

ARTICLE

ADHD and learning: gaps in translating scientific evidence into teacher training

TDAH e aprendizagem: lacunas na tradução da evidência científica para a formação docente

TDAH y aprendizaje: brechas en la traducción de la evidencia científica a la formación docente

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ABSTRACT

Teacher training programs on ADHD increase teachers' knowledge immediately after the intervention, but the maintenance of that gain and its transfer to classroom practice remain insufficiently demonstrated. This is the central conclusion of a critical narrative review of international and Brazilian literature on ADHD neurobiology, teacher training, school-based interventions, and education policy in Brazil. The synthesis covers the state of the art of empirically supported school interventions, what international studies show about knowledge retention and behavioral change following ADHD-focused teacher training programs, foundations from neuroeducation relevant to the topic, contributions from implementation science that help explain why good evidence does not automatically translate into good practice, and the Brazilian regulatory framework, including Law 14,254/2021, which explicitly mandates continuing teacher training for ADHD identification and management. As an original contribution, the article proposes a research agenda organized around the distinction between intervention efficacy, teacher-training efficacy, and implementation effectiveness, along with four conceptual elements for training oriented toward practice change, not merely a one-off gain in knowledge.

Keywords: ADHD; teacher education; school-based interventions; inclusive education; evidence-based implementation.

Introduction

Over the course of their careers, teachers in Brazilian basic education encounter students with characteristics consistent with ADHD, whether diagnosed or not. ADHD is among the most extensively studied neurodevelopmental disorders in childhood and adolescence, with worldwide prevalence estimates ranging from roughly 5% to 7% in samples of children and adolescents, depending on the diagnostic criteria and assessment method used (Polanczyk et al., 2007; Faraone et al., 2021). Its manifestation in the school setting — difficulty sustaining attention on lengthy tasks, motor restlessness, impulsive responses, disorganization of materials and deadlines — usually appears long before any formal diagnosis. The teacher is often the first to observe this pattern, and is also the one who must decide, in the everyday practice of the classroom, how to respond to it, frequently without any specific preparation for that task.

The teacher's position as a first-line observer is not incidental. Developmental course studies show that children with ADHD, on average, have worse academic performance, higher rates of grade retention and school dropout, and more frequent use of special education services than their peers without the disorder, even when intellectual level is equivalent (Loe & Feldman, 2007). This pattern of academic disadvantage associated with ADHD tends to accumulate over the course of schooling, which reinforces the importance of early and sustained intervention and positions the school — and, within it, the teacher — as a potentially decisive point of intervention, even though this role is rarely valued as such in teacher training policy.

Training for this task remains incomplete in a large share of education systems. The United Nations Educational, Scientific and Cultural Organization (UNESCO) found, in its 2020 Global Education Monitoring Report, that fewer than one in ten primary school teachers in ten Francophone sub-Saharan African countries had received training in inclusive education, and that a quarter of teachers surveyed across 48 countries reported wanting more training to teach students with specific educational needs (UNESCO, 2020). The report sums up the problem in terms that hold true beyond the countries surveyed: teachers want and need more preparation to handle the diversity of their classrooms, and education

systems, broadly speaking, have not yet organized this training systematically.

In Brazil, this gap takes on a specific shape, and one less obvious than is usually assumed. Contrary to what a hasty reading of Brazilian legislation might suggest, the country does not lack a regulatory provision on the topic: Law 14,254, of November 30, 2021, established comprehensive support for students with dyslexia, ADHD, or other learning disorders, and its Article 5 requires education systems to guarantee basic education teachers "broad access to information, including regarding possible referrals for multisectoral care, and continuing training to enable them to identify early signs related to learning disorders or ADHD, as well as to provide appropriate educational support to these students" (Brazil, 2021, Art. 5). An explicit legal mandate therefore exists; the law already answers the question of whether training on ADHD should exist. This article examines a different question: to what extent does this regulatory provision translate into training that is actually implemented, evidence-based, and capable of producing sustained change in teaching practice.

The legal basis, then, already exists; the central question becomes the effectiveness and implementation of that training, and this is where the scientific literature reviewed in this article has the most to say. This shift, from a question about regulatory existence to a question about practical effectiveness, is also what sets this work apart from much of the Brazilian literature on the topic, which tends to focus on describing the diagnosis and its manifestations, paying less attention to the question of what actually changes a teacher's classroom practice. The question guiding this text is as follows: what gaps persist in the initial and continuing training of basic education teachers for the pedagogical management of ADHD, and to what extent do these gaps explain the limited transfer of teachers' knowledge about the disorder into effective and sustainable classroom practices?

To answer it, we review the neurobiological and cognitive basis of ADHD relevant to the school context, the state of the art of empirically supported school interventions, synthesize what the international literature on teacher training shows regarding knowledge retention and behavioral change in the classroom, examine contributions from neuroeducation and implementation science to help understand this gap, discuss the Brazilian regulatory framework and the role of international bodies in setting parameters for inclusive training, and propose minimum pillars and a research agenda for a training model that translates into practice. The central argument can be summarized as follows: the problem is not a lack of available scientific

knowledge, nor the absence of a law requiring training. The problem lies in the space between these two points, and it is this space that the teacher-training literature has not yet managed to fill consistently.

Methodological approach

This text takes the form of a critical narrative literature review, not a systematic or integrative review in the strict methodological sense of the term. This distinction sets the boundaries on the certainty of the findings presented. The search combined a bibliographic survey assisted by a natural-language research tool, direct consultation of academic databases, journals and institutional websites, and reading of the full texts or extended abstracts of the selected sources. Artificial intelligence tools were used exclusively as exploratory support for identifying references, with the existence, relevance, and content of the documents subsequently verified directly on journal pages, in academic repositories, or on the official websites of the institutions cited. Search terms included combinations of "TDAH," "ADHD," "formação de professores," "teacher training," "intervenções escolares," "school-based interventions," "executive function," "neuroeducation," and "implementation science," in Portuguese and English.

