7. Ahmed, Y.A., Wagner, R.K., & Lopez, D. (2021). The not-so-simple view of writing in struggling readers/writers. *Annals of Dyslexia, 71*(3), 443–470. https://doi.org/10.1007/s11881-021-00229-0 [in English].

8. Canet-Juric, L., Gelpi-Trudo, R., Zamora, E., Galli, J.I., Abusamra, V., & Tabullo, A. (2024). Executive functions contributions to copying and text production in elementary school children. *Applied Neuropsychology: Child*. Advance online publication. https://doi.org/10.1080/21622965.2024.2440929 [in English].

9. Drijbooms, E., Groen, M.A., & Verhoeven, L. (2015). The contribution of executive functions to narrative writing in fourth grade children. *Reading and Writing, 28*, 989–1011. https://doi.org/10.1007/s11145-015-9558-z [in English].

10. Kellogg, R.T. (2022). Book review: Executive functions and writing (Limpo & Olive, Eds.). *Journal of Writing Research, 13*(3), 473–479. https://doi.org/10.17239/jowr-2022.13.03.05 [in English].

11. Korkman, M., Kirk, U., & Kemp, S. (2007). *NEPSY–II: Clinical and interpretive manual*. San Antonio, TX: Harcourt Assessment / PsychCorp. [in English].

12. Ruffini, C., Osmani, F., Martini, C., Giera, W.K., & Pecini, C. (2024). The relationship between executive functions and writing in children: A systematic review. *Child Neuropsychology, 30*(1), 105–163. https://doi.org/10.1080/09297049.2023.2170998 [in English].

13. Smith-Spark, J.H., & Gordon, R. (2022). Automaticity and executive abilities in developmental dyslexia: A theoretical review. *Brain Sciences, 12*(4), 446. https://doi.org/10.3390/brainsci12040446 [in English].

14. Soto, E.F., Irwin, L.N., Chan, E. S. M., Spiegel, J.A., & Kofler, M.J. (2021). Executive functions and writing skills in children with and without ADHD. *Neuropsychology, 35*(8), 792–808. https://doi.org/10.1037/neu0000769 [in English].

15. Valcan, D.S., Malpique, A.A., Pino-Pasternak, D, Asil, M., & Teo, T. (2024). The contributions of executive functioning to handwritten and keyboarded compositions in Year 2 children. *Contemporary Educational Psychology, 77*, 102272. https://doi.org/10.1016/j.cedpsych.2024.102272 [in English].

Матеріал надійшов до редакції 6.03.2026 р.

Прорецензовано 26.03.2026

Схвалено до друку 30.03.2026

УДК 376.42

Kateryna Latysheva,

Independent Researcher

E-mail: kateryna.latysheva@gmail.com
ORCID ID: 0009-0000-1026-1173
Researcher ID: OFN-0792-2025

Катерина Латишева,
незалежний дослідник

San Francisco, USA
3535 Wawona St., Unit 234, San Francisco, CA 94116, USA

м. Сан-Франциско, США
вул. Вавона, буд. 3535, кв. 234, м. Сан-Франциско, Каліфорнія, 94116, США

MICRO-SENSORY PEDAGOGICAL INTERVENTIONS AS A MECHANISM FOR ENHANCING LEARNING ENGAGEMENT IN CHILDREN WITH AUTISM SPECTRUM DISORDERS

