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Embodied PDP and PEI: Neuro-Sensory Observation, Cognitive Sustainability, and Inclusive Educational Design. An Analysis of Three Longitudinal Case Studies

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Abstract: This paper proposes an embodied reinterpretation of Individualized Education Plans (IEPs) and Personalized Learning Plans (PDPs) within inclusive school contexts. Starting from the risk that these tools may be reduced to bureaucratic or compensatory documents, the study argues for a pedagogical shift toward a dynamic, relational and transformative understanding of educational planning. The theoretical framework integrates special pedagogy, embodied cognition, sensory gating and cognitive sustainability, highlighting the role of the body, perception, sensory regulation and environmental conditions in learning processes. The research explores how neuro-sensory observation can support a deeper understanding of students' functioning, with particular attention to sensory thresholds, overload signals, attentional regulation and spontaneous self-regulatory strategies. Through the analysis of three longitudinal case studies, the paper examines how embodied strategies integrated into PDPs and IEPs may foster school well-being, emotional self-regulation, participation and learning outcomes. The findings suggest that inclusive planning should not merely adapt contents or assessment procedures but should transform the neuroecological quality of learning environments. The paper concludes that cognitively sustainable schools require pedagogical tools capable of recognizing students' cognitive, emotional, bodily and sensory complexity as essential dimensions of access, participation and inclusion.

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Introduction

In the contemporary debate on inclusive education, the Personalized Learning Plan (PDP) and the Individualized Educational Plan (PEI) represent two key instruments for individualizing and personalizing learning pathways and promoting the participation of students with Special Educational Needs (SEN). From both pedagogical and legal perspectives, their function should not be limited to the provi-

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sion of compensatory or dispensatory measures, nor to the mere formal documentation of educational interventions. Rather, the PDP and the PEI should be understood as dynamic tools for interpreting the student's overall functioning, capable of integrating cognitive, emotional, bodily, sensory, relational, and contextual dimensions.

In everyday school practice, however, these instruments are often used in a predominantly administrative, reductionist, and deterministic manner. As a result, personalization is frequently interpreted as a series of accommodations implemented in response to identified difficulties, rather than as a transformative educational design that critically examines the learning environment, modifies educational conditions, and acknowledges the complexity of students' neuropsychological functioning. From this perspective, the Personalized Learning Plan should be regarded not merely as a technical tool for compensation but as a dynamic, relational, and transformative pedagogical framework capable of fostering authentic inclusion when embedded within a systemic understanding of both the student and the educational context (Damiani & Gomez Paloma, 2022).

This limitation becomes particularly evident when learning and participation difficulties are not solely attributable to cognitive or academic factors but are closely associated with complex sensory, attentional, self-regulatory, and emotional profiles. For many students with neurodevelopmental disorders, neurodivergent profiles, sensory hypersensitivity, emotional vulnerabilities, or atypical cognitive functioning, access to learning is profoundly influenced by the quality of environmental stimuli, processing time, background noise, the relational density of the classroom, evaluative pressure, the predictability of instructional activities, opportunities to use bodily self-regulation strategies, and, more broadly, the overall cognitive sustainability of the school environment.

In light of these considerations, this article proposes a reinterpretation of the meanings and educational practices associated with the PDP and the PEI from an embodied perspective, considering the body, perception, movement, sensory regulation, and situated experience as constitutive dimensions of learning processes. The underlying assumption is that inclusive educational planning should move beyond an exclusively performance-oriented and discipline-centered conception of personalization toward an ecological, systemic, and neuro-sensory understanding of student functioning.

The Embodied Cognition paradigm provides a theoretical framework for understanding learning as an embodied, situated, and relational process. Within this perspective, the body is not merely the biological substrate of the mind but an active structure through which meaning is constructed (Priore, 2022). Knowledge does not emerge solely through abstract and disembodied cognitive processes; rather, it develops through the continuous interaction among the organism, the environment, action, perception, and emotion (Varela, Thompson, & Rosch, 1991; Wilson, 2002). Applying this perspective to inclusive educational design means recognizing that students learn through their bodies, their sensory experiences, their postures, rhythms, tensions, movements, relationships, and the concrete conditions in which schooling takes place.

Accordingly, this article explores how the PDP and the PEI can be reconceptualized as embodied pedagogical frameworks capable of integrating the observation of students' sensory profiles, attentional processes, indicators of cognitive and sensory overload, spontaneous self-regulation strategies, and the environmental conditions that facilitate or hinder participation and learning. This perspective is developed through an interdisciplinary theoretical framework that brings together special education, educational neuroscience, embodied cognition, sensory gating, and cognitive sustainability, and is illustrated through the analysis of three longitudinal case studies conducted in different educational settings.

The aim is neither to propose a clinical-diagnostic model nor to transform teachers into neuropsychological assessors. Rather, the objective is to broaden the pedagogical perspective so that educational observation extends beyond students' observable academic difficulties to include the bodily, sensory, and emotional conditions that enable, or constrain, participation and learning. From this standpoint, the article argues that a truly inclusive school cannot be limited to adapting assignments and assessment procedures; instead, it must critically examine the neuroecological quality of the learning environment as a fundamental condition for meaningful educational inclusion.

1. Theoretical Framework: Moving Beyond the Compensatory Approach to the PDP and PEI

The Personalized Learning Plan (PDP) and the Individualized Educational Plan (PEI) are distinct educational planning tools with different target populations, legal frameworks, and organizational structures. However, they share a fundamental pedagogical purpose: to make explicit the relationship between the student's functioning, the educational context, existing barriers and facilitators, and instructional planning. The PDP is generally designed for students with Specific Learning Disorders (SLDs) or other Special Educational Needs (SEN) that are not necessarily formally diagnosed or certified under Italian Law 104/1992, whereas the PEI is the educational planning document developed for students with certified disabilities and is prepared within the framework of the Operational Working Group for Inclusion.

In both cases, personalization should not be understood as lowering educational expectations or simplifying the curriculum. Rather, it should involve creating conditions of accessibility that foster the development of students' capabilities and ensure their freedom to achieve meaningful functioning, in line with the capability approach. Accessibility, therefore, extends beyond instructional materials or compensatory tools to encompass the entire learning ecosystem, including time, space, interpersonal relationships, communication methods, classroom organization, perceptual channels, attentional demands, cognitive load, emotional regulation, and opportunities for active participation.

A common limitation is the tendency to complete PDPs and PEIs using standardized templates, in which educational accommodations are selected almost automatically, for example, providing additional time, concept maps, scheduled oral assessments, reduced workload, computer use, or simplified instructions. Although these measures are often beneficial, they are insufficient unless they are preceded by

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a thorough understanding of how the student perceives, processes, regulates, and experiences the school environment. From this perspective, the PDP should be regarded as a generative planning framework, within which schools, families, and the broader educational community collaboratively develop strategies that are genuinely inclusive rather than merely compensatory (Damiani, 2014; Damiani & Gomez Paloma, 2022).