The selection prioritized meta-analyses, systematic reviews, and institutional documents, since they offer a more stable synthesis than isolated studies, complemented by primary reference studies when relevant to illustrate a specific point of the argument. No reference was included solely on the basis of its retrieval by an artificial intelligence tool; bibliographic data, quantitative results, and direct quotations were checked against primary sources, recognized bibliographic databases, or the official websites of the institutions cited before being incorporated into the text.

No formal protocol for identification, screening, eligibility, and inclusion was followed, there is no record of the total number of documents tracked and excluded at each stage, and there was no independent double-checking of the selection by a second reviewer. These are genuine limitations of the method used, not merely a formality to be mentioned: they mean this article should be read as a critical, argumentative synthesis of the available literature, useful for mapping the problem and guiding further reading, but not as a systematic review capable, on its own, of supporting aggregated effect estimates or clinical practice recommendations. Where the literature consulted is a published meta-analysis or systematic review, as is the case for most of the central sources in this article, the figures and conclusions

reported are those of the original authors themselves, not an independent reanalysis.

The core literature for this article includes the meta-analysis by Ward and colleagues (2022) on ADHD teacher training, which constitutes one of the main quantitative syntheses considered in this review, and the meta-analysis by Moore and colleagues (2018) on non-pharmacological school interventions. The review's time frame closed at the end of 2024.

Theoretical framework

ADHD: definition, developmental course, and heterogeneity

In current psychiatric nosology, ADHD is characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development, with symptoms present before age twelve and manifest in more than one setting, generally home and school (APA, 2022). It is a neurodevelopmental disorder with a strong hereditary component: twin studies estimate heritability at around 70% to 80%, among the highest recorded in child psychiatry, which does not imply biological determinism, since pre- and perinatal environmental factors, family context, and the quality of the school environment substantially modulate the course and severity of the condition (Faraone et al., 2021).

The international consensus review coordinated by Faraone and colleagues (2021), published in *Neuroscience & Biobehavioral Reviews* under the endorsement of the World Federation of ADHD, synthesizes 208 evidence-based conclusions about the disorder, drawing on findings from neuroimaging, molecular genetics, epidemiology, and clinical course. Among the points relevant to this article is the finding that ADHD persists into adulthood in a substantial proportion of cases diagnosed in childhood, even though the symptomatic presentation changes with age, and that the disorder is associated with discrete but replicable structural and functional alterations in frontostriatal and frontoparietal circuits related to attention, inhibitory control, and reward processing. These alterations are not, on their own, valid diagnostic markers at the individual level, and diagnosis remains clinical, based on behavioral and functional criteria rather than imaging.

Clinically, ADHD tends to present in three forms: predominantly inattentive, predominantly hyperactive-impulsive, and combined. This distinction has direct pedagogical relevance, because the three forms produce distinct behavioral patterns in the classroom: a predominantly inattentive child tends to go unnoticed for longer, since they do not disrupt the class

dynamic, whereas a predominantly hyperactive-impulsive child tends to be identified earlier, precisely because their behavior is more visible and more disruptive to the teacher. This asymmetry in visibility has a practical consequence: students with a predominantly inattentive presentation run the risk of receiving no support at all, precisely because they do not bother anyone.

Comorbidities are the rule, not the exception. Specific learning disorders, anxiety, oppositional defiant disorder, and conduct disorders occur at elevated frequency in children with ADHD, and each of these associated conditions changes the picture that arrives in the classroom (APA, 2022; Faraone et al., 2021). This heterogeneity makes it even harder for a teacher without specific training to distinguish what is a core symptom of the disorder, what is a pedagogical difficulty of a different origin, and what is an emotional reaction to an accumulated history of school failure.

Executive functions and Barkley's model

The most influential attempt to explain ADHD through a unifying cognitive mechanism is Barkley's model (1997), published in *Psychological Bulletin*, which locates the disorder's core deficit in behavioral inhibition, on which four executive functions would hierarchically depend: nonverbal working memory, internalization of speech (verbal self-regulation), self-regulation of affect and motivation, and reconstitution, understood as the capacity to analyze and synthesize behavior into new sequences to solve problems. According to this model, difficulty inhibiting automatic responses secondarily impairs these four capacities, producing the broad clinical picture of disorganization, impulsivity, and planning difficulty.

Barkley's model was extensively reviewed and discussed in the following decades, and current literature acknowledges that not all children with ADHD show a measurable executive deficit on neuropsychological tests, which suggests that executive functions are one of several pathways leading to the clinical picture, not a necessary and sufficient explanation for all cases (Faraone et al., 2021). Even so, the model remains useful as a conceptual tool for teachers, because it translates observable symptoms into nameable cognitive processes. A teacher who understands executive functions as the capacity to plan, initiate, and sustain a task, to inhibit impulsive responses, to hold information in working memory while carrying out an activity, and to shift focus between competing demands has a more precise vocabulary for describing what they observe, and that descriptive

precision is the first step toward a proportional, rather than punitive, pedagogical response.

From a pedagogical standpoint, this picture reinforces the importance of strategies that make steps, goals, deadlines, and feedback more explicit, rather than relying on one-off verbal instructions such as "pay attention" or "get organized," whose effect tends to be limited when used in isolation, precisely because they ask the student to exercise, on demand, the very function that is impaired. This is why the school intervention literature reviewed in the next section converges, relatively consistently, on strategies for restructuring the environment and the task rather than verbal exhortation: the target of the intervention shifts from the student's willpower to the structure of the task and the context in which it is carried out.

This distinction matters because it guides the teacher's response at the moment the behavior occurs. Behavior read as a lack of discipline or lack of interest tends to elicit reprimand and, over time, deterioration of the relationship between the student and the school; the same behavior, read as a manifestation of a self-regulation difficulty, tends to elicit task adaptation and support. The teacher-training literature discussed below shows that this capacity for functional interpretation of behavior remains a dimension still little explored in the programs reviewed.

Neuroeducation: possibilities and limits of a bridge

The field conventionally called neuroeducation, or educational neuroscience, aims to link findings from cognitive and developmental neuroscience with pedagogical planning, on the expectation that a better understanding of how the developing brain works will help teachers teach more effectively (Tokuhamas-Espinosa, 2010). In the case of ADHD, this bridge has real value, but also risks that the field's literature has already discussed critically.