МІКРОСЕНСОРНІ ПЕДАГОГІЧНІ ВТРУЧАННЯ ЯК МЕХАНІЗМ ПІДВИЩЕННЯ НАВЧАЛЬНОЇ ЗАЛУЧЕНОСТІ ДІТЕЙ З РОЗЛАДАМИ АУТИСТИЧНОГО СПЕКТРА

Abstract. The article substantiates micro-sensory pedagogical interventions as a conceptually distinct and methodologically structured tool for supporting learning engagement of children with autism spectrum disorders (ASD) in inclusive educational settings. The purpose of the article is to provide a theoretical clarification of the definition, to identify criteria, and to systematize micro-sensory interventions as a pedagogical mechanism for regulating sensory load, stabilizing behavioral responses, and enhancing a child's cognitive readiness for learning activities. The methodological framework is based on an analysis of interdisciplinary scientific sources in the fields of special education, sensory integration, and educational psychology, as well as on conceptual and structural-functional modeling of pedagogical processes. The study employs methods of theoretical analysis and synthesis, comparison, generalization, typology construction, and pedagogical procedure design. The results of the study consist in conceptualizing micro-sensory interventions as an autonomous level of pedagogical influence that differs from "sensory breaks" and therapeutic procedures by their minimal duration, direct integration into the lesson structure, preventive orientation, and focus on pedagogical indicators of engagement. A logical impact model is proposed that links micro-sensory action, sensory regulation, behavioral stabilization, increased attentional focus, and learning engagement. A typology of interventions (by

sensory modality and pedagogical function) has been developed, along with an algorithm for their selection, conditions for safe application, and observation-based tools for recording changes in learning engagement in real time. The scientific novelty of the study lies in the formulation of a new pedagogical concept, “micro-sensory pedagogical interventions,” and in the clarification of its boundaries, operational characteristics, and functional role within the structure of a lesson. For the first time, the possibility of standardizing short-term sensory-oriented actions as a systemic pedagogical mechanism for supporting learning engagement of children with autism spectrum disorders in inclusive education is theoretically substantiated.

Key words: inclusive education; sensory regulation; micro-sensory interventions; learning engagement; autism spectrum disorders.

Анотація. У статті обґрунтовано мікросенсорні педагогічні втручання як концептуально окремий і методологічно впорядкований інструмент підтримки навчальної залученості дітей з розладами аутистичного спектра (РАС) в інклюзивному освітньому середовищі. Метою статті є теоретичне уточнення дефініції, визначення критеріїв та систематизація мікросенсорних втручань як педагогічного механізму регуляції сенсорного навантаження, стабілізації поведінкових реакцій і підвищення когнітивної готовності дитини до навчальної діяльності. Методологічну основу становить аналіз міждисциплінарних наукових джерел у галузях спеціальної педагогіки, сенсорної інтеграції та освітньої психології, а також концептуальне і структурно-функціональне моделювання педагогічних процесів. У межах дослідження використано методи теоретичного аналізу й синтезу, порівняння, узагальнення, типологізації та проєктування педагогічних процедур. Результати дослідження полягають у виокремленні мікросенсорних втручань як автономного рівня педагогічного впливу, що відрізняється від «сенсорних пауз» і терапевтичних процедур своєю мінімальною тривалістю, вбудованістю в структуру уроку, превентивною спрямованістю та орієнтацією на педагогічні індикатори залученості. Запропоновано логічну модель впливу, яка поєднує мікросенсорну дію, сенсорну регуляцію, поведінкову стабілізацію, підвищення концентрації уваги та навчальну залученість. Розроблено типологію втручань (за модальністю та педагогічною функцією), окреслено алгоритм їхнього добору, умови безпечного застосування, а також інструменти спостереження для фіксації змін у навчальній залученості в реальному часі. Наукова новизна дослідження полягає у формуванні нового педагогічного поняття «мікросенсорні педагогічні втручання», уточненні його меж, операційних ознак та функціонального призначення в структурі навчального заняття. Уперше обґрунтовано можливість стандартизації короткотривалих сенсорно орієнтованих дій як системного педагогічного механізму підтримки навчальної залученості дітей з розладами аутистичного спектра в умовах інклюзивної освіти.

Ключові слова: інклюзивна освіта; сенсорна регуляція; мікросенсорні втручання; навчальна залученість; розлади аутистичного спектра.

Relevance of the Study. Inclusive education implies not only access to the curriculum but also a genuine opportunity for a child to be an active participant in learning interactions. For children with autism spectrum disorders (ASD), reduced learning engagement is often associated not with “low motivation” or “unwillingness to work,” but with specific features of sensory processing and self-regulation. In the classroom, a child is simultaneously exposed to the teacher’s voice, peer noise, bright lighting, spatial density, tactile stimuli, and rapid task transitions. The cumulative effect of these stimuli may result in sensory overload, which manifests as avoidance behaviors, increased anxiety, stereotyped movements, oppositional behavior, or withdrawal from activity. Under such conditions, even high-quality instructional practices may fail to produce the expected educational outcomes.