A truly inclusive educational design instead requires an ecological understanding of student functioning. This means moving beyond the question, "What is the student unable to do?" and instead asking, "Under what conditions is the student able to participate?" "Which stimuli facilitate or hinder attention?" "Which bodily signals indicate cognitive or emotional overload?" "What spontaneous self-regulation strategies does the student employ?" "Which modifications to the learning environment reduce cognitive and emotional demands?" and "Which bodily, sensory, and relational mediators facilitate access to learning?"

From this perspective, both the PDP and the PEI become transformative educational tools, because they do not merely seek to adapt students to the school environment; rather, they challenge schools to transform their own practices of observation, organization, and educational planning.

2. Embodied Cognition and Situated Learning

Embodied Cognition emerged as a critique of classical cognitivist models, which conceptualize the mind as a symbolic information-processing system operating independently of the body and the environment. A pivotal contribution to this perspective was provided by Varela, Thompson, and Rosch, who proposed a view of cognition as an embodied and enactive process. According to this framework, knowledge arises through an individual's actions in the world and through the dynamic interaction between the organism and its environment (Varela, Thompson, & Rosch, 1991).

Wilson summarized several core assumptions of embodied cognition: cognition is situated, unfolds in real time, is offloaded onto the environment, is action-oriented, and, even when it appears to occur independently of immediate movement, remains grounded in bodily and sensorimotor structures (Wilson, 2002). These assumptions are particularly relevant to educational contexts, where learning is still frequently conceived as the transmission and acquisition of abstract knowledge. In contrast, everyday classroom experience demonstrates that attention, memory, comprehension, participation, and motivation are profoundly influenced by posture, movement, spatial organization, bodily rhythms, sensory perception, and the quality of interpersonal relationships.

Applying embodied cognition to inclusive education means recognizing that learning is not merely a mental process but a situated experience emerging from the interaction between the body, the environment, and meaning (Magnanini et al., 2024; Lo Piccolo et al., 2024). A student who struggles to sustain attention in a noisy classroom, becomes overwhelmed during an assessment because of emotional overload, needs to move in order to regulate arousal, has difficulty tolerating bright lights or tactile stimuli, or performs better when instructions are accompanied by visual or

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motor supports is not simply displaying an individual deficit. Rather, the student is expressing a distinctive way of engaging with and experiencing the school environment (Ciccarelli et al., 2024).

This perspective shifts the focus from deficit to the relationship between individual functioning and the environment. Difficulties are not denied; instead, they are understood as the outcome of dynamic interactions, consistent with the biopsychosocial model and the International Classification of Functioning, Disability and Health (ICF) (WHO, 2001). Consequently, educational planning moves beyond merely compensating for performance deficits and instead addresses the embodied conditions of learning. This includes the intentional organization of physical space, the incorporation of movement breaks, the use of transition rituals, the reduction of environmental noise, the anticipation of classroom activities, the modulation of sensory stimuli, the integration of multimodal instructional approaches, hands-on learning experiences, cooperative learning, body-mediated teaching strategies, and the promotion of self-regulation skills.

3. Sensory Gating, Attention, and Self-Regulation

The concept of sensory gating refers to the neurophysiological process through which the nervous system selects, filters, and organizes environmental stimuli, enabling individuals to regulate attention and modulate cognitive load. More specifically, sensory gating allows relevant stimuli to be distinguished from redundant or interfering information. When this process functions efficiently, individuals can allocate their attentional resources to task-relevant information. Conversely, when sensory filtering is inefficient or impaired, individuals may experience cognitive overload, distractibility, irritability, fatigue, anxiety, or difficulties with self-regulation.

The neuroscience literature has primarily investigated sensory gating using electrophysiological paradigms such as P50, N100, and P200 suppression. Studies involving children with sensory processing disorders have identified developmental differences in sensory gating performance compared with typically developing peers, suggesting a relationship between sensory processing difficulties and early-stage stimulus filtering mechanisms (Davies, Chang, & Gavin, 2009). Other studies have examined the relationship between sensory gating, attention, behavioral inhibition, and working memory, highlighting the close connection between basic sensory processing mechanisms and higher-order cognitive functions (Lijffijt et al., 2009; Yadon et al., 2009).

Within educational settings, however, these dimensions are rarely considered systematically. Schools often assess attention solely through observable behavior: whether a student listens or does not listen, looks at the teacher or looks away, remains seated or moves around, completes a task or fails to do so. Far less attention is paid to the sensory processes that precede and shape these behaviors. A student may appear inattentive not because of a lack of motivation, but because background noise, lighting conditions, physical proximity, the density of visual stimuli, or the duration of sustained attentional demands exceed the student's threshold of cognitive and sensory sustainability. Likewise, oppositional behavior may represent a maladaptive attempt to escape an unrecognized state of sensory or cognitive overload.

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Integrating the concept of sensory gating into educational planning does not imply the medicalization of teaching practice. Rather, it enriches pedagogical observation by encouraging educators to ask which environmental stimuli interfere with learning, which contextual conditions facilitate regulation, which early warning signs precede episodes of dysregulation, which embodied self-regulation strategies students spontaneously employ, and which environmental adaptations can effectively prevent sensory and cognitive overload.

4. Sensory Profiles and Dunn's Model

Winnie Dunn's work has made a particularly significant contribution to understanding the diversity of sensory processing profiles. Her model distinguishes between high and low neurological thresholds and passive and active behavioral responses, identifying four distinct sensory processing patterns: low registration, sensory seeking, sensory sensitivity, and sensory avoiding (Dunn, 1997, 1999). This framework helps explain why different students respond differently to the same educational environment: some appear largely unaware of sensory stimuli, whereas others actively seek them; some are easily distracted, whereas others deliberately avoid situations they perceive as overwhelming.

Within educational settings, Dunn's model is particularly valuable because it enables educators to move beyond moralistic interpretations of student behavior, thereby challenging common prejudices and biases. A student who is constantly moving may be perceived as "restless" or "disruptive," but this behavior may instead represent an attempt to seek proprioceptive and vestibular input in order to maintain an optimal level of arousal. Similarly, a student who avoids particular activities may be viewed as "uncooperative," whereas the behavior may actually reflect a low sensory threshold for tactile, auditory, or social stimuli. Likewise, a student who appears passive may not be disengaged but may instead experience difficulties in registering and organizing sensory information effectively.

