedagogical practices, in others, despite the existence of equipment, there were restrictions and strict controls that hindered and limited their use.

There is all the necessary technological apparatus, there is Wi-Fi in all classrooms, there are TV rooms, there are smartbooks, for example, the PATI teacher, who is the technology assistant teacher, and it is much easier to bring this dynamic to the students. Just like with the Room of the Future, with their app and our call app, they interact too, it's a good exchange.

(TEACHER, PUBLIC SCHOOL, SÃO PAULO)

I realize that some things are kind of controlled, that's terrible. So, for example, 50 mobile phones arrived there and were not distributed to anyone. They seem to be holding back the computers. Even pens are held back. They even put a padlock on the toilet paper. So, this issue of management, it bothers us. But there is a network, there are devices.

(TEACHER, PUBLIC SCHOOL, SÃO PAULO)

There is a prevailing view among teachers of different profiles that technology represents a positive element for teaching, as it facilitates access to content and optimizes class preparation. However, there is also a concern about changes in students' learning and study habits.

Before, when we didn't have the platforms [...], you depended on the student to bring the book [...]. And it was a struggle, because they didn't bring it [...]. Today, you have the technology and you can already offer the materials in real time.

(TEACHER, PUBLIC SCHOOL, SÃO PAULO)

This generation is not in the habit of taking notes while listening. [...] Soon their hands will atrophy, because they don't use them, they don't take notes on anything

(TEACHER, PRIVATE SCHOOL, RECIFE)

Although the initial questions to the focus groups addressed the use of digital technologies in a broad way, without mentioning or encouraging the use of specific tools, the mention of AI emerged spontaneously in the teachers' reports, sparking intense debates. Among teachers in Recife, references to AI appeared in practical contexts, associated with the creation of materials, the preparation of classes, and the planning of activities. In São Paulo, teachers reported using some tools, such as ChatGPT and Gemini, in tasks carried out outside the classroom, including the preparation of tests, the production of slides, and the adaptation of entrance exam questions.

The naturalness with which AI was mentioned, side by side with other technological resources, revealed that these tools were incorporated into the daily repertoire of pedagogical practices of educators.

I love to use GPT, since I work with texts a lot. When it's something I don't understand, I write: "Explain it to me as if I were a 10-year-old child with learning difficulties." And it does.

(TEACHER, PRIVATE SCHOOL, RECIFE)

> I use Canva a lot, Prezi to make slides, all these apps have a bit of Artificial Intelligence. I input what I need and everything comes out ready.
>
> (TEACHER, PUBLIC SCHOOL, SÃO PAULO)

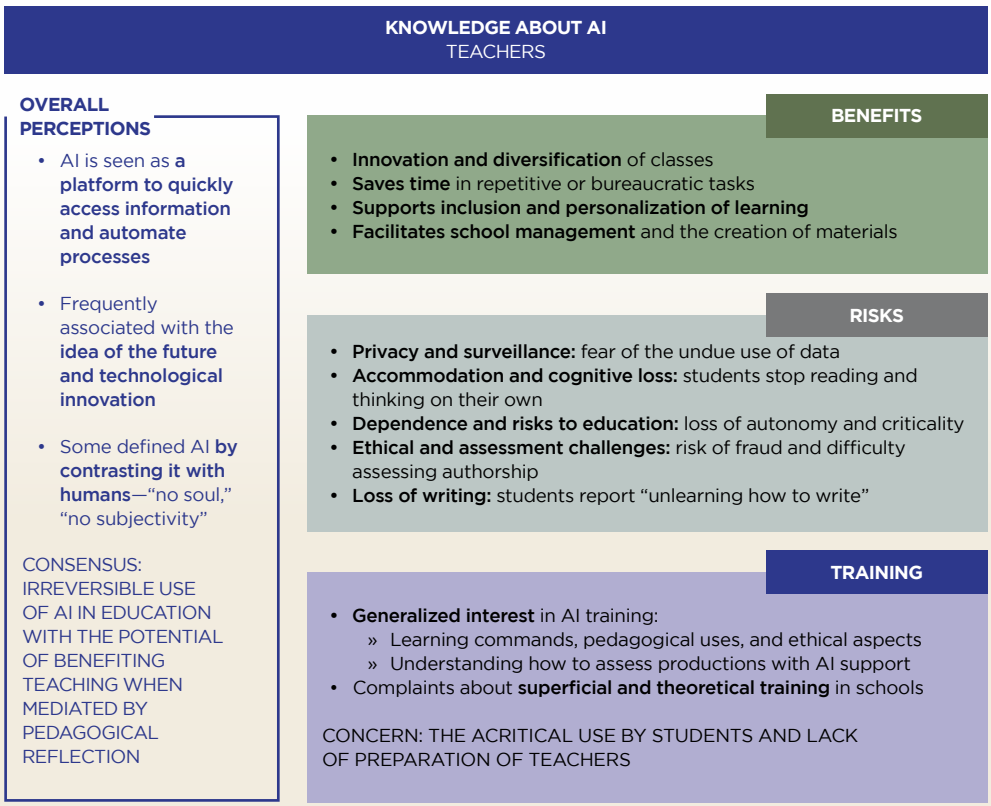
In this first part of conversation with teachers, despite the reports of recurrent use of AI in teaching work, discourses of resistance also emerged. A public school teacher in São Paulo, for example, said that, although he widely used digital technologies, he avoided using AI in lesson preparation, arguing that his performance in the classroom should offer something different from what students found on digital platforms.

In summary, the spontaneous mention of AI in the teachers' statements revealed that its incorporation was concrete in the daily life of teachers, especially as a support for the preparation of classes and activities and adaptation of content. At the same time, this presence also highlighted tensions between enthusiasm and caution, innovations and institutional constraints, practical appropriations and personal resistance, aspects that will be deepened in the next topics.

PERCEPTIONS AND GENERAL KNOWLEDGE ABOUT AI

This topic analyzes the debate held in the focus groups with teachers about the perceptions and definitions attributed to AI. The main objective was to spontaneously explore the teaching knowledge on the subject, especially in the context of educational application. In addition, it sought to identify the tools best known by them and their perceptions about the potential benefits and risks of using these technologies in education. Their interests in relation to continuing education and the expansion of debates on the subject were also discussed. Figure 4 summarizes the main points measured in relation to teachers' knowledge and general perceptions of AI.

FIGURE 4 – TEACHERS' KNOWLEDGE ABOUT AI



SOURCE: PREPARED BY THE AUTHORS.

Teachers were invited to define what they understood by AI and presented different concepts. In general, this technology was frequently associated with the future and the technological transformations it represents. Some teachers emphasized its innovative character and practical usefulness, while others resorted to expressions such as "mechanization of knowledge" and "practicality" to describe the phenomenon. More abstract definitions also emerged, in which AI was characterized by what it is not, in contrast to the human: something devoid of soul or subjectivity.

I believe that [the AI] is the future in the same way that mobile phones are today a present tool. Maybe thirty years ago, we thought it was just a change from landlines to mobile phones.
(TEACHER, PUBLIC SCHOOL, SÃO PAULO)

Simulator. It is a facilitator. Support. A tool. It's like a cloud. We know that it doesn't have the essence of the soul. But it is a numerical capacity for response.
(TEACHER, PUBLIC SCHOOL, SÃO PAULO)

In general, AI was considered to be a platform for immediate access to information, capable of automating and facilitating processes, but which requires care and discernment in its use, as a public school teacher in Recife said: "It is a platform that takes everything you ask for. For me, that is it. A double-edged sword."

Thus, there were those who defined it critically, emphasizing the need for caution, responsibility, and knowledge to use it properly:

I think of it as a tool. It's a tool. But you need to be critical, responsible, a series of things to know how to use it. [...] Even for you to know if the result of Artificial Intelligence is satisfactory for what you want, you need to know the theory.
(TEACHER, PRIVATE SCHOOL, RECIFE)

Despite some critical notes, it is important to highlight that, in general, teachers recognized the use of AI in education as an irreversible path, full of potential. They considered it a resource capable of bringing benefits to the teaching-learning process and to the teaching work, as long as it is accompanied by critical mediation and reflection on its pedagogical and ethical implications.

By deepening the discussion on the benefits of AI from the teachers' point of view, the discussion brought different perspectives, which differed according to the network and the city. However, a certain consensus was observed around two points: the possibility of innovating and diversifying classes, and saving time in tasks that currently burden teaching.