Pedagogical practice indicates that regulatory support should not be episodic but embedded directly within the lesson structure. At the same time, two polarized approaches often prevail in schools. The first approach, “doing nothing special,” relies on general discipline requirements and effectively leaves the child alone with sensory challenges. The second approach, “relocating regulation outside the lesson,” relies on extended breaks or separate therapeutic procedures that are difficult to integrate into real classroom schedules. This creates a need for an intermediate, pedagogically managed level of intervention that preserves lesson structure while reducing the risk of sensory overload. Micro-sensory pedagogical interventions may serve as such an intermediate level.

Analysis of Previous Research and Publications. The theoretical foundations for understanding the relationship between sensory processing and child functioning were established in studies on sensory integration and sensory profiles (Ayres, 1979; Dunn, 1997). Research highlights the prevalence of atypical sensory responses in children with ASD and their impact on adaptation and behavior (Tomchek & Dunn, 2007). Within

school contexts, a relationship has been identified between sensory characteristics and emotional, behavioral, and educational outcomes (Ashburner, Ziviani, & Rodger, 2008). A distinct line of research focuses on grouping children with ASD according to sensory subtypes, underscoring the heterogeneity of sensory profiles and the need for differentiated support strategies (Lane, Molloy, & Bishop, 2014).

In parallel, the scientific literature documents the effectiveness of structured sensory intervention approaches, including randomized controlled trials of manualized programs (Schaaf et al., 2014). Importantly, much of the existing evidence base relates to clinical or therapeutic formats, whereas pedagogically embedded solutions are often described fragmentarily, without clear definitions, criteria, or application algorithms. This creates a methodological gap between theoretical knowledge about sensory challenges and teachers' everyday classroom practice. Consequently, there is a need to clarify the concept of short-term regulatory actions specifically as a pedagogical tool oriented toward learning engagement and lesson dynamics.

Purpose of the Article. The purpose of the article is to provide a conceptual justification for micro-sensory pedagogical interventions as a mechanism for enhancing learning engagement of children with ASD in inclusive educational settings, as well as to define their criteria, typology, selection algorithm, and principles of safe classroom application.

Research Methods / Procedure. The study has a theoretical and methodological design and employs the following methods:

1. theoretical analysis and synthesis of contemporary scientific sources in special education, sensory integration, and educational psychology;
2. comparative analysis of classroom-based sensory support approaches;
3. structural-functional modeling of pedagogical mechanisms through which sensory actions influence engagement;
4. typology development based on sensory modality and pedagogical function;
5. design of a pedagogical procedure for selecting and implementing interventions, including observation indicators.

The article does not include individual case descriptions and does not involve work with personal data. The proposed provisions represent a conceptual model and methodological framework that may be used in future empirical research.

Research Results. 1. Definition and Criteria of Micro-Sensory Pedagogical Interventions

Micro-sensory pedagogical interventions are defined as short-term (typically ranging from 10 seconds to 2 minutes), sensory-oriented actions that are directly integrated into the educational process without disrupting the lesson structure. The key distinguishing feature of such interventions is their pedagogical orientation: they are not applied for therapeutic purposes but serve as tools for supporting learning activity and regulating the child's state in the moment. The criteria for classifying an action as a micro-sensory pedagogical intervention include minimal duration, functional relevance, preventive character, and orientation toward indicators of learning engagement.

The application of micro-sensory interventions is based on the understanding that sensory dysregulation is dynamic and may change during a single lesson. Therefore, effective interventions are those that require minimal time resources yet can quickly reduce sensory load intensity or, conversely, increase the level of activation necessary for task performance. Such interventions may be planned (embedded within the lesson structure) or reactive (applied in response to early markers of overload).