From an embodied perspective, the Personalized Learning Plan (PDP) and the Individualized Educational Plan (PEI) should therefore include a pedagogical description of the student's sensory profile, not as a diagnostic label, but as an observational hypothesis that supports the design of accessible learning environments. At a minimum, this description should address four key dimensions: sensory thresholds, tolerance to environmental stimuli, indicators of sensory overload, and self-regulation strategies. A further essential dimension concerns the relationship between sensory regulation and active participation. Specifically, educational planning should consider questions such as: Under which conditions does the student participate most effectively? At what moments does withdrawal occur? Which environmental conditions promote engagement? Which sensory stimuli contribute to disorganization? These questions provide valuable guidance for designing learning environments that are responsive to students' individual sensory and regulatory needs.

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5. Executive Functions and Cognitive Sustainability

Executive functions comprise a set of higher-order cognitive processes involved in the regulation of goal-directed behavior. The literature identifies working memory, inhibitory control, and cognitive flexibility as their core components. Diamond has emphasized that these executive functions are fundamental for learning, self-regulation, problem solving, and social behavior (Diamond, 2013). Likewise, Miyake and colleagues clarified both the unitary and differentiated nature of executive functions, demonstrating that although they share common underlying processes, they also possess distinct functional characteristics (Miyake et al., 2000).

The relationship between executive functions and the school environment is of central importance. Many school tasks impose substantial executive demands: listening to explanations, retaining instructions in working memory, inhibiting distractions, shifting between activities, organizing materials, planning responses, sustaining attention, monitoring errors, and regulating frustration. For some students, particularly those with neurodevelopmental disorders or vulnerabilities in self-regulation, these executive demands may become excessive.

This consideration gives rise to the concept of cognitive sustainability, defined as the capacity of the educational environment to modulate the cognitive, emotional, and sensory demands placed on students, thereby promoting conditions of balance, accessibility, and neuropsychological well-being (Morsanuto, 2025). A cognitively sustainable environment is not a simplified or impoverished one; rather, it is intentionally designed to be clear, predictable, well-regulated, multimodal, responsive to individual processing times, capable of minimizing unnecessary interfering stimuli, and supportive of self-regulation strategies.

Cognitive sustainability therefore represents a fundamental design principle for both the Personalized Learning Plan (PDP) and the Individualized Educational Plan (PEI). It is not sufficient simply to acknowledge that a student requires additional time; educators must also understand why that additional time is necessary. Likewise, it is not enough merely to provide concept maps; it is essential to determine whether they reduce working memory demands, facilitate visual organization, support response planning, or compensate for language-related difficulties. Similarly, allowing breaks is insufficient unless they are embedded within a broader strategy aimed at regulating attentional and emotional load.

From this perspective, personalization cannot be reduced to the mere provision of accommodations or instructional tools. Instead, it should be understood as the ecological design of the learning experience, in which educational planning intentionally aligns instructional demands with the student's functional profile to foster meaningful participation, accessibility, and learning.

6. Research Questions

The research question guiding this study can be formulated as follows:

How can an embodied reinterpretation of the Personalized Learning Plan (PDP) and the Individualized Educational Plan (PEI), grounded in neuro-sensory observation, sensory gating, and cognitive sustainability, contribute to improving

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school well-being, emotional self-regulation, participation, and learning outcomes among students with complex functional profiles?

Several specific research questions stem from this overarching question.

The first concerns the pedagogical indicators that enable educators to observe students' sensory and self-regulatory profiles within the school context. This issue is central because educational observation cannot be limited to academic performance or observable behavior but should also encompass sensory thresholds, tolerance to environmental stimuli, signs of sensory overload, and embodied self-regulation strategies (Dunn, 1997, 1999).

The second question addresses the ways in which environmental, relational, and organizational conditions influence the cognitive sustainability of the learning experience. This dimension is particularly relevant in light of research on executive functions, which demonstrates that attention, working memory, inhibitory control, and cognitive flexibility are strongly influenced by contextual demands (Miyake et al., 2000; Diamond, 2013).

The third question concerns the embodied strategies that can be integrated into the PDP and PEI in order to transform personalization from a predominantly compensatory practice into an inclusive educational design. From this perspective, the body, movement, perception, and interpersonal relationships become fundamental pedagogical mediators of learning (Varela, Thompson, & Rosch, 1991; Wilson, 2002).

The fourth question explores the recurring patterns emerging from the longitudinal analysis of three educational pathways in which neuro-sensory observation and embodied regulation strategies were systematically implemented.

The interpretative hypothesis underlying this study is that integrating neuro-sensory indicators and embodied strategies into educational planning can promote greater alignment between students' functional profiles and their learning environments, thereby reducing cognitive overload, enhancing participation, and progressively supporting learning outcomes.

7. Methodology

This study adopts a qualitative exploratory design based on the analysis of three longitudinal case studies. The case study methodology is consistent with the aim of gaining an in-depth understanding of complex, situated educational processes that cannot be reduced to isolated variables. Rather than experimentally measuring the effectiveness of a standardized intervention, the study seeks to reconstruct how an embodied and neuro-sensory approach to educational observation can inform educational planning within authentic school contexts.

The longitudinal nature of the cases makes it possible to examine the evolution of students' profiles over time, relating educational strategies, environmental modifications, levels of participation, school well-being, self-regulation, and learning outcomes. Two cases involve students who were followed throughout the entire five-year upper secondary school program, whereas the third case concerns a student monitored during the three-year lower secondary school cycle.

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Data sources included longitudinal pedagogical observations, analysis of educational documentation, monitoring of academic progress, recording of critical incidents, consultations with teachers and educational professionals, observation of students' spontaneous self-regulation strategies, and analysis of modifications implemented within the learning environment.

Consistent with the embodied perspective, observation extended beyond academic performance to include bodily signals, patterns of activation, posture, responses to sensory stimuli, tolerance thresholds, reactions to unexpected changes, task persistence, sensory seeking or avoidance behaviors, anxiety levels, and participation in classroom activities.

The neuro-sensory pedagogical observation was organized around four main domains. The first concerned the sensory threshold, understood as the student's level of tolerance to auditory, visual, tactile, proprioceptive, vestibular, and social stimuli. The second focused on signs of overload, namely bodily, emotional, or behavioral indicators that preceded episodes of dysregulation. The third domain examined spontaneous self-regulation strategies, including movement, temporary withdrawal, object manipulation, deep-pressure seeking, scheduled pauses, and preparatory rituals. The fourth domain concerned the attentional profile, which was conceptualized not as a fixed individual trait but as a context-dependent function influenced by environmental conditions.

The strategies implemented across the three cases were not applied as a rigid protocol but were individually tailored to each student's functional profile and educational context. These strategies included advance preparation for learning activities, simplification of instructions without reducing curricular complexity, visual organization of tasks, flexible time management, scheduled movement and self-regulation breaks, use of visual supports and graphic organizers, reduction of environmental sensory overload, establishment of predictable routines, incorporation of students' specific interests, relational mediation, breathing and emotional regulation techniques, biofeedback in selected situations, adaptation of assessment methods, and collaborative educational planning with the teaching team.