The value lies in offering the teacher an explanatory model that shifts the reading of behavior from a moral register, in which inattention and impulsivity are seen as choice or lack of effort, to a functional register, in which these behaviors are understood as an observable expression of differences in the development of attention and inhibitory-control circuits. This shift in register has a documented practical effect: teachers who attribute self-regulation difficulties to stable, internal causes in the student, rather than to modifiable environmental factors, tend to report greater frustration in managing the class and less willingness to invest in

pedagogical adaptation (Blotnicky-Gallant et al., 2015, discussed in Section 7).

The risk, widely discussed in the critical literature on neuroeducation, is the so-called neuromyth: the simplification or distortion of neuroscience findings to the point where they no longer correspond to the original evidence, yet still circulate in teacher-training settings as if they were scientific consensus (Howard-Jones, 2014). In the field of ADHD, a recurring neuromyth is the idea that diet, on its own, is a relevant cause or effective treatment for the disorder, a belief that empirical research on teacher knowledge has itself identified as persistent even among teachers able to correctly recognize the core symptoms (Mohr-Jensen et al., 2019, discussed in Section 7). A second, more subtle risk is the use of neuroscientific language as rhetorical reinforcement for practices that would already be adopted anyway, without neuroscience actually informing the choice of strategy, a practice Howard-Jones (2014) describes as one of the most common patterns of neuroscience being misappropriated by educational practice.

The position adopted in this article is intermediate: the neuroscience of ADHD offers a useful explanatory model, one that helps the teacher interpret behavior in a less punitive and more functional way, but it does not replace the specific evidence on what works in the classroom, which comes from research in school psychology and behavioral and academic interventions, discussed in the next section. Teacher training on ADHD that stops at explaining brain circuits, without advancing to empirically tested management strategies, hands the teacher a new vocabulary without a corresponding tool for action.

Teacher training: from technical rationality to the reflective practitioner

The literature on teacher training has, for decades, offered a useful counterpoint to the idea that simply transmitting correct content is enough to produce correct practice. Schön (1983) described this limitation under the label of technical rationality: the model, dominant in much of twentieth-century professional training, according to which competent practice results from the direct application of previously acquired theoretical and technical knowledge. Schön argues that competent professionals, including teachers, operate with a repertoire of tacit knowledge, built in and on action, that cannot be reduced to the content delivered in formal courses. This argument is relevant to this article because it helps explain, from a theoretical standpoint, why an informational workshop on ADHD can increase a teacher's declared knowledge without changing their classroom practice to

the same degree: declarative knowledge and situated competence in action are related but distinct constructs.

Later contributions on teacher professional development reinforce this point with direct empirical evidence. The review by Darling-Hammond, Hyler, and Gardner (2017), produced for the Learning Policy Institute, identified seven characteristics associated with effective teacher professional development, understood as development capable of changing practice and improving student learning: a focus on content specific to the subject or pedagogical problem, use of active learning methods for the teacher, support for collaboration among peers, use of models of good practice, provision of coaching and expert support, opportunities for feedback and reflection, and sustained duration over time. Nearly all of these characteristics are absent from the single, short, follow-up-free workshop format that the specific literature on ADHD training, discussed in Section 7, associates with substantial loss of knowledge and uncertain behavioral effects on students.

Implementation science: why good evidence does not always become good practice

The distinction between efficacy, defined as the effect of an intervention under controlled research conditions, and implementation effectiveness, defined as the effect and sustainability of that same intervention when applied under real-world service conditions, is central to implementation science, a field consolidated since the 2000s in healthcare and progressively incorporated into educational research (Fixsen et al., 2005). Fixsen and colleagues, in a reference review produced for the National Implementation Research Network, synthesize evidence from multiple fields showing that the passive dissemination of information about an effective practice, through written materials or one-off training without follow-up, rarely produces sustained adoption of that practice by frontline professionals, whether teachers, nurses, or social workers.

This body of knowledge offers concepts that this article uses to organize the discussion of ADHD teacher training. Implementation fidelity refers to the degree to which the essential components of an intervention are applied as originally designed, without precluding justified contextual adaptations. Sustainability refers to the maintenance of the practice after formal external support ends, such as the presence of a researcher or consultant. The Consolidated Framework for Implementation Research, proposed by Damschroder and colleagues (2009) in the journal *Implementation Science*, organizes the determinants of successful implementation into five domains:

characteristics of the intervention itself, the outer setting, the inner setting of the organization, characteristics of the individuals involved, and the implementation process itself. Applied to ADHD teacher training, this framework helps explain why a strategy with good efficacy evidence, such as the Daily Report Card discussed in the next section, can fail in a specific school not because the strategy is poor, but because paid planning time, management support, or ongoing support for the teacher trying to apply it are lacking — factors that belong to the inner setting and the implementation process, not to the design of the intervention.

This theoretical framework, bringing together knowledge about the biology and cognition of ADHD, the limits of simplistic neuroeducation models, teacher training as a process that goes beyond content transmission, and the determinants of successful implementation of evidence-based practices, underpins the empirical reading presented in the following sections. It also explains, in advance, why it would be naïve to expect a single law or a single course to solve, on its own, the problem this article investigates.

The state of the art of school interventions

Research on school interventions for ADHD has nearly three decades of systematized accumulation. One of the earliest landmarks is the meta-analysis by DuPaul and Eckert (1997), published in *School Psychology Review*, which brought together studies on behavioral, academic, and cognitive-behavioral interventions applied in the school setting and found consistently positive effects, especially for contingency-management interventions. This work was updated fifteen years later by DuPaul, Eckert, and Vilaro (2012), who examined the literature produced between 1996 and 2010 and confirmed the general direction of the earlier findings, indicating that academic interventions, not just behavioral ones, had been gaining ground in the more recent literature at the time. A reference manual by DuPaul himself, co-authored with Stoner (DuPaul & Stoner, 2014), consolidated these decades of research into a practical three-tier model of school assessment and intervention, compatible with the response-to-intervention model adopted across several U.S. school systems: universal strategies for the whole class, targeted strategies for at-risk groups, and intensive, individualized strategies for cases of greatest need.