In the public school system of Recife, AI was seen as a resource that can be used by teachers to innovate pedagogical activity without losing the link with traditional practices, responding to the constant pressure for more attractive classes and improving student engagement.

Innovation. It is innovation without wanting to leave the traditional. Because it helps, as everyone has said, it optimizes our time a lot. It makes us really bring a totally different lesson, trying to make students pay attention. Normally, we use, as the teacher said, slides. This, in a few years, will already be tiring for them. AI can help us set up another type of class. Another dynamic. Because we, all year round, are asked to innovate.

(TEACHER, PUBLIC SCHOOL, RECIFE)

In this sense, in private schools in Recife, the need for guidance and supervision of the use of AI by students was more highlighted. The teachers admitted to the technological potential, but said that, without monitoring, the risks can outweigh the gains. Although they recognized that AI can support studies, the dominant statement was that its use by students, to be positive, requires the active presence of the teacher. The shared perception was that the unassisted use by young people, that is, without pedagogical direction, can generate more problems than benefits:

The way it is today, it causes harm. I think it contributes if we take on the role of inspecting. That I don't want this problem for myself.

(TEACHER, PRIVATE SCHOOL, RECIFE)

Among teachers in São Paulo, the benefits of AI were associated with the personalization of learning and inclusion. The tool can be a potential ally to support and serve different student profiles, including those with cognitive difficulties, disabilities, or health issues.

It makes classes more dynamic, it gives you the possibility to meet all student profiles, that auditory student, that visual student, that student who needs to work with their hands, we have several tools to work with all types of students and work on inclusion.

(TEACHER, PRIVATE SCHOOL, SÃO PAULO)

I didn't know how to create adapted questions, for example. And ChatGPT itself taught me, in a way, to understand how to adapt a question. It was a source of research for me to begin to understand how to adapt the questions I had to each of the case reports we have. For me, it made this path easier.

(TEACHER, PRIVATE SCHOOL, SÃO PAULO)

Also in São Paulo, there was emphasis on the optimization of teaching time. Teachers pointed out that AI helps to plan classes, correct activities, set up assessments, and prepare materials more quickly, in addition to creating diversified and attractive activities, such as games. In the administrative field, AI was also perceived as an ally to reduce time allocated to bureaucratic tasks:

We waste a lot of time with bureaucratic things in education. [...] In terms of management, ChatGPT is your best friend. Sometimes you're there in need of last-minute reports, you give it the description, it helps you and you say: "I saved at least 40 minutes." Great guy, this one. Thank you, ChatGPT.

(TEACHER, PUBLIC SCHOOL, SÃO PAULO)

In general, the most mentioned benefits focused on the ability of AI to facilitate, streamline, and personalize teaching practice. However, in all contexts, the idea emerged that its positive impact is not automatic. It depends on the teacher's mediation, the training of students for the critical use of the tool, and the balance between technological innovation and the school's pedagogical objectives.

After discussing the benefits, teachers were asked about the risks of using AI in education. They raised different aspects and expressed concerns about pedagogical, ethical, and privacy issues. In the public network of Recife, for example, they highlighted the fear that the data collected by AI could be used against users, increasing a sense of surveillance and loss of control:

AI feeds on all the information you input, it will usually use it against you one day. [...] Nowadays, your TV captures your voice, consequently, your image, and this is stored in the database. This database can also be used against you.

(TEACHER, PUBLIC SCHOOL, RECIFE)

In general, public and private school teachers in Recife highlighted the danger of self-indulgence of students, who tend to stop reading or researching on their own, transferring the work of thinking to the machine. In private schools in Recife, the main risk identified referred to the possible negative impact on the cognitive ability of students. Teachers considered that there is a risk of skills loss if students fully delegate their tasks to AI. The idea that students are "dumbing down" with the indiscriminate use of AI came up recurrently in the statements:

They've given me wrong information more than once. [...] The negative impact doesn't affect us, it affects the kids because they are dumbing down. I didn't know it was possible for someone to dumb down. It's possible. They're getting dumb. Sorry, that's the word.

(TEACHER, PRIVATE SCHOOL, RECIFE)

Among teachers in São Paulo schools, concerns converged on the risk of an impoverished education, with less autonomous students who are dependent on AI and have difficulty thinking

critically. Teachers in the private education system in São Paulo verbalized the risks imposed by technology on forms of pedagogical evaluation. According to them, the excessive and unsupervised use of AI can compromise the authenticity of school productions, generate excessive dependence on AI, and "form beings incapable of acting in society."

> I'm afraid I'll never be able to evaluate them. [...] They can ask the Chat to create a summary for them, and then they memorize it and ace the test, but how am I going to make sure that I evaluated them correctly?
>
> (TEACHER, PRIVATE SCHOOL, SÃO PAULO)

Teachers in the São Paulo public school system also identified a more specific risk: the loss of writing skills. They reported that the students themselves recognize that they are "unlearning how to write." At this point in the discussion, the ethical issue also appeared among the risks: Teachers worried about being deceived by students, which affects the strategies and criteria for pedagogical evaluations:

> [...] at the same time that the students manage to build knowledge, they can also deceive, because they input any topic they want to there, they take the research done and hand it in, there is no deepening, no discussion. What really worries me is the issue of ethics.
>
> (TEACHER, PUBLIC SCHOOL, SÃO PAULO)

In light of these perceptions about knowledge, benefits, and risks regarding the use of AI in education, teachers demonstrated a strong interest in training on the subject, especially to better understand the technology, its pedagogical use, and its ethical implications.

Many reported that the introduction to AI in schools has been insufficient or improvised, often limited to theoretical lectures, when they take place at all. They realized that while students know how to operate AI tools, they often lack the skills and critical sense to explore their potential consciously and reflectively. This scenario, according to teachers, generates insecurity in them about effective learning and consistent pedagogical evaluation.

The teachers were interested in carrying out practical training on the subject, in order to safely evaluate student production from these technologies, understand the commands and functions of the tools, and develop strategies to

integrate AI into teaching without harming learning or student autonomy. There was also interest in discussing and deepening the ethical and moral aspects of AI use, to ensure it is used responsibly and critically, aligned with pedagogical principles.

The points addressed by the teachers go back to important discussions related to the incorporation of AI in school contexts. First, their answers showed the perception that the use of AI in education is unavoidable. In this regard, authors such as Selwyn (2022) and Williamson et al. (2025) argued that the construction of a discourse of inevitability of the use of educational AI does not always correspond to reality, especially when considering that evidence of effective improvement in educational quality associated with the use of these technologies is relatively scarce.

In addition, the teachers' statements pointed to the need for adequate qualifications for the incorporation of AI in school educational contexts, reiterated by the main guidelines on the subject, such as the *Referential Framework for AI Competencies for Teachers* (Miao & Curukova, 2025). These discussions supported the perception of the teachers participating in the survey that AI can bring benefits, as long as the conditions of use, training, and structure are adequate.

In short, teachers from all groups stated that AI can be a useful tool when used well, but they felt that, in everyday school life, it infiltrates as a threat through damage to creativity, writing, student autonomy, the reliability of assessments, and even the preservation of the essence of the teaching work itself.

USES AND NON-USES OF AI BY TEACHERS

As pointed out, the use of AI emerged spontaneously in the first questions asked of teachers about the use of technologies in their daily lives. Many have resorted to AI tools to optimize and facilitate teaching work. Thus, in this topic, these findings on the uses of AI are revisited, and situations of non-use are analyzed, based on the questions that delved into this theme during the focus groups. Figure 5 summarizes the main results on uses and non-uses of AI by teachers.

FIGURE 5 - USES AND NON-USES OF AI BY TEACHERS

Spontaneous mention of AI use: There is concrete incorporation of these tools into teachers' daily routine, especially to support lesson and activity preparation, and adapting content
For what? As ways of saving time, facilitating tasks, and organizing routines

AI USES
TEACHERS

PERSONAL USE

- Support for **task and appointment organization.**
- **Help with writing texts** and help with **one-off questions.**

Perception of AI as a **practical and complementary resource**, which quickens processes without substituting reasoning and individual decisions.

USES IN TEACHER ROUTINE

- **Preparing lessons** and creating **teaching materials.**
- **Adapting content** and activities to **different student profiles**.
- Support in a**dministrative tasks** (tests, lists, records).

They emphasize the **importance of reviewing and adjusting AI-generated content**.