The proposed approach to micro-sensory pedagogical interventions was developed by the author as an independent conceptual and methodological model of pedagogical influence. Unlike fragmented descriptions of sensory actions in the scientific literature, this article is the first to systematize micro-sensory interventions as an autonomous level of pedagogical regulation of learning engagement, with clearly defined criteria, functional characteristics, and an application algorithm within educational environments.

2. Sensory Triggers of the Learning Environment and Their Impact on Engagement

Analysis of the inclusive classroom environment makes it possible to identify a range of typical sensory triggers that reduce learning engagement in children with ASD. These include auditory overload (noise, multiple voices), visual chaos (excessive stimuli

on walls and screens), tactile discomfort (crowded spaces, material contact), and rapid transitions between activities without sufficient adaptation time. The interaction of these factors creates heightened sensory tension, directly affecting behavioral responses and the child's ability to sustain attention.

Micro-sensory interventions are considered tools for localized influence on these triggers. For example, brief proprioceptive input may reduce hyperactivity before a written task, while visual structuring of space can decrease distractions during instruction listening. Thus, educators gain the ability to promptly modify sensory conditions without altering the overall organization of the lesson.

3. Typology of Micro-Sensory Interventions in Educational Contexts

Depending on the format of learning activity, micro-sensory interventions may serve different functional purposes. During whole-class instruction, interventions aimed at reducing sensory noise and supporting auditory attention are appropriate. In group activities, interventions facilitating spatial orientation and reducing social anxiety become relevant. During individual work, interventions supporting task pace and completion are most effective.

Types of Micro-Sensory Interventions

Practical experience allows identification of several types of micro-sensory interventions applicable in educational settings (Table 1).

Table 1

Types of Micro-Sensory Pedagogical Interventions and Their Pedagogical Purpose

Type	Brief Description	Pedagogical Purpose
Motor	Short, controlled body movements (postural changes, rhythmic movements, muscle compression)	Increase activation level, reduce motor disorganization, prepare for task performance

Proprioceptive	Actions involving deep pressure and muscle engagement	Stabilize sensory regulation, reduce anxiety, enhance bodily control
Tactile	Brief interaction with textures or tactile objects	Reduce tactile hypersensitivity, shift attention, decrease sensory overload
Visual-regulatory	Visual cues, gaze focusing, visual field simplification	Support visual attention, reduce visual overload
Breathing-regulatory	Short, structured breathing exercises	Reduce physiological tension, stabilize emotional state

This approach allows educators not only to respond to behavioral manifestations but also to plan sensory support in accordance with the instructional logic of the lesson. Micro-sensory interventions become elements of pedagogical design rather than emergency corrective measures.

4. Algorithm for Pedagogical Selection of Micro-Sensory Interventions

Based on conceptual analysis, an algorithm for selecting micro-sensory interventions has been developed for use by general and special education teachers. The first step involves identifying sensorily demanding moments within the lesson. The second step includes observing early markers of dysregulation. The third step consists of selecting the minimally sufficient intervention, considering the child's sensory profile and activity context. The fourth step involves evaluating the intervention's effect using engagement indicators. The fifth step integrates effective strategies into classroom routines.

Applying this algorithm facilitates a shift from intuitive decision-making to systematic pedagogical practice, enhancing predictability and stability of the learning process. The proposed algorithm enables sensory support to move from an intuitive level

to conscious pedagogical design, creating conditions for reproducibility of decisions, improved outcome predictability, and scalability across educational environments.

5. Packages of Micro-Sensory Interventions for Different Lesson Types

For practical implementation, it is advisable to develop packages of micro-sensory interventions tailored to specific lesson types (language, mathematics, creative, movement-based). Each package may include 3–5 validated actions applied at key lesson stages: beginning, transition, complex task execution, and completion. Such standardization reduces teacher workload and ensures consistency of support.

6. Pedagogical Indicators for Assessing Learning Engagement

Assessment of the effectiveness of micro-sensory interventions should be conducted using pedagogical indicators that are easily observable in classroom settings. Unlike clinical measures, these indicators directly reflect the quality of learning interaction and can be used by teachers or assistants without specialized training. A summary of indicators is presented in Table 2.