The most comprehensive and methodologically diverse synthesis remains that of Moore and colleagues (2018), published in *Review of Education*. The authors systematically reviewed randomized controlled trials of non-pharmacological interventions for ADHD in the school setting, bringing

together 28 studies and more than 1,800 participants across eight intervention categories. The results, synthesized through meta-regression, show effects ranging from null to moderate depending on the outcome assessed: "beneficial effects ranging from no effect to medium effect sizes were reported for teacher- and parent-rated academic outcomes ($g = 0.30$ and $g = 0.37$)" (Moore et al., 2018). For inattention, effects were likewise small to moderate: "small beneficial effects were seen for inattention outcomes (teacher-reported $g = 0.33$; parent reported $g = 0.27$)" (Moore et al., 2018). Daily Report Card interventions — a protocol in which the teacher records the student's performance on a few observable behavioral goals throughout the day and shares that record with the family — showed the largest effect size among the categories assessed, around $g = 0.62$.

This result is consistent with earlier findings. The review by Fabiano and colleagues (2009), published in *Clinical Psychology Review*, had already synthesized evidence that behavioral school interventions — especially those combining a reward system, frequent feedback, and structured communication between school and family — produce moderate-to-large effects on disruptive behavior and classroom academic productivity, with effects consistent enough that the authors themselves classify them as a well-established practice, in the technical vocabulary used by reviews of evidence-based treatments.

One finding from the Moore and colleagues (2018) review deserves careful note, without being turned into a general rule: the authors identified suggestive evidence that tailoring the intervention to the recipient and delivering it within the classroom setting may contribute to better academic outcomes in certain contexts, although the review itself works with multiple synthesis methods and heterogeneous results across studies, which recommends caution before generalizing this finding to the full spectrum of possible interventions. Even so, it is a relevant indication that the existence of a formal protocol is not, on its own, sufficient to produce change: the ability of the responsible adult, usually the teacher, to adjust the intervention to a specific student's needs and sustain, over time, a cycle of observation, adjustment, and feedback appears to matter as much as the design of the intervention itself.

On the side of interventions aimed at secondary education, historically less studied than the early years, DuPaul and colleagues (2021), in a study published in the *Journal of School Psychology*, evaluated a multicomponent school intervention for adolescents with ADHD and observed improvement in academic, organizational, and social functioning. The growing interest in

adolescence is relevant because most of the classic literature on school interventions has focused on the early years of elementary school, leaving relatively unexplored the period when demands for organization, long-term planning, and autonomy increase sharply — precisely when students with ADHD tend to be at greater risk of falling behind and dropping out. Later work by Sibley and colleagues on organizational interventions for adolescents with ADHD, although conducted mostly outside the school setting proper, reinforces the same direction: planning and organizational skills can be explicitly taught and produce measurable gains, but they require practice distributed over time, not a single orientation session.

The Brazilian literature on school interventions

The Brazilian literature on school interventions for ADHD is smaller and less consolidated than the international literature, especially with respect to experimental studies and implementation evaluations. Even so, it exists and occupies distinct roles: some studies measure immediate gains in teacher knowledge, others assess adherence and ongoing management in small samples — a methodological heterogeneity worth spelling out before describing each study.

One of the Brazilian studies most cited in the international literature on the topic is Aguiar and colleagues (2014), published in the *Journal of Attention Disorders*: the authors applied a brief psychoeducational intervention to 37 teachers from four public elementary schools in Porto Alegre, measuring knowledge about ADHD and learning disorders before and after training. Knowledge increased significantly ($p < 0.001$), and the only significant predictor of improvement was the teacher's prior level of knowledge — that is, those who already knew more learned proportionally more. The authors themselves acknowledge the central limitation of this design: it measures knowledge gain immediately after the intervention, with no medium-term follow-up and no assessment of classroom practice change, and they recommend future studies to verify efficacy and lasting impact (Aguiar et al., 2014). The finding is therefore Brazilian, positive, and at the same time a direct example of the gap discussed throughout this article: it shows that one-off training can increase knowledge, but it does not test whether that knowledge is sustained or translates into practice.

The review by Santos and Albuquerque (2019), published in *Psicologia: Teoria e Prática*, is the most direct national reference on school interventions as such. Covering the period from 2000 to 2018 across national and international databases, the authors identified 33 eligible

articles on school interventions for ADHD, but only two of them conducted in Brazil. The rest originated mainly in the United States, a limitation the authors themselves point out: "papers that mostly originated in the United States. Thus, cultural differences that impact the school context should be taken into account" (Santos & Albuquerque, 2019).

The review's overall balance is favorable toward school interventions as a category: "all the interventions promoted an increase in the repertoire of students with ADHD," and, in the studies that measured behavioral outcomes directly, "the frequency of behaviors characteristic of this disorder diminished, while attention and concentration behaviors increased" (Santos & Albuquerque, 2019). The authors also note that, when well applied, these interventions "contribute to removing from the students' shoulders the full responsibility for their difficulties" (Santos & Albuquerque, 2019), shifting part of the weight of school failure away from the child and onto the environment and the pedagogical practice surrounding them.

The methodological limitations the authors themselves point out deserve mention, because they qualify the reach of these findings: only two of the seven studies published in the review's most recent period included ten or more participants; the quality criterion adopted for inclusion was, in essence, publication in a peer-reviewed journal, without more rigorous assessment of methodological design; and the 33 selected articles together used 29 different names for interventions, suggesting a poorly standardized field.