NON-USES (resistance)

- Preference for **traditional methods** that value reflection and human interaction. **The presence of a teacher** makes a difference.
- AI is **still no substitute for human sensitivity** in tasks such as correcting assignments.
- Few cases of non-use due to **fear and lack of knowledge** (although they recognize the potential for time-saving).

SOURCE: PREPARED BY THE AUTHORS.

On a personal level, teachers reported using AI for organizational tasks, support for the production of texts, and resolution of specific doubts. The tools are considered to be facilitators, as they allow time optimization on everyday issues and offer quick answers to different situations: from planning activities to organizing appointments and day-to-day tasks. The general perception was that, outside the classroom, AI works as a practical and accessible resource that complements knowledge and streamlines processes, without replacing the teacher's own reflection or decision.

> I use it for personal use. Thus, AI for me was not necessarily something pedagogical, not linked, it was a consequence for the use of the school. Because for me, I like it, I've always liked innovation, but that which is not so involved with social networks, etc. But AI fascinated me on a positive side in the matter of knowledge. So, you're having a conversation, you want a basic concept, you input it there: "Concept based on such and such." I want prompts, you have to use the right commands to get objective answers, which I plan sometimes.
>
> (TEACHER, PUBLIC SCHOOL, SÃO PAULO)

In the pedagogical context, teachers used AI mainly to support the preparation of classes and the production of teaching materials. The tools allow the content adaptation, create diversified activities, and explore different presentation formats, making it easier to adapt activities to varied student profiles.

In addition, AI appeared as an ally in administrative tasks related to teaching, such as organizing tests, preparing lists, and recording information, contributing to reducing the overload of repetitive activities. However, the teachers reinforced the importance of reviewing the content generated, highlighting the critical evaluation of the results and the adjustment of resources to the learning needs of each class.

I did something I had never done; I tested it. I created an activity, wrote it in a notebook, just to test it. I wrote the description step-by-step, took a photo, and sent it to AI to see if it could translate and create a file of what was there. It did it. For me, this made it a lot easier. I had never seen this happen. For me, it even makes it easier for you to be able to take the image of what is there and transfer it into a partly digital format.

(TEACHER, PRIVATE SCHOOL, SÃO PAULO)

I think it's a facilitator with big ideas. Sometimes you have a topic to teach and you want something more attractive, you input the lesson on that theme and it helps you create a class.

(TEACHER, PRIVATE SCHOOL, SÃO PAULO)

In my case, it was due to exhaustion, I was proud, until I came to the point where I said: Lord, I need to plan activities, but I'm exhausted.

(TEACHER, PRIVATE SCHOOL, RECIFE)

You know when something is our obligation, which was not meant to be, to prepare the AE test, which is for atypical students.

(TEACHER, PRIVATE SCHOOL, RECIFE)

There were also reports of situations in which teachers chose not to use AI or not to expose its use. Some reported personal resistance, preferring to maintain traditional methods that value reflection, creativity, and direct interaction with students. The following examples illustrate these attitudes at two distinct times in teaching work: lesson preparation and correction of activities.

[...] I already know that the material that comes ready from Seduc is already made by AI, it has already been said. So it already comes with AI, and I try to adapt it, like everyone here does, I adapt the slides to the reality of each group, each classroom, each school, and I do this deconstruction, precisely in this place. And I could use it, to add things, I could, but I don't do it exactly for that reason. I think that the only difference today between what the student accesses and what I am able to offer him there is my figure. I say, man, no, I'm not going to.

(TEACHER, PUBLIC SCHOOL, SÃO PAULO)

> [...] at the time of correction, I don't correct in such a cold way. I can verify what the student is learning in his own development. I think AI can't do that yet.
>
> (TEACHER, PRIVATE SCHOOL, SÃO PAULO)

Although they reported not using AI in any situation due to fear, lack of confidence, and lack of knowledge, a few teachers believed that its use could facilitate their work, especially in optimizing time and assisting with lesson preparation.

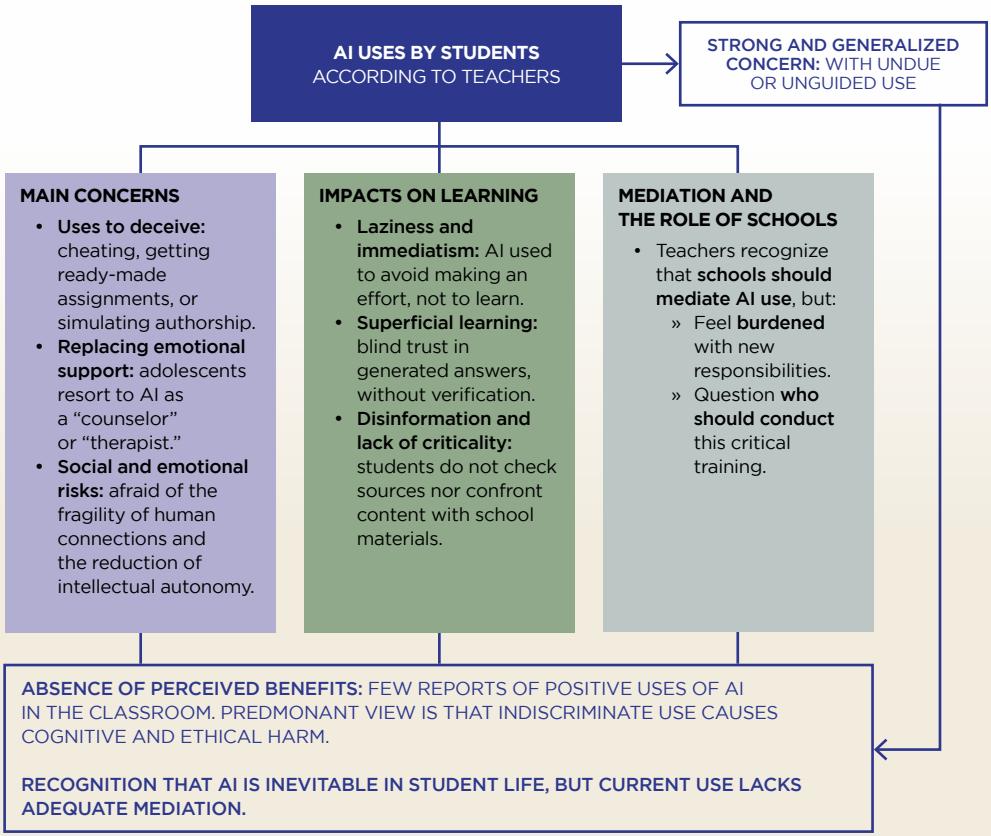
Therefore, the way teachers reported using or not using AI showed a combination of experimentation, pragmatism, and caution. Although technology is increasingly incorporated into personal and pedagogical practices, its application remains subject to criteria of relevance, adequacy, and teacher responsibility. AI is perceived as a complementary resource, capable of enhancing teaching work, but it always needs to be mediated by conscious decisions that preserve the value of human presence and intervention in the educational process.

The centrality of the teacher as a critical mediator of technology, therefore, is a fundamental aspect, reiterated by experts and by the main international guidelines for the use of AI in education. The literature shows a consensus on the idea that AI can bring benefits to the work of teachers, as long as agency and teacher autonomy are safeguarded as fundamental educational values, components that integrate the rights of this professional category (Bartoletti, 2022; Holmes & Tuomi, 2022; Miao & Curukova, 2025; UNESCO, 2021).

STUDENTS' USES OF AI: TEACHERS' VIEW

This topic presents teachers' perceptions of students' uses of AI. It is worth emphasizing that the topic arose spontaneously among teachers from the first questions of the focus groups, which indicates concerns about the improper, decontextualized, or unguided use of this technology. The survey also investigated whether teachers encouraged the use of AI by students, in addition to the pedagogical opportunities and possible ways of using it. Figure 6 briefly presents the teachers' view of the use that students make of AI.

FIGURE 6 – TEACHERS' VIEW OF THE USE OF AI BY STUDENTS



SOURCE: PREPARED BY THE AUTHORS.

In general, teachers expressed concern about the use of AI by students, associating it with ethical and pedagogical risks. One aspect frequently pointed out was that of "deception," i.e., the use of AI to cheat evaluative activities, such as cheating on tests or delivering ready-made work, without real involvement in the learning process. As a teacher from Recife reported:

> Because I know the student, I know when something is not good. Tell me what happened. "Teacher, this is what happened. I put the following there on the GPT website: 'I want a text about this, with the thinking of a student of such and such age'. It wrote the text."
>
> (TEACHER, PUBLIC SCHOOL, RECIFE)

In São Paulo, teachers said that this practice has become sophisticated, making it difficult to control digital assessments. According to a public school teacher: "The speed at which these boys can open and close a browser window, man, you do not see it. [...] He aced the test, and he does not even know what he is talking about."