The study has several limitations. The small number of cases does not allow for statistical generalization. Furthermore, the observational and longitudinal nature of the design makes it possible to identify plausible relationships between educational strategies and observed changes but does not permit definitive causal inferences. In addition, the cases are embedded within specific educational contexts characterized by particular resources, professional expertise, and organizational conditions that may not be directly replicable elsewhere. Nevertheless, the strength of the case study methodology lies in its capacity to generate context-sensitive pedagogical knowledge, providing hypotheses, interpretative frameworks, and observational tools that may be transferable to other educational settings.

7.1 Case Analysis

Case 1. The Sensory Personalized Learning Plan as a Framework for Learning and Emotional Regulation: A Longitudinal Case Study of a Student with Autism Spectrum Disorder

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The case concerns a young person with Autism Spectrum Disorder (ASD) without intellectual disability, characterized by age-appropriate cognitive functioning and marked sensory hyperreactivity. The student attended a five-year music and dance high school (Liceo Coreutico e Musicale), successfully completed upper secondary education by obtaining a standard high school diploma, and is currently continuing his education at a Conservatory of Music, where he studies classical guitar.

The longitudinal analysis focused on academic performance, emotional regulation, and the student's ability to recognize, differentiate, and verbalize his personal emotional experiences. The findings indicated that the observed difficulties were not attributable to cognitive impairment but rather to the dynamic interaction among instructional demands, methods of content presentation and assessment, emotional states, and characteristics of sensory processing. Altered responsiveness to environmental stimuli represents a clinically significant feature of Autism Spectrum Disorder and may manifest as heightened responses to auditory, visual, tactile, or proprioceptive stimuli, influencing arousal, attention, adaptive behavior, and participation in school activities (American Psychiatric Association, 2022; Patil et al., 2023). Educational research further demonstrates that differences in sensory processing are associated with the emotional, behavioral, and academic outcomes of autistic students, particularly in contexts characterized by high sensory density, unpredictability, and multiple simultaneous demands (Ashburner, Ziviani, & Rodger, 2008). Likewise, qualitative studies involving autistic adolescents have shown that sensory sensitivities, especially auditory hypersensitivity, can directly interfere with learning and make the school experience exhausting and aversive (Howe & Stagg, 2016).

In light of these considerations, the Sensory Personalized Learning Plan (Sensory PDP) served as the overarching framework for the student's entire educational pathway. It moved beyond a merely compensatory or administrative conception of the Personalized Learning Plan and assumed the role of a clinical-pedagogical, instructional, and organizational framework, integrating the student's functional profile with curricular objectives, environmental conditions, instructional strategies, assessment methods, sensory regulation interventions, and work on emotional awareness. This approach is consistent with an educational design aimed at removing barriers to learning and participation, in accordance with the principles of Universal Design for Learning (UDL), which advocate multiple means of engagement, representation, action, and expression without lowering curricular expectations (CAST, 2024).

During the third year of upper secondary school, the introduction of philosophy, a new subject characterized by a high level of conceptual abstraction, was associated with a marked decline in academic performance. Broad and open-ended assignments, the need to independently organize large amounts of information, and the unpredictability of oral examinations substantially increased cognitive, sensory, and emotional load, preventing the student from fully demonstrating his knowledge.

To address these difficulties, the Sensory PDP incorporated instructional materials in PDF format that were organized according to a clear, stable, and predictable structure. This enabled the student to consult the material at his own pace, identify essential information, reduce perceptually distracting elements, and establish consistent visual references to support study organization. The assessment system was

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also redesigned, prioritizing written examinations consisting primarily of closed-ended questions accompanied by a limited number of open-ended items formulated in a direct, unambiguous, and well-defined manner. These modifications did not simplify the curricular objectives but rather changed the modality through which the student could access the assessment and demonstrate learning, thereby reducing ambiguity, minimizing demands for spontaneous planning, lowering communicative pressure, and limiting the impact of anxiety on performance.

The progressive improvement in philosophy confirmed that the student's difficulties did not lie in understanding the subject matter but rather in the mismatch between his functional profile and conventional methods of teaching and assessment. Consequently, the Sensory PDP transformed observations of the student's functioning into a coordinated system of educational decisions, defining not only what should be taught and assessed but also under which environmental conditions, through which instructional mediators, with what degree of structure, and through which forms of assessment and feedback.

During the fifth and final year, the educational plan was further expanded to prioritize emotional regulation. Anxiety, which the student initially failed to recognize as an emotional experience, tended instead to manifest through somatic symptoms such as dizziness, abdominal pain, and a generalized sense of physical discomfort. The literature consistently documents a high prevalence of anxiety symptoms and anxiety disorders among autistic children and adolescents and highlights a significant association between anxiety and sensory over-responsivity, while also emphasizing the complexity and likely bidirectional nature of this relationship (Green & Ben-Sasson, 2010; van Steensel, Bögels, & Perrin, 2011; Vasa et al., 2020). Within this framework, sensory hyperactivation may contribute to increased anxiety, while anxiety, in turn, may further lower the threshold for tolerating sensory stimulation, thereby creating a reciprocal cycle of amplification.

Accordingly, the educational project outlined in the Sensory PDP integrated subject-specific learning with systematic work on recognizing bodily signals, establishing connections among physical sensations, situations, and emotions, expanding emotional vocabulary, communicating emotional distress, anticipating classroom activities, increasing the predictability of assessments, scheduling planned breaks, and allowing the reduction or modulation of non-essential environmental stimuli.

The bodily dimension was therefore not regarded as separate from academic performance but rather as an integral component of learning and self-regulation. Somatic symptoms were progressively reinterpreted as early indicators of emotional or sensory overload, enabling the student to recognize his internal state more promptly and activate self-regulation strategies before discomfort became overwhelming.