Even so, specific Brazilian studies exist on the development and implementation of behavioral management guides for teachers, though they are seldom cited outside the field of behavior analysis itself. Araújo (2012), in a doctoral dissertation defended at Universidade Presbiteriana Mackenzie, developed and evaluated a classroom behavioral-management guide for eight elementary school children in São Paulo identified with ADHD, grounded in stimulus-control and reinforcement strategies. The study recorded a decrease in the frequency of behaviors related to inattention and hyperactivity in the group whose teachers used the guide, compared to a control group, and observed a gradual increase in teacher adherence to the protocol over the weeks of application (Araújo, 2012). Ten years later, Gomes (2023), in a master's thesis at the University of Nebraska-Lincoln, tested the cultural adaptation of the U.S. Teachers and Parents as Partners (TAPP) program for the Brazilian context, with three first-grade children at a private school in São Paulo, assessing not only efficacy on non-compliance behaviors but also acceptability, adherence, and

satisfaction among teachers and families with the adapted program. The author concludes that "TAPP is a promising approach to intervening in children's non-compliance behavior in Brazil" (Gomes, 2023).

These two studies are relevant because, unlike most of the literature reviewed in this article, they directly assess teacher adherence to the protocol over time: not just whether the intervention works when applied by a researcher, but whether a teacher, in their own workplace, can sustain its application. Even so, they are small-scale studies, with samples of eight and three children respectively, conducted in specific contexts — a doctoral dissertation in behavior analysis and a master's thesis produced abroad on the adaptation of a U.S. program — which makes them promising initial evidence, not a sufficient basis for generalizing about the feasibility of this type of training across large Brazilian public school networks.

A second national reference, of a different nature, is the bibliographic survey by Alves, Lima, and Silva (2022), published in the journal *Ensino em Perspectivas*, which specifically examined the intersection between teacher training and ADHD in the database of the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes) between 2017 and 2021. The authors' diagnosis is direct: there is "a minimal amount of published work on the subject" (Alves et al., 2022), and, according to the researchers, teacher training on ADHD faces "many obstacles that need to be overcome" before it can effectively support the access of students with ADHD to quality education. This finding, obtained independently of the Santos and Albuquerque (2019) review and with a specific focus on teacher training, reinforces this article's central reading: to the scarcity of studies on school interventions in Brazil is added an even greater scarcity of national research focused specifically on how to train teachers to apply them.

The Brazilian literature acknowledges the problem and presents findings compatible, in some respects, with the international literature, but it has not yet accumulated a sufficient volume of controlled studies, with robust samples and systematic replication, to support public-policy recommendations with the same degree of confidence available in other countries. None of the references discussed above constitutes, on its own, a robust experimental basis, and they are not directly comparable to one another: Aguiar and colleagues (2014) measure immediate knowledge gain in 37 teachers, with no follow-up assessment; Araújo (2012) and Gomes (2023) assess teacher adherence and ongoing behavior management in small samples of eight and three children, respectively; Santos and

Albuquerque (2019) and Alves, Lima, and Silva (2022) are literature reviews, not primary studies.

What teacher training still does not cover

Initial training is the first point where the gap between research and practice tends to show up. Inclusive education in the training of Brazilian teachers has an older and more detailed curricular and legal foundation for the inclusion of students with sensory, physical, and intellectual disabilities than for ADHD, supported by decades of mobilization by the disability rights movement and consolidated by the 2008 National Policy on Special Education from the Perspective of Inclusive Education (Brazil, 2008). It remains insufficiently documented to what extent Brazilian teacher-preparation curricula specifically address ADHD content, a question that a direct curricular audit, covering a representative sample of training institutions, could answer.

The teacher-training literature reviewed in this article converges on three recurring points. The first is the predominance of simplified or common-sense biomedical knowledge about ADHD, with little understanding of the heterogeneity of presentations and associated comorbidities: the teacher learns that ADHD exists and has some neurological basis, but does not always learn to recognize, in practice, how it manifests differently across different students. The second is limited preparation for concrete pedagogical management: task planning, organization of materials, structuring transitions between activities, and frequent-feedback strategies rarely enter the curriculum with the degree of operational detail the classroom requires. The third is the risk of medicalizing school complaints, discussed in the Brazilian special-education and school-psychology literature under the label of the pathologization of school failure, a line of work associated with Collares and Moysés (1992) and, more recently, Signor, Berberian, and Santana (2017), for whom diagnosis often emerges from the school's own identification dynamics rather than preceding them. In both cases, the issue is the tendency to treat diagnosis as a sufficient, individual explanation for learning difficulties, shifting attention away from the curriculum and the structural conditions of teaching work.

These three points reinforce one another. A teacher who does not understand the heterogeneity of ADHD has a smaller repertoire for differentiating pedagogical strategies; the lack of that repertoire increases the likelihood that the observed difficulty will be attributed entirely to the student; and this individualizing attribution, in turn, reduces institutional

pressure to invest in more robust training, because the problem has supposedly already been explained by the diagnosis. Breaking this cycle requires, at the same time, more precise knowledge about the disorder and operational pedagogical tools, the first two pillars of the model proposed in Section 12.

Continuing training: the problem of knowledge retention

If initial training leaves gaps, it would be reasonable to expect continuing training to fill them over the course of a career. This happens only partially: the most common format, a one-off, informational workshop with no in-service follow-up component, has limited capacity to sustain practice change over time, for the theoretical reasons discussed in Section 3.4 and the empirical evidence gathered below.

Before examining studies that test the training itself, it is useful to establish the starting point: what teachers already know about ADHD without any specific training. Mohr-Jensen and colleagues (2019) answered this question with a nationally representative sample of 528 Danish primary and secondary school teachers. The results overturn a common assumption: between 79% and 96% of teachers correctly identified ADHD symptoms, and between 75% and 98% recognized effective classroom management strategies, depending on the item assessed, but only 56% correctly rejected diet as a cause of the disorder, and only 17% recognized that dietary interventions are not an effective treatment (Mohr-Jensen et al., 2019). The strongest predictor of correct knowledge was having received specific graduate-level training on the topic. This finding qualifies the discussion in this article: many teachers already recognize basic symptoms and management strategies, albeit unevenly and with specific pockets of misinformation, such as around dietary causes — exactly the kind of neuromyth discussed in Section 3.3. The open question is whether this surface-level recognition translates into systematic, sustained application.