Another issue that worried teachers was the use of AI by adolescents as a form of psychological or emotional support, replacing professional support or interpersonal relationships. According to reports, the tools used for this purpose are mainly ChatGPT and Luzia.

> There is also something that they use, including girls: They ask for advice, vent to ChatGPT, to Luzia. [...] They are psychologists. That makes me very desperate. [...] That's troubling, because you're working through emotions with something that has no emotions. [...] It's kind of scary. Imagine having a 15-year-old teenage daughter, who is asking ChatGPT for advice.
> (TEACHERS, PUBLIC SCHOOL, SÃO PAULO)

This practice raises concerns about the risk of resorting to automated responses instead of trusting human connections. Another possible effect that worried teachers was the possibility that AI would weaken social relationships and reduce intellectual autonomy. According to teachers in the public school system in São Paulo, the excessive use of mobile phones, combined with AI tools, can reduce socializing and compromise the development of critical thinking.

The apprehension regarding complacency and immediacy also appeared recurrently in the teachers' statements. In general, they observed that many students do not use AI as a learning tool, but only as a means of reducing cognitive effort. Therefore, teachers said that students use the tools as facilitators in the search for answers and quick results, instead of promoting reflection and autonomous construction of knowledge.

There was also a consensus that indiscriminate use contributes to superficial learning and the spread of misinformation. In a planned activity on AI, a teacher proposed that students evaluate whether the content of a text prepared by an AI tool was true. The exercise, however, was a trick: The text was part of the class's own teaching material. The teacher was frustrated, because most said that the text was wrong, without researching in the book they had in their hands:

> [...] unfortunately, 80% [...] said that Artificial Intelligence was wrong. But the text was the text from their books. [...] They relied on the tool, but they didn't do the task of comparing.
> (TEACHER, PRIVATE SCHOOL, RECIFE)

Overall, there were no significant reports on the positive aspects of students' use of AI in the classroom. Teachers in both Recife and São Paulo reported concerns, frustrations, and laments about the indiscriminate use of these tools by students. Although they understood the inevitability of this technology in student life and future insertion in the labor market, they did not perceive concrete pedagogical benefits without critical and consistent mediation of use.

When stimulated to discuss how and by whom this mediation should be done, they reported that schools have a central role in this process, but they also manifested fatigue and resistance about the possibility of being burdened with one more function, in the midst of the many responsibilities and demands that overload their daily lives. The challenge, therefore, is how to transform this technology into an opportunity for critical learning, avoiding the dissemination of uncritical, unethical, or potentially harmful uses for the intellectual and civic formation of young people.

CRITICAL AI TOPICS (BEHIND THE TOOLS)

In this topic, teachers' perceptions of central aspects related to the functioning of AI are presented, covering the way the tools operate, the role of algorithms, data privacy and security issues, the reliability of responses (factual errors and distortions), inequalities and biases present in the generated content, and the role of the school in promoting the ethical, responsible, and critical use of these technologies.

Some topics had emerged spontaneously in previous discussions and were taken up here in a more targeted and in-depth way, based on specific questions in the script. In the overall results observed, no significant differences were identified in the perceptions of these issues, in both Recife and São Paulo, and in both the public and private networks:

> I think it's a very smart set of machines. I don't know for sure, but I think it's all in Silicon Valley, I saw something about how they consume a lot of water, the machines.
> (TEACHER, PRIVATE SCHOOL, SÃO PAULO)

In general, teachers showed difficulty with understanding how the algorithms that underpin AI tools work. Many reported using these resources daily, but without clarity about the criteria or logics that organize the results. Others compared the algorithms to "black boxes," capable of delivering convincing answers, but not very transparent and often difficult to verify.

Understanding how AI systems operate is fundamental in the educational field. Authors such as Holmes and Tuomi (2022) and Fox (2022), as well as UNESCO (2021) guidelines (Miao & Holmes, 2023), pointed out that the explainability and transparency of AI are essential in education, since the processes linked to learning need to be understandable to both education professionals and students. The remarks of the teachers participating in this survey indicated important gaps in understanding, which can compromise the critical, ethical, and pedagogical use of AI in the educational context.

The issue of privacy and data security also raised recurring concerns among teachers in São Paulo and Recife. Teachers expressed concern that personal information (theirs and students') could be used for various purposes without proper consent. Therefore, the lack of knowledge about the possible uses of the data entered in these tools contributes to the feeling of vulnerability and distrust in relation to AI.

> Information today has become like water. There is no control. People try to put up barriers, they try to put up controls, but, in fact, it is flowing. And AI is in this context.
>
> (TEACHER, PUBLIC SCHOOL, SÃO PAULO)

> Because each one will have, theoretically, their own ideology. There's no way around it, each AI will have its enterprise behind it. Either the enterprise, or in this case, the government. And each one will capture this data from us, from research, for X many ways. Some to simply sell to the data market, others to create the standard of the population.
>
> (TEACHER, PUBLIC SCHOOL, SÃO PAULO)

Another point debated was the reliability of the content generated by AI tools. Many teachers mentioned factual errors, inconsistencies, and biased responses. This problem requires teachers to maintain a constant posture of vigilance, reviewing and checking the information before using it in the classroom.

The discussion about inequalities also appeared among teachers in the two cities. They recalled that not all students have the same access to technologies, while dependence on tools can widen existing disparities between students from

different socioeconomic backgrounds. In addition, the teachers noted biases in the results generated by these technologies, which they identified as an ethical and pedagogical challenge. Some teachers reported that, when testing the AI with questions about social topics, they noticed answers loaded with stereotypes, which reinforces the importance of critical mediation and debate on algorithmic equity in the school environment.

> If you don't give the right command, for example, ask it to draw a picture: "Draw a woman." It's going to draw a white woman, because that's the pattern of where it was created. You have to specifically say, "I want you to make a drawing of a black woman with a nose like this, hair like this." Even so, sometimes, it may not do it, because it will not recognize that phenotype trait.
>
> (TEACHER, PRIVATE SCHOOL, RECIFE)

> ChatGPT will never bring the criticality of a student doing a minority analysis. It will not understand what a minority is. [...] And it's a great danger because, once again, we're going to be in a digital native generation.
>
> (TEACHER, PRIVATE SCHOOL, RECIFE)

Finally, the teachers highlighted the absence or insufficiency of debates about AI in schools. Many teachers felt the lack of institutional spaces to collectively reflect on the impact of these tools on the education of young people and the way students are guided in a critical and conscious way. They also pointed out that not all their colleagues are interested in knowing more about the subject, which highlights internal inequalities in teacher appropriation of AI. In general, the respondents argued that schools should take on the role of mediating this process, offering not only access to the tools but also training conditions for teachers and students, so that they can analyze and question them, and understand their limits and ethical implications.

> In fact, I think it should be included in the BNCC – National Common Curriculum Base. Just as the issue of discussing bullying came in. Just as from this year on, the discussion of bullying in the classroom has become mandatory every year, the ethics of technology, it has to be part of the BNCC, which is used in upper secondary school.
>
> (TEACHER, PRIVATE SCHOOL, SÃO PAULO)

Again, this point is supported by the specialized literature on the use of AI in an educational context, which emphasizes that the integration of AI into school processes should not be the exclusive responsibility of teachers or students, but rather a task for school institutions as a whole. According to

UNESCO (Miao & Holmes, 2023), the ethical and effective incorporation of AI into education requires coordinated actions that involve the entire school community, including management, teachers, students, and families, in a joint training effort, reflection, and governance.

In short, while teachers recognized the presence and importance of AI in education, in the current scenario, there are significant uncertainties and gaps, both technical and ethical. The difficulty of understanding how the tools work, the fear about the use of personal data, the perceptions of biases and inequalities, and the lack of institutional spaces for reflection reveal that the insertion of AI in schools cannot be restricted to simple access to the tools. For it to be consolidated as a consistent and socially responsible pedagogical resource, it is essential to invest in continuing teacher training, clear policies for data regulation and governance, and structured ethical debates, capable of preparing teachers and students to critically engage with the challenges and potentials of this technology.

THE FUTURE WITH AI

The last questions in the focus groups with teachers investigated their perceptions and expectations about the future of education in the context of increasing AI presence. They were encouraged to reflect on the potential impacts of this technology on teaching work, the expected transformations in school practices, and the necessary conditions for these technologies to become a resource effectively integrated into teaching.

