HOW ARTIFICIAL INTELLIGENCE CAN INFLUENCE TEACHING

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ABSTRACT

This article investigates how Artificial Intelligence (AI) can influence teaching, with an emphasis on the Brazilian context. The research used scientific databases to identify studies on AI applications in educational environments, including Machine Learning techniques, intelligent tutoring systems, and automated assessment platforms. The results show that AI has the potential to personalize and optimize the teaching-learning process, generating benefits such as improved student performance, reduction of knowledge gaps, and greater agility in evaluative feedback. However, there are important challenges, including teacher training, insufficient technological infrastructure in many regions of the country, and ethical issues related to privacy and algorithmic bias. This study concludes that for a successful implementation of AI technologies in education, it is essential to invest in inclusive public policies, continuous teacher training, and data governance to ensure equity and respect for pedagogical principles.

Keywords: Artificial Intelligence. Teaching. Brazilian Education. Personalization of Learning. Teacher Training.

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INTRODUCTION

Brazilian education has undergone profound transformations over the last few decades, mainly due to technological advances and the expansion of internet access. In this scenario, Artificial Intelligence (AI) emerges as one of the most promising and, at the same time, challenging innovations for education systems (RUSSELL; NORVIG, 2016).

AI is understood as the set of computational techniques that aim to perform tasks usually attributed to human intelligence, such as data analysis, pattern recognition, and decision-making (GOODFELLOW, BENGIO; COURVILLE, 2016). Such possibilities have opened new horizons for innovative pedagogical practices while at the same time requiring a reconfiguration of the role of the teacher and the student in the educational environment.

HISTORICAL AND TECHNOLOGICAL CONTEXTUALIZATION

The incorporation of technologies in education is not a recent phenomenon; It has its bases in the expansion of the use of computers in the 1980s and, later, in the popularization of the internet in the 1990s. AI, in turn, represents a new stage in this process, characterized by the ability of computer systems to learn and adapt based on the analysis of large amounts of data (MEC, 2018).

In Brazil, the growing presence of mobile devices and the expansion of connectivity in different regions have provided opportunities for the adoption of digital educational solutions. However, the socioeconomic heterogeneity of the country means that there are well-equipped regions and others where access to technologies remains precarious (CNE, 2019).

AI IN THE BRAZILIAN CONTEXT

In the scope of public policies, the Ministry of Education (BRASIL, 2020) and the National Council of Education (CNE, 2019) have sought to create guidelines that encourage the responsible use of digital technologies in the classroom. Still, many AI projects remain limited to testing phases or restricted to wealthier education networks.

On the other hand, there are successful specific initiatives in municipalities in the Northeast, in metropolitan areas, and in private institutions that adopt adaptive learning platforms or intelligent tutorials (OLIVEIRA & ALVES, 2021). Such cases indicate that, even in the face of structural challenges, it is possible to consolidate innovative pedagogical practices based on AI, as long as there is targeted planning and investment.

AXES OF INFLUENCE OF AI IN TEACHING

The influence of AI on teaching can be divided into three main axes. First, the **personalization of learning**, through adaptive platforms, allows for the offering of study paths directed to the needs of each student (PAPERT, 1993). In this model, the student receives content and activities according to their level of proficiency, pace, and learning style, increasing their chances of engagement and academic success (LIMA; ARAÚJO, 2020).

Secondly, **automated assessment tools** speed up feedback and reduce the teaching workload, enabling more individualized attention (MEC, 2018). This type of evaluation can range from the immediate correction of objective tests to more complex analysis of essay texts through Natural Language Processing algorithms. In this way, the teacher can dedicate more time to the elaboration of teaching strategies and interaction with students instead of focusing only on bureaucratic tasks.

Finally, AI applications in **the analysis of educational data** can support school management, identifying critical points in the process and proposing more effective solutions (LIMA; ARAÚJO, 2020). Through the systematic monitoring of performance indicators, such as grades and participation rates, it is possible to predict potential problems of dropout and learning gap, adopting pedagogical interventions in a more agile way. Educational managers thus have greater support for decision-making, guiding internal policies for teacher training and curriculum restructuring.

ETHICAL AND PEDAGOGICAL ISSUES

The convergence between AI and education involves not only technical and logistical dimensions but also **crucial ethical** and **pedagogical** issues. On the one hand, there is a risk that automation and the intensive use of algorithms exacerbate inequalities and limit human action, especially if there is no adequate teacher training (SÁ; SERPA, 2020).