The most robust evidence on this point comes from the meta-analysis by Ward, Bristow, Kovshoff, Cortese, and Kreppner (2022), published in the *Journal of Attention Disorders*. The authors systematically searched six electronic databases through April 2020, identifying 29 studies on ADHD teacher-training programs, of which 22 entered the quantitative synthesis. The central finding is numerical: the standardized mean difference (SMD) for teacher knowledge measured immediately after training was 1.96, a very large effect by the usual interpretive benchmarks for this statistic, dropping to -1.21 when the same teachers were reassessed at follow-up. For student

behavior, the immediate effect was more modest ($SMD = 0.78$) and, between different subjects, did not reach consistent significance ($SMD = 0.71$, with a confidence interval crossing zero). The authors' own conclusion, from the study abstract, is that training programs "may initially improve teacher knowledge," but there is "inconsistent evidence for their efficacy in reducing students' ADHD-type behaviors" (Ward et al., 2022).

The decline observed at follow-up should not automatically be interpreted as simple forgetting. It may reflect, among other factors, the absence of reinforcement or subsequent practice after training, differences between the instruments used at different assessment points, regression to the mean, and heterogeneity among the studies included in the meta-analysis; Ward and colleagues (2022) themselves report a moderate-to-high risk of bias in nearly all the studies analyzed, which recommends caution in interpreting the magnitude and stability of the reported effects. The pattern observed is, nonetheless, consistent with the theoretical hypothesis discussed in Section 3.5: without a mechanism for reinforcement, follow-up, or distributed practice, knowledge gains tend not to consolidate into stable competence, a hypothesis the studies gathered here do not isolate definitively, but which converges with the pattern observed by Latouche and Gascoigne (2019), discussed below.

For school systems planning to invest in ADHD training, this has a direct consequence: short-duration training programs evaluated in the reviewed literature produced knowledge gains that declined substantially at follow-up assessments, with even more uncertain behavioral effects on students. Continuing training models, contextualized within the school and followed up over time, with classroom observation, individualized feedback, review of real cases, and regular opportunities for peer exchange, have greater theoretical plausibility for favoring the transfer and maintenance of practices, in line with the characteristics of effective professional development described by Darling-Hammond and colleagues (2017). This is a hypothesis still insufficiently tested by direct comparisons in the specific field of ADHD, since the literature offers few controlled studies comparing this format to the single-workshop model.

Other studies, independent of the Ward and colleagues meta-analysis, converge on a similar diagnosis through different routes. Latouche and Gascoigne (2019), in a trial with 274 teachers from ten primary schools, found that a brief in-service workshop more than doubled teachers' knowledge and self-efficacy regarding ADHD immediately after the intervention, with that gain diminishing but remaining above baseline at

reassessment one month later (Latouche & Gascoigne, 2019). Syed and Hussein (2010) obtained a result in the opposite direction with a longer program: a full week of training produced a knowledge gain sustained through six-month follow-up among the 35 teachers who completed it, suggesting that the duration and intensity of the program may influence retention — a variable most of the studies reviewed in this article do not clearly isolate, but one that reinforces the reading that the format of training, not just its content, matters for outcomes.

Blotnicky-Gallant and colleagues (2015), in research with 113 teachers in Nova Scotia, Canada, found no significant correlation between teachers' specific knowledge about ADHD and their actual classroom management practices; what was associated with the use of evidence-based strategies was teachers' beliefs about the disorder, not factual knowledge measured by questionnaire (Blotnicky-Gallant et al., 2015). This result, reached through a methodological route distinct from Ward and colleagues but pointing in the same direction, offers empirical evidence that declarative knowledge alone is not necessarily associated with the use of evidence-based practices, empirically confirming Schön's (1983) theoretical argument about the limits of technical rationality in professional training.

Elik and colleagues (2015), in mapping the barriers that prevent trained teachers from applying evidence-based practices day to day — among them insufficient time, large class sizes, and the absence of ongoing support after training — proposed incorporating remote coaching as a component of the training design. This proposal was tested by Corkum and colleagues (2019) in a randomized controlled trial: a six-session online program, with a moderated discussion board and individual remote coaching, produced significant improvement in core ADHD symptoms as reported by teachers, though not replicated in parent reports, along with good acceptability among participants (Corkum et al., 2019). This is one of the few studies identified in this review that directly tests, in a controlled design, an ongoing-support component following initial training. The results are consistent with the hypothesis that this component favors the maintenance of gains, but the study's own design — a single trial, with an outcome not replicated across informants — does not allow the conclusion that follow-up support is, on its own, the decisive factor.

Evidence from outside the specific field of ADHD reinforces this direction while also imposing a realistic limit on expectations. Kraft, Blazar, and Hogan (2018), in a meta-analysis of the general educational literature on teacher coaching drawing on 60 studies with causal designs, found a pooled

effect of 0.49 standard deviations on instructional practices and 0.18 standard deviations on student academic achievement, sizable effects for professional-development interventions. The authors themselves, however, note that these effects were systematically smaller in studies conducted at larger scale than in small-scale efficacy studies (Kraft et al., 2018). This caveat is relevant to this article's argument: even an ongoing coaching component, which the ADHD-specific evidence suggests is more promising than a single workshop, does not by itself guarantee that results observed in controlled pilot studies will hold when the model is scaled up to entire school systems — a scale problem that adds to, rather than replaces, the format problem discussed throughout this section. This same caveat echoes, in another field, the implementation-science warning about the difference between pilot-study efficacy and large-scale effectiveness, discussed in Section 3.5.

The role of international bodies and the Brazilian regulatory framework

UNESCO frames the problem at a global scale: its 2020 Global Education Monitoring Report finds that education systems frequently fail to take into account the specific needs of different student profiles, and identifies insufficient teacher training as one of the central factors behind this failure (UNESCO, 2020). The OECD, in its 2017 Trends Shaping Education Spotlights series, names neurodiversity, including ADHD and autism spectrum disorder, as an explicit category of education policy, advocating teacher training capable of recognizing and responding to different learning profiles (OECD, 2017). The World Bank offers the most operational recommendation: that continuing training preferably take place within the school itself or clusters of schools, for greater impact and contextual specificity (World Bank, 2020) — the opposite format to the centralized, one-off event that, in the empirical literature reviewed above, is associated with rapid knowledge loss.