Concerning expectations, the teachers presented, in a paradoxical way, optimism, caution, and insecurity, reflecting an ambivalent combination: on the one hand, enthusiasm about the pedagogical possibilities; on the other, concern about the challenges to its effective implementation. Some teachers in São Paulo perceived AI as a tool capable of optimizing teaching, automating tasks, and stimulating creativity, in addition to providing greater autonomy to students.

I'm optimistic, because it gives them autonomy. I think it sharpens their creativity. I think it makes things easier; optimizes; automates. Because we live in a fast-paced society. There's nothing to be done. There is no way to escape it. I am very optimistic in this sense.
(TEACHER, PUBLIC SCHOOL, SÃO PAULO)

At the same time, respondents warned of the risk of negative impacts in the short and medium term, especially given the lack of preparation of teachers and family members to guide young people on the proper use of AI.

Teachers in the public school system of Recife valued AI as an educational support tool, although there were reservations about the need to use it in a conscious and contextualized way. On the other hand, in that city's private school network, teachers maintained a cautious tone: Although they recognized the usefulness of AI, they highlighted that it does not replace human care or the pedagogical bond, and it is necessary to re-signify the teaching work to keep up with the transformation of teaching.

Regarding the expected impacts on teaching, in general, teachers emphasized that AI cannot replace the human dimension of teaching, which is marked by embracement, attentive observation, and the mediation of relationships, essential elements for the integral formation of students.

> You can tell when students are in trouble. Is this boy being bullied? Did something happen? AI can't do that. So, he can have the content at home, but he will not have humanity.
>
> (TEACHER, PRIVATE SCHOOL, RECIFE)

Teachers were asked to imagine what the ideal school would look like with the use of AI. In general, they argued that the tool should serve as a support in the construction of knowledge, rather than as a substitute for human relations or teacher protagonism. In this "ideal" school, students need to be encouraged to develop autonomy, critical thinking, and awareness of their own learning, using AI as a tool to support, mediate, and expand educational experiences.

> In this case, a dialogue. Thus, they would build synapses about the subject and would not use the ready-made text. AI shouldn't give them everything. As the student asks questions, the tool answers, and the student builds knowledge.
>
> (TEACHER, PUBLIC SCHOOL, RECIFE)

Finally, teachers reiterated the need for continued training with practical learning spaces, such as workshops, to integrate AI safely and effectively into pedagogical practices. Training actions of this type are essential for teachers to feel prepared and confident in mediating the use of AI to ensure that students

take advantage of its potential pedagogical benefits without compromising the quality of the learning process.

In general, teachers valued AI as an innovative resource but defended the human presence as a fundamental and indispensable part of education. Although they consider the technology as a chance to improve teaching work, they stated that this is only possible with effective mediation, constant training, and care for the human relationships that sustain schools.

FINAL CONSIDERATIONS: CONVERGENCES AND CONTRASTS BETWEEN TEACHERS AND STUDENTS

This study showed that AI is inserted in the daily life of schools in a recurrent, but fragmented, way, accompanied by enthusiasm, insecurity, and lack of institutional preparation. The topics on AI addressed with the two profiles of focus group participants, teachers and students, were very similar, despite certain counterpoints and nuances of their own.

Before directly addressing the topic of AI, the groups explored the use of digital technology in general, revealing that it is frequent in both cases, although with different purposes. Students use it mainly for entertainment, while teachers use it for work tasks, especially for the organization of administrative and pedagogical tasks.

In general, participants in public schools, both students and teachers, expressed several criticisms of the use of government digital platforms. Both profiles understood that this method reduces the teacher's autonomy in the classroom and compromises the quality of teaching. Amid the adaptation of schools to a more technological routine, AI appeared as another layer of this transformation, associated with the debate on the use (or restriction) of mobile phones and digital platforms. Thus, the topic of AI emerged spontaneously in the initial questions for the focus groups, suggesting a high adherence to this type of tool by both audiences, with most teachers and students indicating the use of AI in everyday life.

As for perceptions and knowledge about AI, participants described it, in a simplified but antagonistic way, as a tool for accessing information or a "black box" that is difficult to understand. The lack of clarity about algorithms and their functioning indicates the need for critical and technical

training to deal with their limits and implications: Both students and teachers expressed interest in learning more about how AI works, where their personal data is sent, and what ethical limits and responsibility are involved in its use.

Regarding the uses and non-uses of AI, a diversity of practices was observed. In general, teachers know less about AI tools than students and tend to use those aimed at pedagogical or administrative purposes, such as preparing materials, planning lessons, preparing tests, creating interactive activities, and organizing school tasks.

At the same time, there are situations in which its use is avoided or kept confidential, due to institutional restrictions, insecurity in relation to the technology, or fear of developing dependence on the tool. On the other hand, students use AI in multiple contexts, often beyond schools, including psychological support and seeking companionship, a practice that has aroused attention and concern among teachers due to the replacement of human connections with automated responses.

Teachers mentioned the benefits of AI for education as a whole. For them, this technology provides the opportunity to personalize teaching, include different learning profiles, save time, and diversify pedagogical strategies. However, among teachers, there are also consistent concerns: loss of intellectual autonomy, fragility of writing and critical thinking, fraud in pedagogical evaluations, presence of biases in the generated content, and lack of guarantees regarding the protection of personal data.

Between the risks and potential benefits, there were conflicting opinions. While students reported enthusiasm for the practicality and speed provided by AI, teachers adopted a more cautious stance: They believe in a positive potential in their own use but identify risks and losses when student use is done without adequate mediation. This asymmetry stood out in the topic of autonomy and learning. For teachers, AI threatens students' writing, creativity, and critical thinking. For young people, it represents agility, convenience, and support to deal with school demands.

In addition, teachers often associate AI with excessive mobile phone use, reinforcing a judgment about the habits of the younger generation, a perception not verbalized by

students. Despite the differences, the two groups converge on some perceptions about risks associated with AI, such as the unreliability of the content generated by the tool. In other words, the first risk emphatically identified by both groups was obtaining wrong or inaccurate answers, which therefore requires critical verification and caution in the use of this technology.

Based on these perceptions, the analysis of the results produced in the focus groups allows them to be organized into three dimensions, according to the reflections of the different profiles of participants, teachers, and students:

- **AI: What for?** The teachers highlighted time optimization and innovation in teaching methodologies, while students used it to support their study, and, in some cases, as a form of company or emotional support.
- **AI: How?** The teachers affirmed that it should be used as an instrumental resource aimed at generating materials and organizing information, while the students used it in a more free and experimental way, as a tool for quick answers on various topics (pedagogical and personal) and completion of school activities.
- **AI: When?** Teachers highlighted the relevance of its use at times of lesson preparation and management of school activities, while students considered times of personal demands and improvisation in the face of deadlines or pedagogical difficulties.

In their perceptions of the future, teachers expressed a balance between optimism and insecurity: They recognized that AI can positively transform education, but only if existing structural and ethical challenges are addressed. These barriers are mainly focused on the inequality of access between different school contexts, which tends to widen existing disparities, such as the unequal availability of equipment and connectivity, in addition to the absence of ethical debates and practical training that allow for guiding more conscious and pedagogical uses.

In contrast, students showed greater enthusiasm when designing the future of education with AI. For them, technology

represents a more dynamic, creative, and personalized school experience. At the same time, they feared the impact on the labor market, worrying about the replacement of professions and increased unemployment, which could harm their future. Students also showed fears of risks of addiction and impaired learning, as they recognized that the excessive use of this technology can compromise their cognitive development and intellectual autonomy.

In summary, teachers and students shared similar concerns, but they came from different places. Teachers spoke as responsible mediators, attentive to risks and inequalities, while young people spoke as direct users who explore AI tools without great restrictions and incorporate them into different dimensions of their lives.

The data from this study suggest, therefore, that the future of AI in education depends less on the simple availability of tools and more on the ability to build critical mediation, teacher training, and the creation of spaces for reflection that attribute pedagogical meaning, both ethical and social, to this technology.