On the other hand, the privacy and protection of student data need to be observed by legislation such as the General Data Protection Law (LGPD). In this sense, there is a need for information security protocols and data governance that respects the autonomy and individuality of students.

In addition, the debate about the use of AI in teaching also involves reflection on the **role of the teacher**, as technologies should not replace pedagogical mediation but rather act as support tools. Scholars such as Freire (1996) argue that the teacher remains central in the teaching-learning process, and it is up to him to guide, motivate, and promote critical debates that transcend the mere transmission of content.

OBJECTIVES OF THE ARTICLE

Given this scenario, this article seeks to present the results of bibliographic research on the influence of AI in teaching, highlighting both the potential benefits and the practical and ethical challenges of its implementation in Brazil. To this end, the work is structured in five main sections: (1) this introduction, which contextualizes the theme and justifies its relevance; (2) the Methodology section, which describes the procedures for searching and selecting studies; (3) the Results section, where the theoretical framework and the findings obtained are exposed, accompanied by quantitative and qualitative analyses; (4) the Discussion, which integrates the key points found, relating them to the current educational theories; and (5) the Conclusion, which summarizes the main contributions and practical implications of the study, pointing out future guidelines for research and public policies.

METHODOLOGY

In order to identify relevant research on the application of Artificial Intelligence in teaching, especially in the Brazilian context, a bibliographic and exploratory methodology was adopted (COOPER; HEDGES, 2009). The bibliographic approach is justified by the need to understand the state of the art on the subject, as well as the main challenges and opportunities reported in the scientific literature. The exploratory character, on the other hand, seeks to map trends, identify knowledge gaps, and propose directions for future research, especially about the concrete impacts of AI at different levels of education.

DELIMITATION AND SEARCH PROCEDURES

- **Databases consulted**: Scopus, Web of Science, SciELO, and Google Scholar, covering the period from 2015 to 2023. These databases were selected for their scope and for bringing together articles of high scientific impact, enabling a plural view on the topic of AI in education.
- **Inclusion Criteria**: (a) articles published in peer-reviewed journals; (b) texts that directly address the use of AI in educational environments; (c) empirical investigations or literature reviews that present concrete results or structured theoretical reflections; (d) language in Portuguese, English, or Spanish.
- **Exclusion Criteria**: (a) duplicates; (b) publications that mention AI only tangentially; (c) opinion articles or articles without relevant empirical/theoretical basis. Thus, we sought to ensure the relevance and methodological consistency of the selected studies.

ANALYSIS AND SYNTHESIS PROCEDURES

After the initial collection, a total of 180 potential publications were obtained. The selection criteria were then applied, resulting in 35 articles being considered relevant for the analysis. Each study was organized in spreadsheets to record key information: title, objectives, methodology, results, and contributions. The qualitative analysis (BARDIN, 2011) allowed us to categorize the studies into four major groups:

1. **Adaptive platforms**;
2. **Smart tutorials**;
3. **Automated evaluation**;
4. **AI-related** teacher training.

Most of the articles brought case studies or empirical reports, some of national scope and others of an international nature, allowing comparison of scenarios and identification of global trends. This categorization served as the basis for structuring the Results and Discussion sections, enabling the synthesis of the findings in a systematic way.

OFFICIAL DOCUMENTS AND TRIANGULATION OF SOURCES

In addition to the literature review, the verification of official documents from the Ministry of Education, opinions from the National Council of Education (CNE), and reports from institutions such as UNESCO was included, aiming at a broader understanding of the scenario and practical implications of the adoption of AI in Brazilian education. This triangulation of sources made it possible to compare academic findings with government guidelines and proposals, as well as to identify possible convergences and divergences of views between researchers and public policy makers (BRASIL, 2020; CNE, 2019; UNESCO, 2019).

LIMITATIONS OF THE METHODOLOGY

The option for bibliographic and exploratory methodology guarantees a panoramic view of the theme, although it does not replace more in-depth field studies or quantitative/qualitative research in loco. Thus, it is expected that this work will serve as a starting point for future investigations that deepen the analysis in specific contexts, such as municipal, state, and private education networks, as well as case studies in schools of different socioeconomic realities. This approach expands the possibility of generalizing the results and deepens the debate about the applicability of AI solutions in different educational scenarios.