Table 2

Pedagogical Indicators for Assessing Learning Engagement in Children with ASD

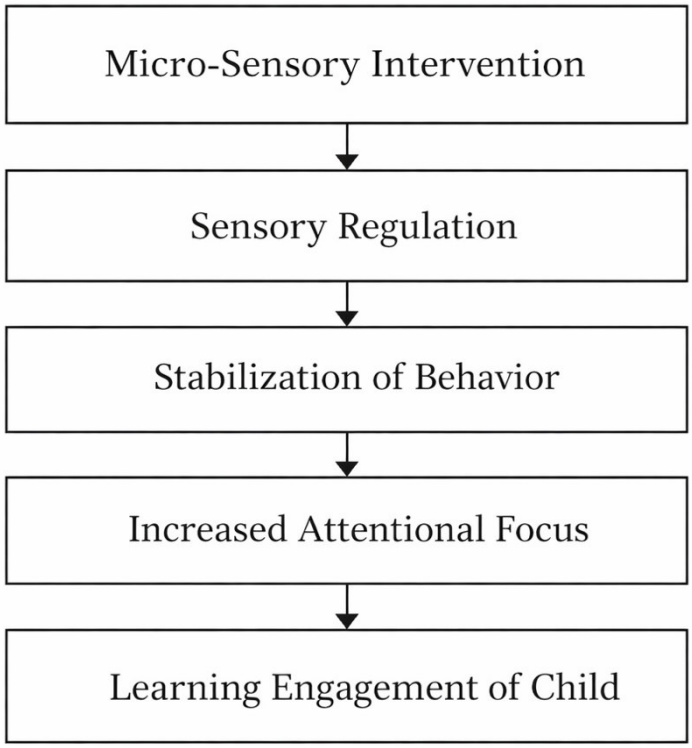
Indicator Group	Description	Classroom Observation Example
Temporal	Time on task; speed of engagement after instruction	Child begins task within 30 seconds without reminders
Behavioral	Number of distractions; need for corrective prompts	Reduced number of teacher prompts
Cognitive	Task completion; accuracy	Task completed without missing steps
Social	Participation in group interaction; initiation of contact	Child responds to peer questions during pair work
Regulatory	Frequency of sensory overload markers	Absence of stereotypies during learning episode

Using this table as an observation tool enables tracking engagement dynamics before and after intervention implementation, forming a basis for further empirical validation.

7. Graphical Modeling of Intervention Impact

For visual representation of relationships between sensory regulation and learning engagement, graphical models are appropriate. Figure 1 presents a generalized functional model of the impact of micro-sensory pedagogical interventions within lesson structure.

Figure 1. Functional Model of the Impact of Micro-Sensory Pedagogical Interventions on Learning Engagement of Children with ASD



The model illustrates a sequential transition from sensory action to behavioral stabilization and increased learning activity, confirming the logic of using micro-sensory interventions as a preventive pedagogical mechanism.

8. Comparative Visualization of Pedagogical Approaches

To highlight differences between traditional sensory breaks and micro-sensory pedagogical interventions, a comparative table is proposed (Table 3).

Table 3

Comparison of Sensory Breaks and Micro-Sensory Pedagogical Interventions

Criterion	Sensory Breaks	Micro-Sensory Pedagogical Interventions
Duration	5–10 minutes	10 seconds–2 minutes
Lesson Placement	Between activities	Within learning process
Pedagogical Purpose	Rest, tension reduction	Support engagement and attention
Teacher Role	Break organizer	Active process regulator
Risk of Tempo Loss	High	Minimal

This table demonstrates the pedagogical feasibility of using micro-sensory interventions within standard lessons.

Learning Engagement of Children with ASD as a Pedagogical Category

In pedagogy, learning engagement is understood as an integrative characteristic of student participation in the educational process, combining activity, interest, focus, and readiness to interact with learning material and the teacher. In children with ASD, engagement is often unstable and largely dependent on the child's internal sensory state.