REFERENCES

Bartoletti, I. (2022). AI in education: An opportunity riddled with challenges. In W. Holmes, & K. Porayska-Pomsta (Orgs.), *The ethics of Artificial Intelligence in education: Practices, challenges, and debates* (pp. 74-90). Routledge. https://doi.org/10.4324/9780429329067

Brazilian Network Information Center. (2025a). Survey on Internet use by children in Brazil: ICT Kids Online Brazil 2025 [Tables]. https://cetic.br/pt/tics/kidsonline/2025/criancas/B3/

Brazilian Network Information Center. (2025b). Survey on Internet use by children in Brazil: ICT in Education 2025 [Tables]. https://www.cetic.br/en/tics/educacao/2024/alunos/H4D/

Fox, A. (2022). Educational research and AIED: Identifying ethical challenges. In W. Holmes, & K. Porayska-Pomsta (Orgs.), *The ethics of Artificial Intelligence in education: Practices, challenges, and debates* (pp. 47-73). Routledge. https://doi.org/10.4324/9780429329067

Goulart, T. (2025). Crianças recorrem à IA para apoio emocional e neurocientista alerta: "Risco de vício e isolamento". *Revista Crescer*. https://revistacrescer.globo.com/criancas/comportamento/noticia/2025/08/criancas-recorrem-a-ia-para-apoio-emocional-e-neurocientista-alerta-risco-de-vicio-e-isolamento.ghtml

Holmes, W., & Tuomi, I. (2022). State of the art and practice in AI in education. *European Journal of Education, 57*(4), 542-570. https://doi.org/10.1111/ejed.12533

Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S. B., Santos, O. C., Rodrigo, M. T., Cukurova, M., Bittencourt, I. I., & Koedinger, K. R. (2022). Ethics of AI in education: Towards a communitywide framework. *International Journal of Artificial Intelligence in Education, 32*, 504-526. https://doi.org/10.1007/s40593-021-00239-1

Law No. 15.100, of February 15, 2025. (2025). Provides for the use, by students, of personal portable electronic devices in public and private basic education establishments. https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2025/lei/l15100.htm

McBain, R. (2025). Adolescentes estão usando IA como terapeutas e isso é alarmante. *Folha de São Paulo*. https://www1.folha.uol.com.br/equilibrio/2025/08/adolescentes-estao-usando-ia-como-terapeutas-e-isso-e-alarmante.shtml.

Miao, F., & Holmes, W. (2023). *Guidance for generative AI in education and research*. UNESCO. https://doi.org/10.54675/EWZM9535

Miao, F., Shiohira, K., & Lao, N. (2025). *AI competency framework for students*. https://unesdoc.unesco.org/ark:/48223/pf0000391105

Miao, F., & Curukova, M. (2025). *AI competency framework for teachers*. https://unesdoc.unesco.org/ark:/48223/pf0000391104

Ministry of Education. (2022). *Computação – Complemento à BNCC*. https://www.gov.br/mec/pt-br/escolas-conectadas/BNCCComputaoCompletodiagramado.pdf

Pinotti, F. (2025). Quase 40% de crianças brasileiras usam IA em busca de companhia, diz estudo. *CNN*. https://www.cnnbrasil.com.br/tecnologia/quase-40-de-criancas-brasileiras-usam-ia-em-busca-de-companhia-diz-estudo/

Selwyn, N. (2019). *Should robots replace teachers? AI and the future of education*. Polity Press.

Selwyn, N. (2022). The future of AI and education: Some cautionary notes. *European Journal of Education, 57*(4), 620-631. https://doi.org/10.1111/ejed.12532

Silva, E. R. A., Junior, F. G. P., & Júnior, J. H. S. (2017). Aplicação da governança eletrônica na área de educação pública: o caso do portal Sistema de Informações da Educação de Pernambuco – SIEPE. *Revista Gestão. Org*, *14*(Edição Especial), 188-199. https://periodicos.ufpe.br/revistas/index.php/gestaoorg/article/view/22545

United Nations Educational, Scientific and Cultural Organization. (2021). *AI and education: Guidance for policy-makers*. https://doi.org/10.54675/pcsp7350

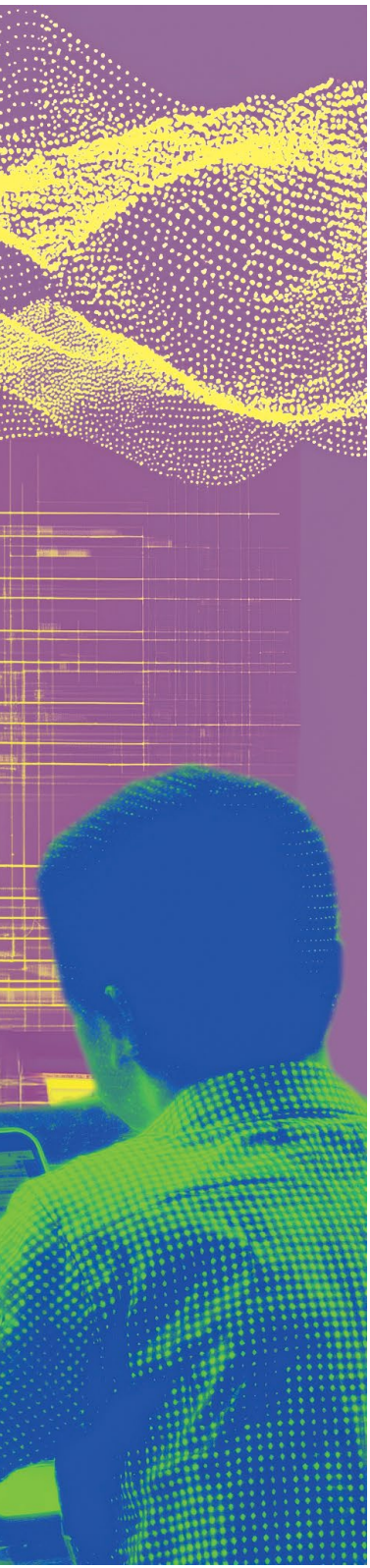
Williamson, B., Celis, C. V., Sriprakash, A., Pykett, J., & Facer, K. (2025). Algorithmic futuring: Predictive infrastructures of valuation and investment in the assetization of edtech. *Learning, Media and Technology, 50*(1), 87-101. https://doi.org/10.1080/17439884.2024.2435820

FINAL CONSIDERATIONS

Artificial Intelligence and education: Possible paths for public policies

Diogo Moyses[1]

1 Master's degree in Law and PhD in Communication Sciences from the University of São Paulo (USP). He is a specialist in regulation and communication policies and a national project coordinator in Brazil for the International Telecommunication Union (ITU).



NOTES TO THE READER

The structural challenges of Brazilian education are neither few nor unknown. In recent years, they have been added to another, quite complex and somewhat nebulous challenge: the urgency of incorporating, albeit in an uncertain way and based on references still under construction, Artificial Intelligence (AI) tools into school management and, in particular, pedagogical practice.

This need does not spring from the enchantment with the new generation of supercomputers and the potential benefits for education, although these may exist, as well as numerous risks and potential misuses. Instead, it is motivated by the fact that the use of global AI tools, especially ChatGPT, is already part of the daily lives of students and teachers in public and private schools. There is no reason to doubt that this use will continue to grow in the coming years, despite material inequalities and the various forms of tool appropriation. So, dear reader, pay attention: It is likely that your children are already using AI applications to do their schoolwork.

Where all this will ultimately lead, no one can be entirely sure, but disregarding the factual reality that AI is already present in the day-to-day realities of education tends to make public policies in the sector disconnected and ineffective. More than that, whether by action or omission, it is possible that undesirable results are produced in a very sensitive dimension: the very nature of the society that is built every day through education.

"WE PRETEND WE DO NOT USE IT, THEY PRETEND THEY DO NOT SEE IT"

The above sentence was uttered by a high school student in one of the focus groups that were the object of the study presented in this book. It describes the relationship between students and teachers around the use of generative AI applications in the school environment. The comment is evidently a half-truth—not least because the same students, throughout the discussions, revealed strategies to "deceive teachers." The teachers, in turn, talked about tactics they have developed to "catch students." In this way, half of the truth is symbolic and indicates that the conversation on the subject in the school environment needs to gain speed and scale.

Information presented objectively in Chapter 1 ("General introduction to the study and methodological notes"), with national statistics on the use of AI by students, and discussed further in Chapter 4 ("Competences and uses of Artificial Intelligence in education: A qualitative study with upper secondary students and teachers in Brazil"), based on the focus groups that problematize this use by the same audiences, reveals the same reality: Students report having incorporated these tools into their daily lives, using various applications, especially ChatGPT. Although some even admit to using "Chat" "all the time and for anything," it is in the use of applications for school activities that the nerve center of this new and deep relationship of young people with AI applications lies. This use occurs mostly, at least for now, when students and teachers are at home, and not in the school environment. For young people who have the material means to do so, it is already common to use one or more applications at home to make summaries of texts, organize notes, and "generate" ideas and repertoires for the preparation of work and essays; they also sometimes use AI to solve exercises and complete activities. Teachers, who are generally less familiar with digital technologies and concerned about where it is all going, are also increasingly using new AI applications, especially to support preparation for classes and production of teaching materials, such as presentations, summaries, and tests.