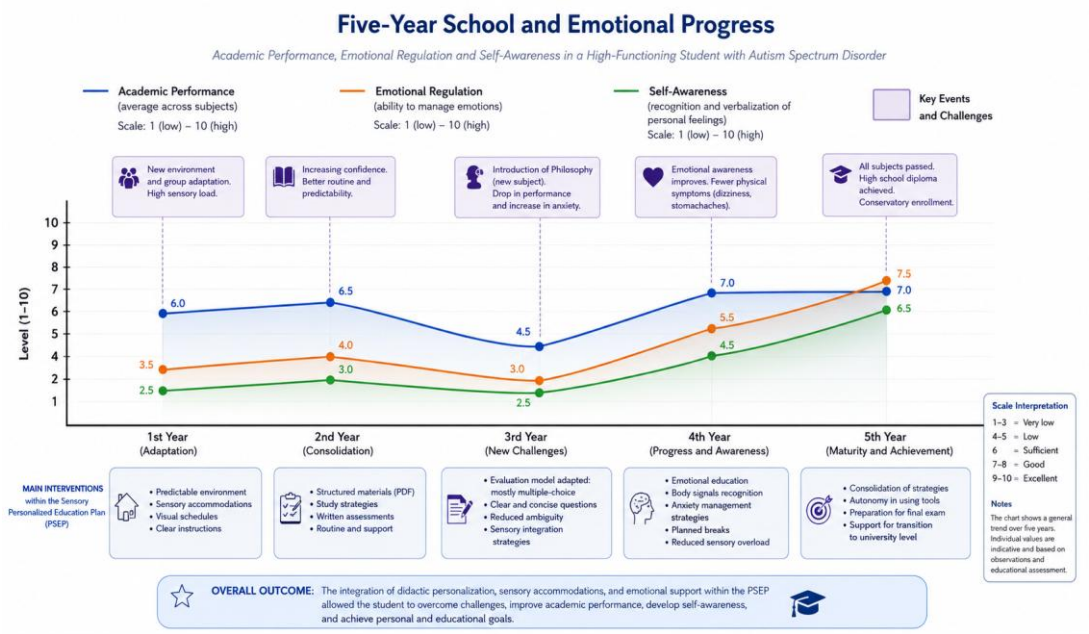
In this way, the Sensory Personalized Learning Plan evolved into a dynamic and continuously monitored framework capable of integrating curricular, sensory, emotional, bodily, and relational dimensions while ensuring coherence among observed needs, educational objectives, instructional strategies, support measures, and assessment criteria. This perspective is also consistent with the Italian Ministry of Education's guidelines on Special Educational Needs, which emphasize that personalized educational planning should be developed collaboratively and explicitly specify in-

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tervention strategies, instructional tools, assessment criteria, and shared educational actions, thereby preventing the PDP from becoming merely a checklist of compensatory and dispensatory measures (Ministero dell'Istruzione, dell'Università e della Ricerca, 2012, 2013).

The final outcome of the educational pathway, characterized by successful achievement of passing grades in all subjects, completion of the national upper secondary school examination according to the standard curriculum, and subsequent enrollment in the Conservatory of Music, demonstrates that a Sensory Personalized Learning Plan, conceived as the overarching framework for the entire educational project, can support not only improvements in academic performance but also the development of bodily and emotional awareness, self-regulation skills, autonomy, and the capacity to construct a life project consistent with the individual's abilities and personal interests.

Overall, this case confirms that educational personalization does not entail lowering academic expectations. Rather, it involves creating conditions of accessibility and equity that minimize the impact of environmental, sensory, and assessment-related barriers, thereby enabling students to demonstrate their competencies accurately and to realize their full educational potential.



Case 2. The Individualized Educational Plan with Sensory Integration as a Pedagogical Framework for Educational Continuity: A Three-Year Longitudinal Study and Transition to Upper Secondary School

The second case concerns a student with an intellectual disability associated with the long-term effects of a soft tissue tumor diagnosed during the first year of life. This condition resulted in cognitive vulnerabilities, difficulties adapting to

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school demands, oppositional behaviors, and occasional epileptic seizures. The student was monitored throughout the entire three-year lower secondary school cycle and supported during the transition to upper secondary education, with particular attention to the evolution of learning outcomes, behavioral regulation, and the frequency of critical episodes.

During the initial phase, behavioral crises occurred frequently, significantly interfering with participation in classroom activities, task persistence, and the quality of relationships with teachers and peers. Epileptic seizures, considered within their specific clinical framework and managed according to the appropriate medical procedures, were clearly distinguished from episodes of behavioral dysregulation in order to avoid conflating neurological events with educational manifestations.

Systematic observation made it possible to move beyond a purely oppositional interpretation of the student's behavior. Critical episodes were understood not simply as expressions of poor self-control or rule rejection but as possible indicators of cognitive, sensory, emotional, and relational overload. These episodes tended to occur in response to sudden changes, excessively complex demands, insufficiently structured instructions, noisy environments, unanticipated transitions, prolonged work periods, or experiences of perceived failure.

Within this perspective, the Individualized Educational Plan (PEI) served as the overarching framework for the entire educational project, functioning not only as a formal document but also as a planning, preventive, and regulatory instrument. The PEI integrated educational objectives, task adaptations, behavioral management strategies, sensory integration interventions, observation criteria, and actions aimed at ensuring educational continuity.

The educational planning was organized around three closely interconnected levels. The first focused on predictability, achieved through advance preparation for activities, consistent routines, temporal structuring of the school day, explicit explanation of task sequences, and the reduction of abrupt transitions. The second level addressed cognitive modulation by breaking down instructions into manageable steps, reducing simultaneous cognitive demands, establishing achievable micro-goals, alternating activities of varying cognitive intensity, and providing frequent, descriptive, and non-judgmental feedback. The third level focused on bodily, sensory, and emotional regulation, incorporating scheduled breaks, access to quiet decompression spaces, reduction of unnecessary auditory and visual stimuli, educational mediation, and the shared recognition of early warning signs of overload.

Importantly, these strategies were embedded within the PEI as routine components of educational planning rather than as occasional responses to crises. This approach progressively shifted the focus from reactive crisis management to the prevention of the conditions that increased the likelihood of behavioral dysregulation.

During the first year, the intervention concentrated primarily on stabilizing the educational environment, establishing a predictable teacher–student relationship, and identifying the antecedents of behavioral crises. In the second year, greater instructional structure and the systematic implementation of sensory-informed strategies resulted in increased task persistence, improved acceptance of instructional demands, and a reduction in the frequency of oppositional episodes. During the third year, the PEI increasingly emphasized autonomy and educational transition, consoli-

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dating self-regulation strategies, encouraging the student to request breaks when needed, improving frustration tolerance, and promoting participation in group activities.

