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Generative Artificial Intelligence for Educational Inclusion

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Generative Artificial Intelligence for Educational Inclusion

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Abstract- This essay argues that Artificial Intelligence (AI), despite its inherent risks and challenges, can be a valuable tool for promoting the educational inclusion of neurodivergent students within Mathematics Education. We contend that by offering customizable adaptive and functional supports, AI has the potential to mitigate specific barriers to learning, communication, and participation, acting as a complementary resource to inclusive pedagogical practices. We theoretically explore this potential by connecting recent literature on AI in education and inclusion with critical reflections from teaching practice in supporting neurodivergent students, using the methodology of self-study of professional practice. We analyze AI's potential as a functional support and empowerment tool, the barriers to its adoption (cultural resistance, authorship concerns, social representations), and discuss its limits, risks, and implications for a more inclusive Mathematics Education and school culture.

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I. Introduction

"Professor! With you, I can handle it. Without you, I can't. Since I don't have you at home to keep answering my questions, I talk to the AI, and it explains things to me!" (Ana, a high school student)

Ana's statement, emerging from a composite narrative — a methodological resource that blends recurrent experiences from teaching practice to create a fictional archetype — illustrates a concrete use of Artificial Intelligence (AI) in an educational context. This fictional representation serves to illuminate a phenomenon within the paradigm of inclusive education, a global and national commitment aimed at transforming structures, curricula, and pedagogical practices to welcome and value human diversity in its entirety. This movement, driven by landmarks such as the Salamanca Statement (1994) and Sustainable Development Goal (SDG) 4 — to which Brazil has committed to "ensure inclusive and equitable quality education" — underpins the quest for a school that removes barriers and guarantees the right to learn for all.

That said, this essay focuses on a new way of understanding and valuing the natural plurality of human brain functioning, which can be conceptualized as neurodiversity. Understood as the natural variability of human neurological configurations, it encompasses profiles such as Attention-Deficit/Hyperactivity Disorder (ADHD), Dyslexia, Autism Spectrum Disorder (ASD), Bipolar Affective Disorder (BAD), Dyscalculia, Dyslalia, Oppositional Defiant Disorder (ODD), the Obsessive-Compulsive Disorder (OCD) Spectrum, and Tourette Syndrome, among others. The inherent challenges in mathematics learning for these students highlight the limitations of traditional pedagogies. In this landscape, the disruptive emergence of AI in education (Mattos & Kalinke, 2024), with its promises and questions (Silveira & Paravidini, 2024; Barbosa, Taveira, & Peralta, 2024), drives the investigation into how to mobilize it to promote a more effectively inclusive Mathematics Education.

Considering this issue, in this essay, we argue that AI, despite the risks and challenges (Ribeiro, Navarro, & Kalinke, 2024; Silveira & Paravidini, 2024), can be a valuable tool for promoting the inclusion of neurodivergent students in Mathematics Education. We contend that by offering adaptive and customizable supports (Alves et al., 2024), AI can mitigate barriers to learning, communication, and participation, complementing inclusive pedagogical practices.

In this sense, our objective is to theoretically explore this inclusive potential, articulating recent literature on AI in education and inclusion with critical reflections from teaching practice in supporting neurodivergent students, using the self-study of professional practice (Ponte, 2002) as a lens.

Finally, we organize the text by presenting the theoretical foundation (inclusive education, neuro-diversity, challenges in mathematics, AI in education), the methodological perspective, the potential of AI as functional support, the barriers to its adoption (resistance, authorship), a discussion of limits and risks, and the final considerations.

II. Theoretical Foundation

In this section, we establish the theoretical underpinnings of the essay. We begin by contextualizing inclusive education and its target population in Brazil. Next, we delve into the concept of neurodiversity and the specific challenges it presents in the context of mathematics learning. Finally, we provide a conceptual overview of Artificial Intelligence and its general applications in education, culminating in an exploration of AI's specific potential as a tool to promote inclusion.

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a) *The Paradigm of Inclusive Education and its Target Population*

The math teacher asks Mirela to read a problem from the book. Mirela, who has dyslalia, begins to read, mispronouncing some phonemes. "Thee boxes..." Her anxiety rises, and her stereotypies, a subtle rocking of her torso, become more evident. A muffled laugh comes from the back of the room. She continues, her voice trembling: "...the poblem asks to..." The laughter spreads. Mirela stops, ashamed, and the teacher tries, unsuccessfully, to reprimand the class. The damage to her self-image is already done; the barrier erected was not the complexity of the math problem, but the simple expectation of participating orally in class.