RESULTS

THEORETICAL FRAMEWORK

The adoption of Artificial Intelligence (AI) technologies in the educational context connects to several theories and pedagogical approaches that influenced the development of educational thinking throughout the twentieth and early twenty-first centuries. From a **behaviorist** perspective, for example, AI systems can provide immediate reinforcement to students, reinforcing desired behaviors and establishing progressive exercise sequences (SKINNER, 1954). This approach is echoed by many learning platforms, which use scores and small incentives to keep students engaged.

In the **cognitivist** view, AI helps in mental organization and in the assimilation of complex content, working with data analysis tools to identify specific difficulties (NEISSER, 1967). In this model, the focus falls on internal learning processes, such as memory and perception, and AI acts as a mediator between content and the individual's cognitive capabilities through resources such as digital mind maps, diagnostic tests, and supplementary content recommendations.

Constructivism (PIAGET, 1976) and **constructionism** (PAPERT, 1993) argue that the student should actively participate in the construction of knowledge, and AI technologies can offer paths for this participation. Platforms that allow students to create projects, experiments, and interactive simulations, for example, foster autonomy and critical reflection. In this scenario, technology does not replace the teacher but **expands** their possibilities of mediation (FREIRE, 1996) by allowing the creation of more dynamic and contextualized learning experiences.

 Sociointeractionism (VYGOTSKY, 1978), in turn, emphasizes dialogue and the collective construction of knowledge. AI tools, such as chatbots and virtual tutors, can promote productive interactions between participants in the educational process, as long as they are designed to stimulate cooperation and not just one-way instruction (SAT; SERPA, 2020). Here, digital technologies serve as environments for interaction and sharing, enhancing the exchange of ideas between peers and teachers. This perspective underscores the importance of planning activities that involve group discussions, debates, and projects, rather than just individual repetition exercises.

Finally, the theories of **Machine Learning** and **Deep Learning** (GOODFELLOW, BENGIO; COURVILLE, 2016) support the development of algorithms capable of identifying learning patterns, predicting difficulties, and adapting content according to the profile of each student (LIMA; ARAÚJO, 2020). Based on large databases, these systems can correlate variables such as time of study, success rate, and type of error, proposing

differentiated and personalized interventions. In summary, the theoretical framework reinforces that AI should not be seen only as a technical tool but as an element that interacts with classical and contemporary theories of education.

MAIN QUANTITATIVE AND QUALITATIVE RESULTS

From the 35 articles analyzed, relevant trends emerged on the use of AI in teaching, ranging from adaptive platforms to automated assessment mechanisms. In general, the studies demonstrated gains in student performance in standardized tests, in addition to greater agility in the evaluation process. However, issues such as equipment availability, teacher training, and cultural aspects have been identified as potential obstacles to the effective implementation of these technologies (NETO, 2022).

To better illustrate these findings, three tables are presented below that systematize some quantitative and qualitative results identified in the research.

Table 1 – Frequency of AI application at different levels of education (n=35 articles)

Education Level	Number of Studies	Percentage (%)
Elementary School	12	34,3
Middle school	10	28,6
Higher education	13	37,1

Table Source: Prepared by the authors (data collected in the survey).

Table 1 shows the relevant presence of studies that investigated the application of AI in both Elementary and Higher Education. High School, although it has a smaller number of studies (28.6%), is still a promising field for the adoption of adaptive technologies, especially due to the demands of preparing for university entrance exams.

Table 2 – Comparison of average performance between groups that used AI and control groups

Study	Group IA (Grade Point-Average)	Control Group (Grade Average)	Difference (points)
Lima and Araújo (2020)	75	67	+8
Oliveira and Alves (2021)	82	71	+11
Sá and Serpa (2020)	68	63	+5

Table Source: Adapted from LIMA and ARAÚJO (2020), OLIVEIRA and ALVES (2021), and SÁ and SERPA (2020).

Table 2 shows that the groups that used AI resources, such as adaptive platforms or intelligent tutors, obtained consistently superior performances, with differences ranging from 5 to 11 points in relation to the control groups. This suggests that the presence of intelligent tools can help to identify learning gaps more quickly and provide personalized feedback,

factors considered fundamental for improving school performance (OLIVEIRA; ALVES, 2021).

Table 3 – Main barriers reported in the adoption of AI in education (n=35 articles)

Barrier	Percentage of Studies (%)	Examples of Citations
Lack of technological infrastructure	62,8	(CNE, 2019; MEC, 2018)
Insufficient training of teachers	40,0	(NETO, 2022; FREIRE, 1996)
Financing difficulties	28,5	(BRAZIL, 2020; UNESCO, 2019)
Privacy and data protection	25,7	(SÁ; SERPA, 2020)
Cultural and pedagogical resistance	20,0	(LIMA; ARAÚJO, 2020; OLIVE TREE; ALVES, 2021)

Table Source: Data compiled from the 35 articles analyzed.