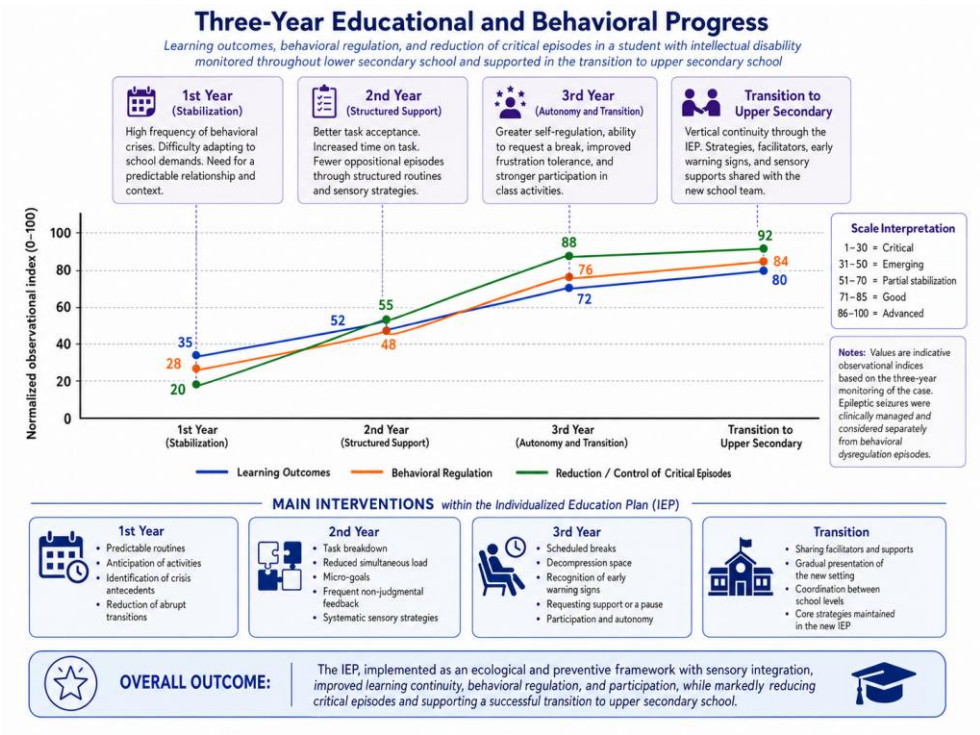
At the same time, improvements in behavioral regulation enabled greater continuity in learning, leading to the progressive achievement of individualized educational objectives and increased active participation in classroom activities. Critical episodes gradually decreased in frequency, intensity, and duration, eventually becoming virtually absent during the later stages of the educational pathway. Simultaneously, the student developed an increasing ability to recognize and communicate signs of fatigue or distress before the onset of behavioral crises.

Relationships with peers also improved as a consequence of the increased predictability of the educational environment and the reduction in episodes of behavioral dysregulation, allowing for more stable social participation that was no longer dominated by crisis management.

During the transition to upper secondary school, the PEI was used as a tool for vertical educational continuity. Information regarding facilitating factors, early warning signs of overload, preferred communication strategies, optimal working times, effective sensory supports, and crisis prevention procedures was systematically shared with the receiving teaching team to prevent educational discontinuity and functional regression. The transition itself was carefully prepared through advance familiarization with the new school environment, gradual introduction to new routines, collaboration between teachers from both educational levels, and the identification of a core set of strategies to be maintained within the new PEI.

Follow-up after the transition demonstrated maintenance of the achievements attained during lower secondary school, further improvements in behavioral regulation, and good adaptation to the new educational demands, provided that the environment remained structured, cognitively accessible, and sensory-supportive.

This case demonstrates how the Individualized Educational Plan, when conceived as an ecological, process-oriented, and collaborative educational framework, can simultaneously influence academic learning, behavioral regulation, and crisis prevention. The reduction in critical episodes did not result merely from increased external behavioral control but rather from the transformation of the educational environment and the creation of conditions more closely aligned with the student's functional profile. Sensory integration, when systematically incorporated into educational planning, contributed to making the learning environment more predictable and sustainable, thereby promoting participation, self-regulation, continuity of learning, and a successful transition to the next level of education.



Case 3. Lower Secondary School Student with High Cognitive Ability and Emotional Dysregulation

The third case concerns a student followed throughout the entire three-year lower secondary school cycle who presented a profile of giftedness, with an intelligence quotient (IQ) of 145. The psychological assessment report also noted that the student had completed the intelligence testing with limited engagement and an apparently indifferent attitude, suggesting that the psychometric score should be interpreted within a broader evaluation of overall functioning rather than as an isolated indicator. From the beginning of lower secondary school, there was a marked discrepancy between the student's exceptional cognitive potential and his observable academic performance. Although he demonstrated rapid comprehension, advanced reasoning abilities, and an aptitude for identifying complex relationships, his academic achievement generally remained at a satisfactory level only. He frequently displayed boredom, low motivation, inconsistent engagement, rejection of tasks perceived as repetitive, and difficulties in regulating emotions and behavior. During the initial phase, his limited tolerance for frustration and mistakes often resulted in oppositional reactions, task withdrawal, inappropriate verbalizations, restlessness, and episodes of emotional dysregulation, negatively affecting classroom participation, relationships with teachers, and social adjustment among peers.

Systematic observation made it possible to move beyond a simplistic interpretation based on laziness, lack of effort, or oppositional behavior, revealing instead that these behaviors emerged from the interaction between cognitive understimulation, emotional sensitivity, a strong need for autonomy, difficulties in self-regulation, and

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the sensory characteristics of the educational environment. When activities were perceived as trivial, predictable, or lacking personal meaning, the student's level of activation and engagement declined rapidly. Conversely, in evaluative situations, socially exposed contexts, or tasks characterized by a high perceived risk of failure, physical tension, irritability, and emotional vulnerability increased substantially.

Within this framework, the Sensory Personalized Learning Plan (Sensory PDP) served as the unifying structure of the student's educational pathway, integrating the enhancement of cognitive potential with support for motivation, emotional regulation, behavioral management, and social participation. Rather than functioning as a tool to reduce academic demands or simplify the curriculum, the Sensory PDP was conceived as a dynamic educational device aimed at qualitatively differentiating learning activities, increasing the meaningfulness of tasks, and creating an educational environment better aligned with the student's individual profile.

The educational planning included cognitively challenging yet sustainable activities, enrichment opportunities, authentic learning tasks, interdisciplinary connections, opportunities to choose among alternative learning modalities, and the systematic incorporation of the student's personal interests in order to reduce boredom and strengthen intrinsic motivation. Assignments were differentiated not only quantitatively, avoiding the common practice of assigning a greater number of repetitive exercises, but, above all, qualitatively, by emphasizing analytical reasoning, synthesis, problem solving, hypothesis generation, and independent knowledge production.

At the same time, the Sensory PDP incorporated visual and organizational supports, advance preparation for classroom activities, explicit success criteria, segmentation of longer tasks, structured opening and closing routines, scheduled breaks, and access to quiet decompression spaces during periods of cognitive or emotional overload.

Particular attention was paid to the sensory dimension by monitoring the bodily signals that consistently preceded episodes of dysregulation. These included changes in posture, increased restlessness, muscular tension, repetitive manipulation of objects, elevated vocal intensity, and reduced responsiveness to verbal interaction. Over time, these signals came to be recognized as early indicators of distress and were used to activate preventive regulation strategies, including brief breaks, breathing exercises, reduction of environmental stimulation, reformulation of task instructions, and opportunities for individual reflection with the teacher.

Special attention was also devoted to the relationship between personal identity, perceived competence, and the experience of failure. The student tended to interpret mistakes as threats to his self-concept as a highly competent individual, responding through avoidance, task devaluation, or emotional outbursts. Consequently, the educational intervention promoted a process-oriented conception of learning by emphasizing effort, revision, exploration of alternative strategies, and the educational value of mistakes as opportunities for growth. Feedback was provided frequently, descriptively, and without judgment, focusing on learning strategies and individual progress rather than exclusively on final outcomes.