Inclusive education represents a paradigm shift that transcends the mere integration of students with special needs into regular classrooms. It is a set of political-pedagogical processes aimed at ensuring the right to learn for all, opposing standardized teaching methods and seeking the removal of barriers that prevent the entry, permanence, and success of any student.

In the Brazilian context, the concept of the "target population of inclusive education" is vast and multifaceted, reflecting the understanding that barriers to learning can have multiple origins. Legislation and educational policies support a broad spectrum of students, which includes:

- *Disabilities:* This covers physical/motor, sensory (visual and auditory), intellectual, and multiple disabilities, which demand specific adaptations in the environment, materials, and communication.
- *Global Developmental and Learning Disorders:* This category includes Autism Spectrum Disorder (ASD), as well as specific disorders like Dyslexia, Dyscalculia, and Attention-Deficit/Hyperactivity Disorder (ADHD).
- *High Abilities/Giftedness:* A group that, although often neglected, has special educational needs that require curricular enrichment and intellectual challenges to prevent disinterest and demotivation.
- *Groups in Situations of Social and Cultural Vulnerability:* Inclusive education recognizes that social, economic, and cultural factors can create significant barriers, supporting working students, nomadic populations, linguistic and ethnic minorities, among other marginalized groups.

The math teacher, excited, comments on the latest superhero movie and asks the class what they thought. Igor shrinks in his chair. For him, the cinema is a distant universe, a luxury his reality does not afford. The conversation flows, but he remains silent, a spectator of a world to which he does not belong. Next, the teacher proposes a group project: a PowerPoint presentation on the history of numbers. Igor feels the ground disappear. He has no cell phone to coordinate with his classmates, nor a computer at home to research or create the slides. The barrier, once again, is not mathematics, but the socioeconomic abyss that separates him from the tools and experiences the school considers universal. Igor is in the classroom, but in practice, he is excluded.

This broad understanding is crucial, as it positions the focus of this essay on neurodiversity as a fundamental piece of a larger, systemic puzzle: the construction of a truly just and equitable school for all.

b) *Neurodiversity and Challenges in the Mathematics Teaching-Learning Process*

Claudio (a high school student) is perpetually frustrated. No matter how much he studies, he doesn't learn. Just when he feels he's starting to understand, the class ends, and by the time he gets home, he has forgotten everything. He becomes even more distressed knowing the teacher won't repeat it all the next day, and even if they did, he would soon forget it again.

The experience of Claudio, a fictional character mirroring the frustrations of many neurodivergent students from the author's teaching practice, illustrates the importance of considering neurodiversity. Armstrong (2011) recognizes this concept not as deficits, but as variations in cognition with both challenges and potentials, requiring Mathematics Education to accommodate their specific needs (Mazzotta & D'antino, 2011).

In this sense, evolutionary psychiatry helps to understand the persistence of these neurological variations. This field seeks to understand mental disorders like ADHD and BAD not as primary 'deficits,' but as expressions of traits or vulnerabilities that may have had ancestral adaptive relevance or be byproducts of other evolutionarily advantageous characteristics (Nesse & Williams, 1994). The 'mismatch' theory, for example, posits that traits adaptive in the past may manifest as dysfunctional in modern contexts, which differ from the environments of cognitive evolution.

This evolutionary perspective, therefore, aligns with neurodiversity by investigating the origins and persistence of different neurological profiles (Armstrong, 2011). Instead of focusing solely on dysfunctions, evolutionary psychiatry explores how certain patterns of thought and behavior — which in extreme manifestations constitute disorders — may be linked to cognitive strategies useful for survival or reproduction. Such an understanding does not minimize the challenges, like those of Ana, Mirela, or Claudio, but enriches the comprehension of neurodiversity as a natural human variation shaped by evolutionary interactions.

Indeed, Claudio's difficulties can be understood in light of the cognitive and functional challenges of neurodivergent students in mathematics. These include problems with executive functions (organization, planning, working memory, cognitive flexibility, initiation, and maintenance of mental effort) (American Psychiatric Association, 2014), variations in attention/energy

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(ADHD, BAD), and difficulties with numbers/calculations, as in Dyscalculia (Shalev, 2004).