In Brazil, this international framework converges, in part, with national legislation that is more advanced than is usually recognized. Beyond the 2008 National Policy on Special Education and the 2015 Brazilian Law on the Inclusion of Persons with Disabilities (Brazil, 2008; Brazil, 2015), Law 14,254/2021 establishes, as noted in the introduction, an explicit mandate for continuing teacher training on the early identification of ADHD signs and the corresponding educational support (Brazil, 2021). The existence of this legal provision shifts the axis of the discussion: the problem is no longer the absence of a legal basis for ADHD teacher training, but the gap between this

regulatory obligation and its actual implementation, with quality and evidence, across school systems — a gap on which, as of this article's reference date, no nationwide implementation-evaluation study has been located.

Structural barriers to school implementation

Even when teacher training is adequate in content and format, its translation into practice runs into structural conditions that educational implementation literature usually treats separately from training itself, but that directly affect the outcome of any intervention — precisely the inner-setting and process domains described by Damschroder and colleagues' (2009) model in Section 3.5. Large class sizes reduce the feasibility of individualized strategies such as supervised self-monitoring or the Daily Report Card, which depend on regular teacher attention to a specific student. The absence of paid planning time limits the teacher's capacity to adapt materials and assessments with the lead time a well-designed intervention requires. The scarcity of support professionals — educational psychologists, school psychologists, specialized educational support teams — overburdens the classroom teacher with decisions that, in the original design of most of the interventions reviewed in this article, presuppose teamwork.

These factors help explain why, even in contexts with relatively robust teacher training, the effects of school interventions on academic outcomes tend to be more modest than their effects on behavioral outcomes confined to the classroom: changing a student's observable behavior during a single class period is a more tractable goal, given available resources, than sustaining learning gains over an entire school year, amid large classes and little institutional support.

Three levels of evidence the debate tends to conflate

A recurring conceptual problem in how ADHD teacher training is discussed, including in some of the popular literature on the topic, is treating as equivalent three levels of evidence that answer distinct questions. The first level is evidence about ADHD itself: prevalence, executive functioning, comorbidities, developmental course, discussed in Section 3. The second is evidence about school interventions: whether a given strategy, applied to a student with ADHD, produces measurable improvement in behavioral or academic outcomes. The third is evidence about teacher training: whether a

training program can get teachers to learn, correctly apply, and sustain these same strategies over time.

The fact that a school intervention has demonstrated efficacy does not automatically imply that teacher training on that intervention will produce a change in practice. The Ward and colleagues (2022) meta-analysis is particularly relevant to this transition between the second and third levels, showing more consistent effects on knowledge than on student behavior. The relationship between training and educational outcomes is not linear: knowledge acquired by the teacher needs to be converted into competence, applied under real working conditions, and maintained over time, and each of these stages can introduce barriers or modifications to the original intervention. Throughout this article, the term implementation fidelity is used in the sense implementation science assigns it, defined in Section 3.5: the degree to which the essential components of an intervention are applied as originally designed, without precluding justified contextual adaptations — one among several dimensions assessed in this field, alongside acceptability, feasibility, adoption, reach, and sustainability.

The literature is more consolidated regarding the characterization of ADHD and the evaluation of specific school interventions. Evidence on the conditions necessary for teachers to adopt, adapt, and maintain these practices in real school contexts is considerably scarcer. Treating these levels as equivalent allows for overly optimistic claims about the effect of an isolated course or lecture; distinguishing them makes it possible to formulate more precise research questions, such as those proposed in Section 13.

Competencies and limits of teacher practice

A proposal for ADHD teacher training must clearly demarcate the limits of the teacher's role: overstepping that boundary has concrete costs for the student and for the credibility of the training itself. It is the teacher's role to observe patterns of behavior and learning over time, systematically record those observations, structure the environment and the task according to management strategies with empirical evidence, explicitly teach organizational and self-regulation skills, monitor the effect of adaptations made, provide frequent feedback, and communicate clearly with the family and the pedagogical team. It is not the teacher's role to diagnose ADHD, interpret neuropsychological assessment results, prescribe or suggest medication adjustments, or turn a behavior pattern observed in class into an informal diagnostic label passed on to the family as though it were a clinical

conclusion. This distinction is rarely made explicit in the programs described in the sources consulted for this article, and it should be an explicit component of any teacher training on the topic, both to protect the student from premature diagnoses and to protect the teacher from responsibilities that are not theirs.

The British clinical guideline on ADHD, from the National Institute for Health and Care Excellence, draws this boundary in a way consistent with the proposal defended here: it recommends regular communication between health services and educational institutions about the effect of symptoms on school life, coexisting conditions, and educational needs, and lists concrete examples of environmental modifications the school should implement: positioning of the student in the classroom, reduction of distractions, instructions presented in writing, shorter periods of concentration interspersed with movement breaks, and support from assistants when available (NICE, 2018/2019). None of these items requires diagnostic competence from the teacher; all are, in practice, operational extensions of the first two training pillars described in the next section.

Elements for a model of ADHD teacher training

Based on the narrative synthesis carried out, four elements are proposed for a training model capable of translating into classroom practice, rather than remaining merely theoretical information. These elements constitute a conceptual proposal derived from the literature reviewed, not a model whose combined efficacy has already been empirically tested.

The first pillar is a functional foundation on what ADHD is and what it is not: distinguishing neurobiological symptoms from disciplinary behavior, understanding the heterogeneity of presentations and associated comorbidities, recognizing common neuromyths such as attributing the disorder to diet, and giving the teacher observation criteria they can communicate precisely to the family and the pedagogical team, always within the limits described in the previous section.

The second pillar is the repertoire of pedagogical management strategies with empirical evidence reviewed in this article: positive behavioral management, the Daily Report Card, explicit and segmented instruction, organizational supports, and self-regulation strategies. This is the point at which part of the programs described in the reviewed literature seems to show the greatest limitation, remaining at the level of diagnosis and not

advancing to the operational practice of lesson planning, assessment adaptation, and routine structuring.