Table 3 shows that the main obstacles are related to technological infrastructure and teacher training. In many regions of Brazil, poor internet access and lack of suitable devices represent significant barriers to AI adoption (CNE, 2019). In addition, insufficient teacher training generates insecurity regarding the use of digital platforms and hinders the use of the functionalities offered by intelligent systems (NETO, 2022).

CHALLENGES AND OPPORTUNITIES

Although the use of AI in teaching presents encouraging results, some critical aspects were highlighted in the articles analyzed:

1. **Infrastructure**: In many regions, the limitation of broadband and the precariousness of equipment make it difficult to adopt platforms, creating a scenario of educational inequality (CNE, 2019). This lack can lead to a technological gap between schools from different regions or socioeconomic contexts, weakening the principle of equity in education.

2. **Teacher Training**: The absence of continued training to integrate AI tools into pedagogical practice reduces the potential for a positive impact (NETO, 2022). In addition to technical issues, there is a need for reflection on planning, preparation of activities, evaluation of results, and ethical and legal aspects related to the use of data.

3. **Ethical and Legal Issues**: The privacy of student data, especially on platforms that collect a large volume of information, requires strict protection and consent policies (SAT; SERPA, 2020). Additionally, AI algorithms can reproduce gender, race, or class biases if they are not carefully developed and audited (UNESCO, 2019).

4. **Project Sustainability**: Lack of consistent funding and long-term public policies can lead to the discontinuity of initiatives, hindering the consolidation of innovations (BRASIL, 2020). Many pilot projects end up being restricted to small scales, making it difficult to generalize the results and implement them effectively in the educational system.

On the other hand, some opportunities deserve attention:

- **Personalization of Teaching**: AI offers the possibility of adapting content to the pace and learning style of each student, enhancing motivation and performance (OLIVEIRA; ALVES, 2021).

- **Feedback Optimization**: Automated assessment tools can provide immediate feedback on the activities performed, allowing for quick pedagogical adjustments (MEC, 2018).

- **Educational Data Analysis**: Predictive models can signal dropout and low-performance risks, supporting the work of managers and teachers in the development of strategic interventions (LIMA; ARAÚJO, 2020).

- **Inclusion and Accessibility**: In some contexts, AI can create personalized solutions for students with special needs, optimizing resources and assisting in the development of specific skills.

The scenario of challenges and opportunities reveals that the adoption of AI in Brazilian education depends, simultaneously, on structural investments (infrastructure, training, public policies) and pedagogical approaches that favor the collective construction of knowledge. Digital technologies are not neutral and, therefore, demand a critical look at their application and effects.

DISCUSSION

In this section, the quantitative and qualitative findings are discussed in an integrated way, relating them to the pedagogical theories presented in the Theoretical Framework. The analysis shows that AI, while providing innovative instruments to personalize and optimize the educational process, is limited by socioeconomic and formative constraints present in the Brazilian context (CNE, 2019).

CONNECTIONS WITH PEDAGOGICAL THEORIES

The positive results achieved in several studies suggest that AI can promote advances in the **personalization of teaching**, corroborating **constructivist** and **constructionist principles** by encouraging students to take a more active role in the

construction of knowledge (PIAGET, 1976; PAPERT, 1993). This is manifested, for example, in platforms that offer practical projects, allowing the student to manipulate concepts and develop autonomy. On the other hand, **sociointeractionism** (VYGOTSKY, 1978) highlights the importance of social and cultural interaction in the formative process, which requires that these tools be planned not only for individual use but also for collaborative exchange (SÁ; SERPA, 2020).

The **behaviorist** perspective (SKINNER, 1954) manifests itself in platforms that provide immediate feedback and symbolic rewards to stimulate student engagement. However, critics point out that this mechanism can become overly "mechanical," restricting the development of more complex skills, such as critical thinking and open-ended problem-solving skills. Therefore, a balance between different pedagogical approaches is necessary, ensuring that AI is used flexibly, according to the demands of each school's context.