During the first year, the Sensory PDP primarily focused on establishing a positive, non-confrontational educational relationship, identifying the antecedents of maladaptive behaviors, increasing the predictability of classroom routines, and restoring

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academic motivation. In the second year, the systematic introduction of differentiated tasks, enrichment activities, and self-regulation strategies promoted greater task persistence, improved acceptance of instructional demands, and a progressive reduction in oppositional behaviors. During the third year, the educational project shifted toward consolidating autonomy, fostering emotional awareness, increasing frustration tolerance, encouraging the independent use of self-regulation strategies, and preparing the student for the transition to upper secondary education.

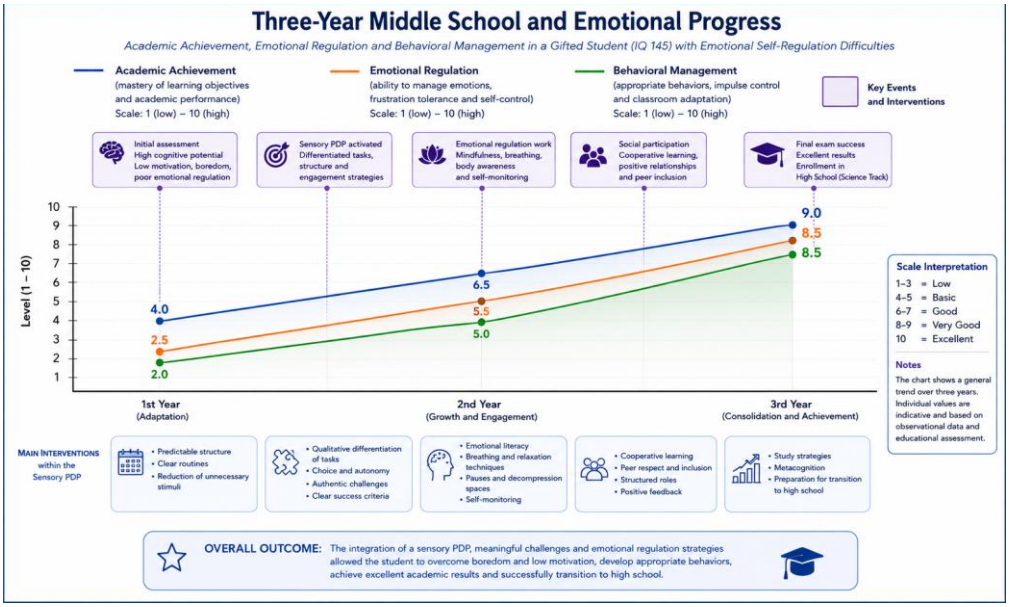
The entire class was also involved through structured cooperative learning activities in which roles, responsibilities, and timelines were clearly defined. This approach promoted more functional social participation while reducing the risk of isolation and interpersonal conflict.

Throughout the three-year period, a gradual improvement in motivation and academic achievement was observed, accompanied by greater consistency in study habits, more active classroom participation, and an increased ability to engage with complex tasks without systematically resorting to avoidance. At the same time, the student developed growing awareness of his emotional and bodily states, learning to recognize early signs of tension, request breaks when necessary, employ self-regulation strategies, and adopt behaviors better suited to the educational context. Episodes of emotional dysregulation progressively declined and, by the end of the third year, no longer represented a significant feature of his school experience.

The completion of lower secondary education revealed a substantial realignment between the student's cognitive potential and his academic functioning. He successfully passed the final state examination with excellent results, demonstrating knowledge, reasoning abilities, independent oral presentation skills, and transversal competencies fully consistent with his cognitive profile. He subsequently enrolled in a scientific high school.

The Sensory PDP also functioned as a tool for educational continuity by transferring to the receiving upper secondary school the strategies that had proven effective, the student's motivational factors, early indicators of overload, preferred feedback approaches, and environmental conditions that best supported learning.

This case demonstrates that giftedness alone does not guarantee academic success and may coexist with emotional, motivational, relational, and sensory vulnerabilities that remain largely invisible when attention is focused exclusively on cognitive performance. The positive educational outcome cannot be attributed to a single intervention but rather to the coherence among systematic observation, personalized instruction, sensory-informed educational planning, supportive teacher–student relationships, and the transformation of the learning environment. From this perspective, the Sensory Personalized Learning Plan moved beyond a compensatory model of personalization, emerging instead as a developmental educational framework capable of integrating talent, motivation, self-regulation, and participation, thereby supporting the student in achieving the full expression of his potential.



8. Discussions

The analysis of the three cases reveals several recurring patterns. The first concerns the need to move beyond a performance-based interpretation of learning difficulties. In all three cases, the initial problem appeared to be related to academic achievement, behavior, or participation. However, a more in-depth analysis showed that these manifestations were closely associated with processes of sensory, emotional, and cognitive regulation. Learning difficulties were not simply the result of student deficits but rather emerged from the interaction between the individual's profile and the characteristics of the educational environment. This interpretation is consistent with the embodied cognition framework, according to which cognition, the body, and the environment constitute an integrated and dynamic system (Varela, Thompson, & Rosch, 1991; Wilson, 2002).

The second recurring pattern concerns the role of predictability. Across all three educational pathways, reducing uncertainty had a substantial positive impact on students' participation. Anticipating activities, making instructions explicit, clarifying timelines, visualizing task sequences, and establishing consistent routines enabled students to reduce executive demands and emotional activation. These findings are consistent with research on executive functions, which highlights the role of working memory, inhibitory control, and cognitive flexibility in regulating goal-directed behavior (Miyake et al., 2000; Diamond, 2013).

The third recurring pattern concerns the centrality of the body as a pedagogical indicator. In the cases examined, bodily signals frequently anticipated learning difficulties before they became evident through behavior or academic performance. Posture, muscular tension, movement, withdrawal, restlessness, fatigue, and physiological responses provided valuable information about the sustainability of students' educational experiences. From an embodied pedagogical perspective, the body is not

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regarded as a secondary or accessory element but as the primary site through which the relationship between the learner and the environment is expressed.

The fourth recurring pattern concerns the reinterpretation of spontaneous self-regulation strategies. Behaviors initially perceived as dysfunctional can instead be understood as attempts at self-regulation. Moving around, seeking isolation, manipulating objects, avoiding eye contact, searching for deep pressure, requesting breaks, or maintaining rigid control over situations may represent adaptive strategies through which students attempt to preserve psychological and physiological balance. Dunn's sensory processing model provides a useful framework for interpreting these behaviors as expressions of different sensory processing patterns rather than merely as resistance to educational demands (Dunn, 1997, 1999).