Furthermore, communication and expression of mathematical thought can be barriers: difficulties in verbalizing reasoning, organizing written ideas, or using formal mathematical language, even when concepts are understood (Geary, 2004). In pedagogical social interaction, participation anxiety, fear of making mistakes, or difficulties in collaborating with teachers can limit engagement (Mazzotta & D'Antino, 2011), straining the dialogical relationship (Freire, 1970).

Frequently, such challenges are exacerbated by a school culture that pathologizes or moralizes divergent behaviors as character flaws rather than neurodivergent manifestations (Mazzotta & D'Antino, 2011). This dynamic, analyzable through the concepts of habitus and cultural capital (Bourdieu, 1989) or the relationship with knowledge (Charlot, 2000), generates stigma and barriers. Given this, we identify, in our teaching practice, the need to seek more flexible and inclusive educational actions.

c) *Artificial Intelligence: A Conceptual and Educational Overview*

In parallel, Artificial Intelligence (AI) is rising as a transformative social force: computational systems performing tasks that would require human intelligence (learning, reasoning, problem-solving, natural language) (Barbosa, Taveira, & Peralta, 2024; Russell & Norvig, 2009, as cited in Durso, 2024). In our case, generative AIs, machine learning systems, and natural language processing are particularly noteworthy (Mattos & Kalinke, 2024).

In the educational field, its applications include adaptive platforms (Mattos & Kalinke, 2024; Alves et al., 2024), intelligent tutors (Mattos & Kalinke, 2024), automated assessment (Durso, 2024), chatbots (Ribeiro, Navarro, & Kalinke, 2024), writing and organization assistants, and accessibility resources (Duffy, 2024; Silva, 2024).

d) *Artificial Intelligence as a Tool for Inclusion*

Patrick (a calculus student in Engineering) has bipolar disorder and, in many situations, becomes irritated and expresses himself aggressively. Now, he has started using a generative AI to filter his written communications. Patrick has become more assertive in expressing his thoughts, reducing communication-related detriments, and has also learned, by reading the AI-corrected texts, strategies to convey his thoughts more efficiently.

Patrick's experience — a fictional archetype reflecting the author's teaching experiences with neurodivergent students — illustrates the growing inclusive potential of Artificial Intelligence (AI) (Alves et al., 2024; Silva, 2024). AI-tools like text-to-speech/speech-to-text conversion, image recognition, and captioning are crucial for overcoming barriers related to sensory/motor disabilities (Duffy, 2024). Moreover, adaptive AI systems promote individualized learning paths, catering to diverse educational needs (Mattos & Kalinke, 2024; Alves et al., 2024).

For neurodiversity, AI functionalities connect to learning challenges: assistance with organization (executive functions); alternative/multimodal explanations (processing styles); and chatbots for questions (reducing social anxiety) (Silveira & Paravidini, 2024). Patrick's experience with AI for suggesting tone and style in writing is particularly relevant: this tool helped him refine his communication, making it more assertive and reducing negative interpretations, while also promoting the learning of communication strategies. The personalization of pace/intensity via AI is also crucial for sensory/attention sensitivities (Alves et al., 2024). We will explore this potential further.

III. Methodological Perspective

This qualitative theoretical essay combines a review of contemporary literature on neurodiversity, Artificial Intelligence (AI) in education, and inclusive processes with critical reflections from the author's teaching experience in supporting neurodivergent students. The self-study of professional practice (Ponte, 2002) is adopted as an analytical lens, allowing for a reflective dive into the complexities of the pedagogical daily life and the transformative potential of AI.

To lend concreteness to the theoretical discussions and illustrate behavioral patterns, recurring challenges, and ethical and practical dilemmas, composite vignettes are used. These are brief, focused narratives constructed by amalgamating recurrent observations and experiences from teaching practice with students. It is important to emphasize that, although inspired by real situations, the characters and dialogues in the vignettes are archetypal constructions, developed to protect the identity of those involved and to highlight dynamics relevant to the discussion.

They do not represent specific individuals but an amalgam of observed characteristics and experiences, allowing for in-depth analysis without exposing the particularities of isolated cases. Thus, this methodological approach "gives life" to qualitative data, transcending traditional academic report formats and facilitating the transmission of meaning succinctly.