In addition to the sincerity of the students, as summarized in the phrase used as the title of this section, the urgency of accelerating and qualifying the dialogue on the subject in the school environment is also evident among the teachers. This need is revealed in the lack of knowledge about the nature and functioning of the tools, in concerns, fears, and anxieties regarding the use of AI applications by students, and in inquiries about their ethical limits. At the same time, teachers, in general, are insecure and lack sufficient knowledge to foster more in-depth conversations and ongoing dialogue on the subject. As a natural self-defense, but not just because of that, they are critical of the widespread use of AI by students, fearing that they will become "dumb" and lazy. Students, in turn, reveal inherent challenges in distinguishing good from bad uses and report that discussions of AI in school are limited, largely due to the discretion of individual teachers.

In this scenario of rapid incorporation of AI applications related to school life—marked by lack of information, mistrust, and ethical-pedagogical uncertainties—the promotion of wide-reaching dialogue on the subject in the educational environment emerges as a central issue to be addressed by public policies. This promotion presupposes: (a) ensuring that teachers have the basic tools to lead these conversations in the classroom; (b) encouraging time for exchange between the different segments of the school community; and (c) incorporating their own learning on the subject into school practices and routines.

INCIPIENT AND CONTROVERSIAL RESULTS

Some findings addressed in the literature on empirical research on the use of AI applications in education, described in Chapter 2 ("Artificial Intelligence and education: History, fundamental concepts, and literature review on uses"), are also valuable to guide regulation processes and the formulation of public policies on the subject. It is worth highlighting three findings.

The first refers to the inception of empirical research on the use of AI as a support for pedagogical practice. Studies are still scarce, research is limited to small universes and, in general, conducted in artificial environments (without control groups and the possibility of comparability), and the practical results—whether the tool actually met the idealized objectives—are most often inconclusive or controversial. Even the tools that point to good potential—for example, automated review of essays or applications for personalizing teaching—still need to be evaluated in greater depth. In other words, the evidence of benefits that have been mapped so far does not justify a race around the use of AI; on the contrary, it reinforces the need for a careful look at the many risks inherent in the incorporation of these technologies into school practices.

Also noteworthy is the research on the specific use of predictive and control tools, such as studies that attempt to predict potential student dropout, assess student engagement, and automate processes, such as calls. Research on these and other applications is also limited and yields inconclusive results. However, because they may have negative impacts on both

management practices and human and pedagogical relations, and because many of these impacts occur within the sphere of children's fundamental rights, there are sufficient reasons for redoubled attention to the implementation of these tools.

These uncertainties are related to a third, more structural point. As the analysis of these empirical studies (Chapter 2) points out, there is often a lack of causal links between the use of AI applications and the most relevant challenges in education. This reinforces that the answer to the question "AI: What for?" is still open, or, at least, it reminds us that the solutions to structural problems in Brazilian education do not fit technology (although today they need it), but, above all, involve historical agendas of the sector, such as the effective valorization of teachers, the limitation of the number of students per class, and the adequacy and qualification of school infrastructure.

MATERIAL INEQUALITIES, INSIDE AND OUTSIDE SCHOOLS

A cross-cutting element present in quantitative and qualitative research is the impact of inequalities in access to digital infrastructure in the school environment. The quality of the Internet in schools and the availability of devices (computers, in particular) are considered—and truly are—as highly relevant by students, teachers, managers, and specialists, since they can provide unequal access and use conditions, that is, they offer greater or lesser opportunities for learning and development of digital skills.

This issue goes beyond the specific use of AI, since it resides in access to emerging technologies in general—of yesterday, today, and the future—and materializes the ambitions of *today* (education needs to be integrated into the concrete reality of students) and *equity* (everyone needs to have the same opportunities for development). This issue is central and extremely challenging, as it is rooted in a systemic continuum of material inequalities: at one end are elite private schools in urban centers; at the other, rural public schools that still lack electricity. In this context, although "unplugged AI" initiatives for scenarios of poor connectivity are relevant, it is important to remember that they do not reach the desired levels of equity.

However, the conversation about "school connectivity," in general, forgets that inequalities begin and are consolidated in the home environment, and that the impact of this inequality is decisive on the development of students, including their digital skills. In practice, the children of the elite and the middle class, in addition to being supposed to have a general environment more favorable to school activities when they are at home, have high-quality connectivity and various devices, including large-screen computers, at their disposal. From the material perspective of the goods necessary for the best enjoyment of the digital environment, this is the best synthesis of what we call meaningful connectivity.

However, this is evidently not the general reality, as shown by the best available indicators. By way of comparison, if these two factors (fixed Internet access and availability of large-screen computers) are considered, the scenario in classes A and B is one of universalization, while in the homes of classes DE the reality is different: only 40% of the residences in classes DE have fixed Internet,[2] and 11% have computers.[3] In the current context, as emphasized by students and teachers in the focus groups, the children in higher classes already have paid versions of AI applications, which adds to the basket of inequalities. In other words, although these two agendas often operate independently (school connectivity and connectivity and devices in the home environment), the structural impact of their combined inequalities on children's development and on education in general cannot be overstated. After all, as some sociologists well remember, it is at home where everything begins, including the structural logic of class perpetuation.

CONSENSUS ON THE FUTURE

Since the integration of AI into social life and education is inevitable, it is up to society to guide it toward its best interests, at the risk that other interests will prevail. Although unraveling this dynamic is not a simple task, the interviews gathered in Chapter 4—with experts, managers, activists, and developers—complement the previous findings and help

2 The full indicator is available at: https://cetic.br/pt/tics/domicilios/2024/domicilios/A5/
3 The full indicator is available at: https://cetic.br/pt/tics/domicilios/2024/domicilios/A1/

translate factual issues into principles and strategic guidelines at the institutional level, pointing out possible and desirable paths for national public policies.

The starting point of this journey seems to be the clarity of the general objectives, consummated in the combined answers to the questions "Why AI?" and "AI: What for?," which, together with the question "AI: How?," form the analytical thread of this publication.

In relation to this, there is enough elaboration to enunciate the general objectives: Technologies based on or supported by AI should be used to favor the development of the human capacities of students and teachers, improve learning, promote, and support the work of teachers. They can also support school management, but without replacing the role of the teacher or reducing the intellectual effort of students, in addition to observing full respect for fundamental rights, to strengthen them.

There also seems to be a broad and sufficient consensus on the fact that potential benefits and risks go together, or overlap. The list of potential negative effects is long and diverse: reduction of critical thinking and the capacity for intellectual development; superficial homogenization of knowledge; creation of dependence; discrimination, distortions, errors and inaccuracies; hypervigilance, breaches in privacy and data protection; and security risks, which, it is worth emphasizing once again, must be taken very seriously because they are children. This is, of course, in addition to the risk of a general lack of intentionality in the development and application of AI and in the production of "innovation," whose basic narrative involves creating solutions to problems that do not exist or for which the solution is known.

Finally, as these risks are high and diverse, the implementation of AI applications in the field of education must be carried out carefully and gradually under ethical supervision. This should not, however, prevent the rapid expansion of the dialogue on the subject in the school environment, and it should give practical consequences to the many and well-founded concerns about the impacts of AI in the field of education and on the general development of children.

VECTORS FOR PUBLIC POLICIES

Currently, the formulation of policies around the AI and education agenda has sufficient elements that allow us to enunciate some of its essential vectors, or key ideas, to guide its elaboration and implementation. Many vectors are already part of the state agenda, particularly at the federal level, but there are strong indications that their implementation should be expanded, qualified, and accelerated. Like this exercise—inspired by the reading of the different studies and analyses that make up this publication—it is expected to contribute to the evaluation of current policies, aiming at their improvement and adherence to the general objectives to be achieved, in terms of incorporating tools and promoting the development of digital skills.

TRAINING, PROMOTION OF DIALOGUE, AND INSTITUTIONAL INTERNALIZATION

The first key idea that can guide the effort of the state and other segments of society is related to the urgency of promoting initial and continuing education of educators and other education professionals, fostering dialogue on the subject in the school environment, and internalizing the training of students around digital technologies.