The fifth recurring pattern concerns the value of the PDP and PEI as mediating educational tools. In the cases examined, meaningful change did not occur when these documents were treated merely as administrative requirements, but when they became spaces for dialogue among teachers, families, specialists, and students. The PDP and PEI acquired a generative function when they enabled educational observations to be translated into pedagogical, organizational, and relational decisions. This perspective is consistent with the conception of the PDP as an instrument for inclusion that promotes participatory and transformative processes when understood as a pedagogical device rather than a formal administrative document (Damiani & Gomez Paloma, 2022).

These findings suggest that school inclusion cannot be conceived solely in terms of formal access or the provision of compensatory measures. Accessibility concerns the quality of students' educational experience. A student may be physically present in the classroom and have a formally appropriate PDP or PEI while still experiencing an educational context that is cognitively and emotionally unsustainable. Conversely, an environment capable of modulating demands, sensory stimulation, timing, and interpersonal relationships can foster more authentic participation.

The embodied perspective also offers an opportunity to redefine the relationship between educational neuroscience and special education. One of the main risks associated with introducing neuroscientific concepts into education is the tendency toward oversimplification or reductionist applications. In this contribution, however, references to sensory gating, executive functions, and self-regulation are not intended to transform pedagogy into neurodiagnostic practice but rather to enrich educational observation. Neuroscience provides conceptual tools for understanding underlying processes, whereas special education translates these insights into pedagogical planning, educational relationships, and contextual interventions.

Another important aspect concerns assessment. In all three cases, improvements in academic performance were not pursued as isolated objectives but emerged as a consequence of creating more sustainable learning conditions. This finding has important pedagogical implications: when students experience lower cognitive overload, improved self-regulation, greater emotional security, and stronger engagement, their academic performance can improve accordingly. Performance is therefore not dismissed as unimportant but repositioned within a broader conception of educational well-being.

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The discussion also highlights several potential risks. The first concerns the possibility of excessive subjectivity in educational observation. To minimize arbitrary interpretations, it is essential to develop shared observation protocols, clearly defined behavioral descriptors, and collaborative opportunities for professional reflection. The second risk concerns the fragmentation of interventions. Embodied strategies are effective only when they are integrated into a coherent educational framework rather than implemented as isolated initiatives by individual teachers. The third risk is the medicalization of educational practice. Discussing sensory profiles or sensory gating should not generate additional labels or diagnostic categories but should instead promote a deeper educational understanding of students' learning needs.

Finally, the findings suggest that cognitive sustainability may represent a valuable pedagogical construct for evaluating the inclusive quality of educational environments. A cognitively sustainable school is not one that lowers expectations, but one that creates the conditions under which students are genuinely able to meet them. Such a school does not avoid complexity but makes it accessible; it does not eliminate challenge but calibrates it appropriately; and it does not shield students from every difficulty but supports them in developing the strategies needed to navigate and overcome those challenges.

Conclusions

This contribution proposes an embodied reinterpretation of the Individualized Educational Plan (PEI) and the Personalized Learning Plan (PDP), arguing for the integration of body awareness, perception, sensory profiles, sensory gating processes, attentional and emotional regulation, and the cognitive sustainability of the school environment into inclusive educational planning.

The starting point is the recognition that, although the PDP and PEI are fundamental instruments for inclusion, they sometimes risk being reduced to bureaucratic documents or simple lists of compensatory measures. To restore their pedagogical value, they should instead be understood as dynamic, relational, and transformative tools capable of connecting individual functioning, the learning environment, and participation (Damiani & Gomez Paloma, 2022).

The Embodied Cognition paradigm provides a particularly fruitful theoretical framework for this reinterpretation. If cognition is situated, embodied, and relational, then inclusive educational planning must also take into account the bodily and sensory conditions that shape learning (Latino & Tafuri, 2024). Learning does not occur through the mind alone but through the body, the senses, action, relationships, and the environment (Varela, Thompson, & Rosch, 1991; Wilson, 2002).

Integrating the concept of sensory gating helps explain how the selection and organization of environmental stimuli influence attention, executive functioning, emotional regulation, and readiness to learn. In contemporary educational settings, which are often characterized by overstimulation, noise, acceleration, and increasing complexity, the capacity of the environment to regulate sensory and cognitive load becomes a fundamental prerequisite for accessibility (Davies, Chang, & Gavin, 2009; Lijffijt et al., 2009; Yadon et al., 2009).

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The concept of cognitive sustainability translates these reflections into a practical design principle. A cognitively sustainable educational environment is one that respects individual processing times, reduces cognitive overload, promotes self-regulation, makes learning demands predictable, values bodily and sensory mediators, supports participation, and safeguards neuropsychological well-being (Morsanuto, 2025).

The analysis of the three longitudinal case studies suggests that integrating embodied strategies into PDPs and PEIs may contribute to improving participation, reducing behavioral crises, supporting emotional self-regulation, and fostering gradual improvements in academic performance. These findings should not be interpreted as causal or generalizable evidence but rather as exploratory results supporting the relevance of an ecological and neuro-sensory approach to inclusive educational planning.

The primary pedagogical implication concerns the process of observation. Before designing educational interventions, schools must learn to observe students' overall functioning within authentic contexts. This involves identifying when students actively participate, when they experience overload, which stimuli facilitate or hinder learning, which bodily strategies they spontaneously adopt, and under which conditions learning becomes possible. Only through this comprehensive observation can the PDP and PEI become genuinely personalized and inclusive educational tools.

A second implication concerns teacher education. Building cognitively sustainable schools requires the development of new observational and instructional competencies capable of integrating special education, inclusive pedagogy, foundational knowledge of sensory processing, and attention to the embodied and emotional dimensions of learning. This does not imply assigning teachers clinical responsibilities; rather, it means equipping them with conceptual and practical tools to better understand the complexity of students' behaviors and learning difficulties.

A third implication concerns the broader culture of inclusion. Reinterpreting the PDP and PEI from an embodied perspective means moving beyond a logic of individual adaptation toward a transformative approach. Inclusion is not about accommodating the "difficult" student within an unchanged environment; rather, it requires transforming the educational context so that sensory, cognitive, emotional, and bodily differences can genuinely become conditions for participation and capability development.

Finally, this work highlights the crucial role of research, interdisciplinarity, and interprofessional collaboration as both the foundation and guiding framework for inclusive educational innovation. Achieving this vision requires systematic investment in dialogue, knowledge co-construction, and the co-design of educational practices involving schools, universities, and local communities.

In conclusion, this contribution argues that the future of inclusive educational planning should move toward schools that are more accessible, sensory-aware, emotionally supportive, and cognitively sustainable. Neurocognitive well-being is not merely an additional component of learning but one of its essential preconditions. When reinterpreted through the lens of Embodied Cognition, the PDP and PEI can become powerful instruments for promoting this educational transformation.

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