Reflections on the use of AI as support and for the inclusion of neurodivergent students are permeated by practical examples of existing and utilized technologies. Such examples include:

- *Virtual Assistants and Voice Interfaces:* Such as Alexa (Amazon Echo) or Google Assistant, which can assist in organizing tasks, reminders, quick access to information, and device control — functionalities useful for students with difficulties in executive functions.

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- *Recording and Transcription Tools:* Voice recording apps, present on smartphones and other devices, and automatic transcription services, such as those integrated into Google Workspace (Google Docs Voice Typing) or dedicated software. These tools are valuable for students who express themselves better orally or who have difficulties with writing, allowing for the recording of ideas and their subsequent conversion into text, as illustrated in the case of "Bruna" in this study.
- *Generative Artificial Intelligences:* Advanced language models like ChatGPT (OpenAI) and Gemini (Google), which can assist in reformulating texts, organizing ideas, exploring different ways to explain a concept, and even generating adapted math problems or examples, as explored in the vignettes of "Bruna" and "Marvin." Gemini, in particular, has proven to be a versatile tool for the author in supporting pedagogical practice and exploring new teaching approaches.
- *Image and Video Generators:* Tools capable of creating visual representations from textual descriptions, which can be useful for making abstract concepts more concrete or for creating visually appealing and personalized teaching materials.
- *3D Modeling and Visualization Software:* As mentioned in the case of "Glória," which can incorporate AI elements to facilitate the transition between 2D and 3D representations, assisting students with difficulties in-spatial visualization.

It is crucial to highlight that the mention of these AIs and their functionalities aims to illustrate the available technological potential and how it can be mobilized critically and reflectively to meet the specific needs of neurodivergent students. The analysis proposed in this essay is not restricted to specific brands or products but explores the categories of tools and their pedagogical implications in the context of inclusive Mathematics Education.

By intertwining theory, the self-study of professional practice, and the illustrative use of composite vignettes and AI examples, this essay seeks to offer a relevant contribution to the debate on the role of new technologies in promoting a more equitable, accessible, and diversity-sensitive education.

IV. The Potential of AI as Functional Support and a Tool for Student Empowerment

As argued, AI offers promising functionalities as a support for neurodivergent students in Mathematics Education, mitigating barriers and fostering autonomy. The following narratives, based on teaching practice, illustrate how the functional aid and empowerment provided by this technology materialize into concrete solutions, connecting fictional experiences to real technologies and projects.

Our first case is Bruna, who has ADHD. She demonstrates sharp mathematical reasoning orally but struggles to translate this clarity into formal writing, resulting in fragmented texts that do not reflect her understanding and cause her distress. Her strategy involves recording her explanation of problems and using transcription software. The transcribed text, still reflecting her non-linear thinking, is then submitted to a generative AI. This tool organizes her ideas into a logical and mathematically cohesive script, acting as an external organizer that translates her verbal logic into a written structure. This practice is enhanced by specific assistive technologies, such as the Microsoft Immersive Reader (Microsoft, n.d.) or Speechify (Weitzman, 2023), which are designed to convert text to speech and aid in reading, allowing Bruna to hear her own reorganized text, validating her understanding and bypassing her decoding difficulty. Thus, she can present her reasoning in a comprehensible way, feeling validated and more confident.

We also have Pedro, with ADHD and traits of Oppositional Defiant Disorder. He deals with inattention, difficulty initiating tasks, and consequent procrastination. AI emerges as a cognitive scaffold. He uses it to get a "starting point" for exercises — an initial outline or strategy-suggestions — breaking the inertia of "I don't know how to start," without giving him the ready-made answer. This need connects directly to the concept of adaptive learning platforms. Tools like DreamBox Learning (DreamBox Learning, n.d.) use AI to analyze not just the student's final answer, but the strategy used to solve a problem, offering the exact cognitive support he needs. The technology acts as an extension of his executive functions, reducing mental overload, which in turn reduces defiant behaviors and improves his engagement.

Let's consider Marvin, a student with high abilities/giftedness, who faces boredom in classes with standardized exercises that he solves quickly. He finds in AI a source of intellectual stimulation, using generative AIs to create complex mathematical problems aligned with his interests (quantum physics, games, music) and advanced level. The AI complements the teacher, offering personalized engagement and transforming boredom into deep, autonomous learning.