The third pillar is the establishment of clear communication and referral protocols — between teacher and family, between teacher and the multiprofessional team, between teacher and school management — so that this communication does not depend on each teacher's individual initiative and does not vary arbitrarily between classes within the same school or school system.

The fourth pillar is continuity: pedagogical supervision, classroom observation, review of real cases, and regular opportunities for exchange among teachers throughout the school year have greater plausibility for sustaining practice change than an isolated workshop at the start of the semester, in line with the characteristics of effective professional development discussed in Section 3.4. This one-off format was associated, in the Ward and colleagues (2022) meta-analysis, with substantial knowledge loss at follow-up and no convincing evidence of a lasting behavioral effect on students.

The four elements should be considered in an integrated way, sustained over time, forming the conceptual proposal presented in this article, distinct from the one-off formats described in part of the reviewed literature.

Research agenda

The reviewed literature allows for proposing three research fronts organized around the distinction discussed earlier between intervention efficacy, teacher-training efficacy, and implementation effectiveness. The first is a training-effectiveness agenda: testing, with controlled designs, specific ADHD teacher-training programs in the Brazilian context, something the review by Alves, Lima, and Silva (2022) suggests is still scarce in the national literature. The second is an implementation agenda, aimed at assessing the acceptability, feasibility, fidelity, and sustainability of the strategies learned when applied under real classroom conditions — large classes, public school systems with unequal resources, frequent absence of support staff — rather than only under controlled research conditions. The third is an outcomes agenda, which goes beyond measuring whether the teacher learned certain content and instead measures whether the teacher changed their practice in an observable way and, ultimately, whether the student benefited from that change in terms of learning, participation, and school retention.

A particularly promising research object, arising directly from this article's argument, is the evaluation of the implementation of Law 14,254/2021 across Brazilian school systems: to what extent education systems have actually been offering the continuing training required under Article 5 of the law, in what format, and with what evidence of effect on teaching practice and on students. At least over the course of the survey conducted for this article, no published studies were identified that evaluated, on a national scale, the implementation of Law 14,254/2021 in this specific respect; this absence reflects the limits of the search undertaken here, which was not systematic and had no formal tracking protocol, and should not be read as definitive proof that such an evaluation does not exist in the Brazilian literature.

A fourth front, complementary to the previous three, follows directly from the theoretical framework presented in Section 3: research that explicitly applies implementation-science tools, such as the Consolidated Framework for Implementation Research (Damschroder et al., 2009), to the study of ADHD teacher training in Brazil, systematically mapping which contextual, organizational, and process determinants favor or hinder the translation of training into sustained practice. This approach would allow more rigorous comparison across school systems than the informal comparison of isolated programs the current literature offers.

Limitations of this essay

This article has limitations that should be acknowledged with the same candor with which the reviewed literature acknowledges its own. The review conducted is narrative and critical, not systematic, without a pre-registered search-and-selection protocol; it is possible that relevant studies, especially in lower-indexed journals or gray literature, were not located. The temporal restriction to sources published through November 2024, adopted for consistency with this text's reference date, also left out later developments in Brazilian education policy and national academic production, which deserve analysis in future work. The international literature reviewed is predominantly American and British, a limitation Santos and Albuquerque (2019) themselves had already identified for the body of work on this topic as a whole, which calls for caution in directly transposing findings to the reality of Brazilian schools, with their regional diversity and unequal resources across school systems. Finally, the characterization of Brazilian initial teacher training presented in this article relies on the literature consulted, not on the author's own documentary analysis of teacher-preparation curricula, which keeps it at the level of a plausible hypothesis

rather than an empirically demonstrated finding of this work. Likewise, the four-pillar model proposed in Section 12 is a conceptual synthesis derived from the literature, not a program already tested in a controlled design; at this stage, its main usefulness is to guide future research design, not to substitute for the empirical validation still lacking.

Concluding remarks

The international literature on school interventions for ADHD is substantial and points to concrete pedagogical management paths with favorable evidence, from positive behavioral management to the Daily Report Card, along with organizational supports and self-regulation strategies, although it remains heterogeneous with regard to components, outcomes, and application contexts. Research on teacher training presents a less consistent picture: teaching about the disorder is not the same as preparing a teacher to act on it in a sustained way. Short-duration training programs evaluated in the reviewed literature produce knowledge gains that can decline substantially at follow-up, and the available evidence on lasting behavioral effects on students remains inconsistent.

The gap identified in this article does not lie in an absence of scientific knowledge. The reviewed literature indicates that such knowledge exists, is accessible, and has been produced systematically for nearly three decades, both regarding the neurobiology and cognition of ADHD and regarding effective school interventions. Nor does it lie in an absence of legal provision, since Law 14,254/2021 establishes an explicit mandate for continuing training on the topic. It lies in the still-limited evidence on how to convert this knowledge and this regulatory obligation into sustained teaching competence and faithful classroom implementation, with the potential to produce better educational outcomes for the student. The theoretical frameworks discussed in this article, from the cognitive psychology of ADHD to implementation science, help explain why this conversion is not automatic: declarative knowledge and situated classroom practice are related but distinct constructs, and moving from one to the other depends on organizational conditions that rarely form part of the design of the training offered.

Continuing training models, contextualized within the school and followed up over time, hold greater plausibility for favoring this transfer than exclusively one-off training interventions, although this hypothesis still awaits direct, systematic testing, particularly in the Brazilian context. For national research, the central question this review leaves open is no longer

whether ADHD teacher training should take place, but whether, how, and under what conditions it produces sustained practice change under the real conditions of the country's schools. Answering that question calls for less a new course and more a new kind of research: studies that follow teachers over time, in their own schools, assessing not just what they learned, but what they do differently in the classroom, and whether that difference actually reaches the student.

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AUTHOR CONTRIBUTION

Fábia Aparecida Silva: conceptualization, investigation, data curation, formal analysis, methodology, writing of the original manuscript, and review and editing.

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ETHICAL APPROVAL

Not applicable. The study is a critical narrative literature review and did not involve human participants, identifiable personal data, or animal experimentation.

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