Initial and continuing training

It all starts by stating that the stimulus for good uses of digital technologies and the critical restriction of their uses in learning processes is teacher training and qualification. This process should cover elementary and secondary school teachers, allowing them to become familiar with the logic of how digital technologies and AI applications work, how to best use them to their advantage in the professional context, and how to guide the relationship between AI and students. Therefore, it is urgent to share knowledge and give teachers the confidence to conduct these processes.

Since 2023, some relevant actions in this direction have been conducted by the Ministry of Education (MEC) and the Social Communication Secretariat of the Presidency of the Republic (Secom), which seek to place the agenda at the center of public education policies. Larger states and

municipalities, although they have very large differences in perspective, also participate in this effort. At the federal level, which can be the inducer of these processes, this effort has occurred, for example, through the expansion of digital and media education courses offered in the MEC's online training environment. However, despite being extremely positive, the evidence indicates the need for these and other related initiatives to increase quickly in scale.

In addition, although little cited in the existing literature on the subject, the incorporation of new agendas linked to technological development in the initial training of teachers in pedagogy and teaching degree courses has the potential to contribute, decisively and systemically, to the process of teacher updating and their continuing education. The burden on teachers, especially in the public school system, is certainly already very high. Therefore, this process should be seen as part of their valorization, which also involves, evidently and among other things, a strong increase in remuneration, so that it is consistent with the social mission assigned to them.

Promotion of dialogue in the school environment

The qualification of teachers is a basic condition to promote dialogue on the digital agenda and the use of AI in education in the school environment, structure the processes that promote these moments of dialogue focused on the digital agenda, and include them in the ordinary periods of classes, while also having the potential to expand critical capacity. Also, in the field of teacher training, MEC and Secom have been leading efforts in this direction since 2023, such as the promotion of the "Brazilian Week of Media Education," held annually. Such events have the potential to involve the entire school community in activities and discussions around the issue, allowing emerging themes to be integrated, and generating new insecurities and anxieties linked to the use of new technologies. Expanding the reach of this and similar initiatives has great potential to increase impact and to align the use of information and communication technologies (ICT) with the established general objectives.

Institutional internalization

A third front of the introduction of technologies in the school context is the institutionalization of teaching around the digital agenda. It is desirable and necessary that the public conversation on these topics be present at various times in school life, such as in classes of subjects that make up the curriculum. However, it is reasonable to imagine that students' relationship with AI and digital technologies, in general, will be more autonomous and fruitful as knowledge about how this universe works expands.

Initiatives led by the federal government, such as the inclusion of the topic in the National Textbook and Teaching Material Program (Programa Nacional do Livro e do Material Didático [PNLD]) and, in particular, the mandatory inclusion of digital and media education classes in the basic education curriculum starting in 2026, are extremely important. The challenge, embedded in the internalization of the new curricular orientation, involves the municipal and state secretariats, as well as the development of a qualified faculty in sufficient numbers to lead such classes. Therefore, it is not trivial and requires time; additional efforts should be made with the states and municipalities, including material support and teacher training for these subjects.

MATERIAL EQUITY

Another action front is the acceleration of the search for equity in access to the material goods necessary for the best use of digital technologies, including AI. This includes school connectivity policies on the one hand, and, on the other, telecommunications policies for the expansion and qualification of Internet access in homes, especially, but not only, through land fiber optic networks. When implemented hand-in-hand, these two fronts have the potential to change the historical scenario of inequalities in access to ICT, making it, conversely, a vector of broader social equity.

Regarding the school connectivity policy, Brazil has had the National Strategy for Connected Schools (Enec)[4] since 2023,

4 More information about Enec is available at: https://www.gov.br/mec/pt-br/escolas-conectadas

which helped organize priorities, establish quality parameters, and guide investments, with resources, for example, from the 5G[5] auction and the Fund for the Universalization of Telecommunication Services (FUST).[6]

On the other hand, although general connectivity has advanced in the last two decades, especially due to the expansion of the performance of small providers, in recent years, the indicators on access to fixed home Internet have shown a trend of stagnation in the growth of access in socioeconomic classes C and DE. Although coverage barriers still exist—and will continue to exist in isolated communities—today, the income barrier (not having enough money to hire the service) is the main element that keeps millions of families—and students, consequently—without access to meaningful connectivity. This is also true for access to computers—a central element of meaningful connectivity—which is restricted to families in classes A and B. In this context, policies that raise these indicators to universalize them are currently an imperative that is little internalized in the agenda of national telecommunications policies. An incisive effort in this direction is essential for equity in access to material means in order to promote the enjoyment of AI and ICT applications in general.

DRIVING THE APPLICATIONS AND PLATFORMS JOURNEY

It is difficult to imagine that, in the short or medium term, the applications of the largest technology and generative AI companies will cease to be part of everyday use, including for students and teachers. It is, at least, possible to share the direction of this journey with national non-profit AI applications and financial barriers to access (no charge for use), developed by different types of institutions. This perspective addresses a series of concerns and seeks to reduce risks, but above all to proactively lead the creation of an ecosystem of AI applications in education guided by the desired ethical and pedagogical principles.

---

5 More information about the school connectivity projects of the School Connectivity Administrator Entity (Entidade Administradora da Conectividade de Escolas [Eace]) available at: https://eace.org.br/

6 More information about FUST is available at: https://www.gov.br/mcom/pt-br/assuntos/fust

In schools—and this is true for all schools, but even more assertively for public schools—the set of digital applications (which include AI and platforms without embedded AI), such as those used by many state and local governments, needs to be aligned with strategic objectives for the sector and for the country in general. Technological sovereignty, in this context, serves as a condition that guides the development and use of technology for desired purposes, as well as ensuring mastery and jurisdiction over the protection of student data, thereby stimulating scientific research and the training of professionals.

Fundamental and high-impact strategic choices, such as the internalization of proprietary tools and applications to replace those currently in use, should be considered. Countries with technological development conditions similar to or inferior to those of Brazil, and whose market for education apps is similar to the Brazilian market (dominated by North American companies, especially Google/Alphabet), will reap the fruits of the journey of replacing these platforms, which will even allow for a more consistent domain to conduct, in a guided way, the journey of integrating AI into education.

INSTITUTIONAL CAPACITY-BUILDING

The backdrop for strengthening the "positive agenda" around AI and other ICT-related topics is the agenda for strengthening institutions, which seeks to organize, coordinate, and articulate the set of training actions, promotion of dialogue, institutional internalization, material equity of access and use, and application development, among others. The agenda around these policies, therefore, demands coordination among different institutions and sectors, as is the most evident case of telecommunications, science and technology, which includes a great diversity of institutions, under the leadership of education.

In the case of the MEC, the mission of coordinating a dialogical and cooperative internalization process—consistent with the design of Brazil's federative pact—together with the states and municipalities, which manage public schools, entails an extremely high level of difficulty. This is not only because of the weaknesses and structural inequalities that still remain

in the educational system and in society, but also because of the differences in vision and the low level of cooperation of relevant state governments in the national context. The recent approval and sanction of the National Education System[7] can contribute decisively to the organization and strengthening of this federative cooperation.

In this environment of immense challenges, a key issue is strengthening the MEC's institutional capacity in the digital agenda. Although there are departments and managers focused on this agenda, the "size of the challenge" is increasing, and it deserves another scale of capacities—in terms of human resources and, certainly, budgetary resources—in the development and implementation of actions with a positive and lasting impact throughout the education system.

In summary, if the presence of AI in education is a reality, it is up to public policies to conduct this integration with purpose and caution: training and supporting teachers to lead the conversation; institutionalizing digital education in the curriculum; addressing material inequalities in connectivity and access to devices; promoting ethically responsible uses; and strengthening solutions under national sovereignty. Through federative coordination, strengthening institutional capacities, and continuous evaluation of evidence, it is possible to guide technology to expand learning, protect rights, and reduce inequalities, thereby transforming a diffuse challenge into a concrete agenda for educational development.

7 Complementary Law No. 220/2025, available at: https://www.in.gov.br/web/dou/-/lei-complementar-n-220-de-31-de-outubro-de-2025-666057479

unesco
Centre
under the auspices
of UNESCO

cetic.br
Regional Center for
Studies on the
Development of the
Information Society

nic.br
Brazilian Network
Information Center

cgi.br
Brazilian Internet
Steering Committee