ETHICAL ASPECTS AND DATA GOVERNANCE

The debate about **ethical aspects** brings to light concerns about student privacy, the protection of sensitive data, and the possibility of reproducing algorithmic biases (UNESCO, 2019). In AI projects applied to education, algorithms can be trained with data that does not reflect the diversity of students' realities, which can generate recommendations or distorted content. In this sense, there is a crucial role for educational institutions and public authorities in defining standards and guidelines, ensuring transparency in the data collection and processing processes (SÁ; SERPA, 2020).

Data governance in the educational environment includes the elaboration of clear consent policies, the definition of levels of access to student information, and the continuous inspection of the systems employed. The General Data Protection Law (LGPD), in force in Brazil, establishes important principles, but its effective compliance still comes up against technical and cultural difficulties. Without a solid governance structure, there is a risk of manipulating information or even commercializing data without the proper knowledge of those involved.

IMPACT ON THE ROLE OF THE TEACHER

Another point that emerges from the studies analyzed is the redefinition of the **role of the teacher**. If, on the one hand, AI can automate routine tasks, such as the correction of objective exercises, on the other hand, it does not replace pedagogical experience and human judgment capacity. The teacher, in this new paradigm, becomes a **mediator** between knowledge and technology, integrating digital resources in a coherent way to the

curricular proposal. This mediation requires solid training not only in technical terms but also with regard to the planning of collaborative activities, formative evaluation, and the promotion of critical debates (NETO, 2022).

In situations where AI platforms work as "intelligent tutors", there is a danger that the machine will be given the function of completely guiding the student, which can limit opportunities for the development of socio-emotional skills. Therefore, it is up to the teacher to interpret the data generated, understand the specificities of the student, and develop pedagogical interventions that value the creative process and integral development (FREIRE, 1996).

PUBLIC POLICIES AND SUSTAINABILITY

The effective impact of AI on Brazilian education is intrinsically linked to the definition of **public policies** that encourage the adoption of technological solutions broadly and inclusively (BRASIL, 2020). One-off initiatives often fail to be maintained in the long term due to management changes or a lack of financial resources (CNE, 2019). A solid plan must provide for investments in infrastructure, continuous training of teachers, and the creation of clear regulatory frameworks regarding the use of data.

In addition, the **sustainability** of these projects involves the articulation between educational institutions, the private sector, and government agencies. Public-private partnership programs can foster innovation and the expansion of AI platforms as long as there is control and transparency in the conduct of projects. In this context, it is up to the public power to play the role of regulator, establishing ethical and pedagogical parameters that ensure the best use of technologies in favor of educational quality.

CONCLUSION

This article analyzed how Artificial Intelligence can influence teaching, highlighting advances, limitations, and implications in the Brazilian context. The literature review and discussion presented show that AI has the potential to:

- **Personalized learning**: Adaptive systems can be integrated into pedagogical practices that respect the pace and learning style of each student, aligning with constructivist and constructionist approaches.
- **Optimize assessment**: Auto-correction tools and immediate feedback reduce teacher burden and can provide timely and individualized guidance to the student (MEC, 2018).

- **Support management and decision-making**: Data analysis allows you to identify trends and anticipate risks, such as school dropout, helping educational managers in the development of specific interventions (LIMA; ARAÚJO, 2020).
- **Include and Cover Diverse Profiles**: At the same time, AI can develop strategies to serve students with special needs, making the educational process more inclusive and equitable.

However, the challenges are equally significant. The lack of digital infrastructure in schools in less developed regions, the need for continuous teacher training, and the concern with biases and data security are obstacles to the effective adoption of these technologies on a large scale (CNE, 2019; NETO, 2022). In addition, cultural and pedagogical resistance, as well as the scarcity of sustained funding, can compromise the consolidation of AI projects in public and private networks.

Thus, it is recommended that public policies invest in a balanced way in **technology and teacher training**, in addition to establishing clear regulations on privacy and ethics in the use of AI. Future research can focus on case studies in different social contexts, assessing the real impact of AI on the quality of teaching and on the reduction of educational inequalities. It is also relevant to deepen investigations around the tools that best adapt to the specificities of each region, considering cultural, linguistic, and socioeconomic aspects.

Above all, AI tools should be seen as **partners of the teacher**, enhancing student autonomy and contributing to meaningful and inclusive learning. If implemented with care and critical vision, AI solutions can play a strategic role in the renewal of the Brazilian educational system, contributing to the formation of citizens who are more prepared for contemporary challenges. Thus, the success of any initiative involving AI in education depends on the confluence of institutional efforts, teacher training, adequate investments, and an ethical framework that preserves the dignity and diversity of the target audience.

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