Finally, let's think about Glória, a student on the autism spectrum with significant difficulty in spatial visualization, especially in transitioning between 2D and 3D representations. She finds in AI, within modeling software, a bridge to this understanding. Tools that allow her to interactively assemble/disassemble geometric solids or transform floor plans into navigable 3D models offer her a concrete experience. To ground this application in the Brazilian reality, we can cite the

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"Rede Incluir" project from the State University of Paraná (UNESPAR). This project uses AI to collaborate in creating accessible pedagogical materials, and one of its first products was a 3D-printed reading guide, demonstrating the practical application of AI in designing tactile materials that can be adapted for exploring geometric concepts (UNESPAR, 2025). The AI acts as a visual and tactile translator, allowing Glória to explore spatial relationships in a way that is meaningful for her processing, thus overcoming barriers.

These examples illustrate the core of the argument: AI, when used critically, can become a powerful ally in inclusion. Table 1, below, systematizes some tools and their applications.

Table 1: AI Tools and Applications for Neurodiversity

Tool	Primary Inclusion Functionality	Primary Target Audience	Practical Use Example
Magic School AI	Generation of Individualized Education Plans (IEPs), rubrics, and adapted assessments.	Inclusive Education Teachers, Students with various SEN.	Generate a draft IEP for a student with ASD, focusing on social communication goals.
Teachy	Creation of interactive and gamified activities with instant feedback.	ADHD, Learning Disorders, General class engagement.	Create a gamified quiz to review a topic, keeping students with ADHD engaged.
Microsoft Immersive Reader	Text-to-speech, adjustment of spacing, syllable highlighting, and translation.	Dyslexia, Low Vision, Reading Difficulties, ADHD.	Activate the reader on an online text so the student can listen to the content, facilitating comprehension.
DreamBox Learning	Adaptive learning platform that analyzes the student's problem-solving strategy.	Dyscalculia, Math Difficulties, High Abilities.	The system identifies a student's inefficient strategy and offers a micro-lesson to teach a more effective method.
Rede Incluir (Unespar)	Use of AI for the design and prototyping of 3D-printed tactile pedagogical materials.	Visual Impairment, Dyslexia, ASD, Kinesthetic Learners.	Design 3D models of geometric solids to aid in understanding spatial visualization.

Source: Prepared by the author based on the cited authors.

V. Barriers to AI Adoption in Mathematics Education: Resistance, Authorship, and Prejudices

Despite the inclusive potential of AI, its integration into Mathematics Education faces pedagogical, cultural, and epistemological barriers, in addition to technical or access-related ones. This hesitation echoes historical resistance to technologies like the calculator, with fears of dependency and the loss of mental calculation skills (Araújo & Soares, 2002; Cunha, 2019), suggesting a pattern of resistance to tools that challenge conceptions of effort and learning.

In the context of generative AIs, the critique of "inauthenticity" — the idea that the work "wasn't done by the student" — ignores the interactive nature of the human-AI process. The user defines objectives, crafts prompts, and validates the final product (Durso, 2024). Since AIs operate through statistical combinations without semantic understanding (Santaella, 2023, as cited in Rodrigues & Rodrigues, 2023), intellectual agency remains with the human (Barbosa, Taveira, & Peralta, 2024). To disqualify the use of AI as a support would be analogous to questioning the authorship of a typed text (Araújo & Soares, 2002).

This issue of authorship is linked to misunderstandings and "prejudices" fueled by a lack of familiarity, ethical concerns (plagiarism, biases), the need for teacher training, and the perceived threat to traditional roles (Marques, 2023, as cited in Rodrigues & Rodrigues, 2023; Silva, 2024; Alves et al., 2024; Durso, 2024; Cunha, 2019). The Theory of Social Representations (Moscovici, 1978; Jodelet, 2001; Andrade, 2007) explains how the technological "new" is anchored in notions of risk or dehumanization, contrasting with an idealized "authentic" past (Andrade, 2007).

Thus, the "prejudice" against pedagogical practices with AI reflects a social representation (Bona & Costa, 2023) that associates technology with a loss of control or undue facilitation. Such a perception invalidates the use of AI for compensation and access,

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ignoring the user's intellectual process (Barbosa, Taveira, & Peralta, 2024) and its assistive potential, especially for neurodivergent individuals.

VI. Discussion: Limits, Risks, and Implications for an Inclusive Mathematics Education

The analysis of Artificial Intelligence's (AI) potential as a support tool for the inclusion of neurodivergent students reveals a complex landscape, full of possibilities but equally fraught with risks and tensions that demand a critical eye. Beyond cultural barriers, the implementation of AI in education imposes technical and ethical challenges of great magnitude.

One of the most critical risks is algorithmic bias. This phenomenon occurs when an AI system produces systematically prejudiced outcomes because it learns from data that reflects societal inequalities and stereotypes (Holdsworth, 2023). In the educational context, this can manifest in pernicious ways, such as discriminatory pedagogical recommendations — suggesting less challenging paths for minoritized groups — or in unfair assessments that may penalize students for linguistic variations or regional accents, mistaking cultural difference for error (Cohen, n.d.).

Another central concern is data privacy. AI platforms collect an unprecedented volume of student information, ranging from grades to behavioral patterns, interactions, and, in more advanced systems, even biometric data. In Brazil, the General Data Protection Law (LGPD) imposes strict rules for the processing of this information. The risks associated with poor governance include the improper commercial use of data, the creation of a surveillance environment that inhibits creativity, and, most importantly, security breaches that can expose vulnerable students to various dangers (Desinteligência Humana, 2024).

Finally, the introduction of AI into a scenario of profound social inequality accentuates the risk of digital exclusion. Without active public policies, technology can widen existing inequities. A World Bank analysis (Saavedra, Barron, & Molina, 2024) points to the creation of three distinct groups of students in the AI era: the empowered, who use technology to enhance critical thinking; the dependent, who use it as a shortcut, losing learning opportunities; and the excluded, the vast majority in low- and middle-income countries, for whom AI remains a distant concept. This scenario reinforces the urgency of ensuring equitable access to infrastructure and digital literacy, so that AI becomes a tool for reducing, not amplifying, inequalities.

In this context, profound implications emerge for teaching practice and public policy. The teacher's role shifts significantly: less as the sole transmitter of knowledge, and more as a critical curator of knowledge and an epistemic validator. Their function becomes to teach students how to interact critically with AI, to question its answers, and to verify sources, ensuring an ethical and reflective use of technology (Santos, 2012).

This transformation, however, is only possible with strong support from public policies. The debate on AI governance in education is already underway in Brazil. The National Education Council (CNE) is in the final stages of drafting the first official guidelines for the use of AI in basic and higher education (Redação TI Rio, 2025). Concurrently, the Ministry of Education (MEC) is developing the "Framework for Responsible Use and Development of AI" and projects like the "Gestão Presente" data hub, which aim to guide the ethical and safe use of technology, aligned with Brazil's educational vision (Brasil, 2025; Alli, 2024). Such initiatives are crucial to ensure that the implementation of AI does not deepen exclusion but instead helps build educational environments where neurodiversity is truly welcomed.

VII. Final Considerations

In this essay, we explored the potential of AI as an inclusion tool for neurodivergent students in Mathematics Education. We argued that, despite resistance and technical and ethical risks, AI can offer valuable functional supports, mitigating barriers and empowering students, thereby promoting autonomy and engagement.

The articulation between literature, the self-study of professional practice, and the analysis of ongoing policies proved fruitful for evaluating the potential and limits of AI in a situated and critical manner. We conclude that AI is neither a magic solution nor a threat to be rejected, but a potent resource whose successful implementation depends on a systemic approach involving teacher training, data governance, and a commitment to equity.

We invite the community of mathematics educators, researchers, and administrators to a continuous, ethical, and pedagogically grounded exploration of AI's possibilities, always in dialogue with the real needs of students and as part of a broader, indispensable effort to transform school culture (Mazzotta & D'Antino, 2011). Technology, by itself, does not guarantee inclusion; it is its critical and intentional use that can assist in building educational environments where neurodiversity is truly welcomed, understood, and potentiated.

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Note: The references have been formatted to align with the APA style recommended by the journal guidelines. The original Portuguese titles are retained for non-English sources, followed by an English translation in brackets for clarity, as is common practice.

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