The behavioral component of learning engagement in children with ASD may manifest as task avoidance, stereotyped movements, or oppositional behavior. The cognitive component is disrupted due to difficulties sustaining attention and processing information under sensory overload conditions. The emotional component is characterized by heightened anxiety or emotional withdrawal. Thus, low learning engagement in children with ASD is systemic and cannot be addressed solely through increased control or instruction.

In this context, sensory regulation serves as a foundational prerequisite for learning engagement. Ensuring an optimal level of sensory activation enables the child to transition from reactive responses to goal-directed learning activity. Therefore,

pedagogical interventions aimed at short-term sensory support may be considered effective tools for enhancing engagement in children with ASD.

Pedagogical Conditions for the Effectiveness of Micro-Sensory Interventions

The effectiveness of micro-sensory pedagogical interventions largely depends on adherence to specific pedagogical conditions. First, predictability of sensory actions is crucial. Children with ASD respond better to interventions with clear structure and consistent formats, reducing anxiety.

Second, micro-sensory interventions must be dosed and aligned with individual sensory characteristics. Excessive stimulation may have the opposite effect, increasing maladaptive behavior. Educators should therefore follow the principle of graduality and closely observe student responses.

Third, sensory actions must be directly connected to the learning context and not perceived as separate activities interrupting instruction. Integrating micro-sensory interventions into lesson structure helps maintain learning rhythm and engagement.

Limitations and Risks of Applying Micro-Sensory Interventions

Despite their pedagogical relevance, micro-sensory interventions have limitations. First, they cannot be considered universal solutions for all learning difficulties in children with ASD. They are components of comprehensive pedagogical support rather than replacements for it.

Second, there is a risk of formal or chaotic use of sensory actions without considering their functional purpose. In such cases, micro-sensory interventions may lose regulatory effect and become additional distractions. This underscores the need for educator and assistant training in conscious application of sensory strategies.

Conclusions and Directions for Future Research

The theoretical analysis substantiates the pedagogical potential of micro-sensory interventions as a means of enhancing learning engagement in children with autism spectrum disorders. Short-term sensory-oriented actions integrated directly into lesson structure contribute to behavioral stabilization, improved concentration, and more active participation in learning.

Future research may focus on empirical validation of micro-sensory pedagogical interventions within author-developed sensory-integration models aimed at supporting learning readiness and engagement in inclusive educational environments. The findings confirm the appropriateness of considering micro-sensory pedagogical interventions as an independent direction within inclusive pedagogy. The conceptual model proposed by the author provides a foundation for further interdisciplinary research, methodological standardization, and practical implementation of pedagogical strategies supporting learning engagement in children with ASD.

REFERENCES

1. American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: American Psychiatric Publishing [in English].
2. Ashburner, J., Ziviani, J., & Rodger, S. (2008). Sensory processing and classroom emotional, behavioral, and educational outcomes in children with autism spectrum disorder. American Journal of Occupational Therapy, 62(5), 564–573. https://doi.org/10.5014/ajot.62.5.564 [in English].
3. Ayres, A. J. (1979). Sensory integration and the child. Los Angeles, CA: Western Psychological Services [in English].
4. Dunn, W. (1997). The impact of sensory processing abilities on the daily lives of young children and their families. Infants & Young Children, 9(4), 23–35 [n English].
5. Lane, A. E., Molloy, C. A., & Bishop, S. L. (2014). Classification of children with autism spectrum disorder by sensory subtype: A case for sensory-based phenotypes. Autism Research, 7(3), 322–333 [in English].
6. Schaaf, R. C., Benevides, T., Mailloux, Z., Faller, P., Hunt, J., van Hooydonk, E., Freeman, R., Leiby, B., Sendecki, J., & Kelly, D. (2014). An intervention for sensory difficulties in children with autism: A randomized trial. Journal of Autism and Developmental Disorders, 44(7), 1493–1506. https://doi.org/10.1007/s10803-013-1983-8 [in English].
7. Tomchek, S. D., & Dunn, W. (2007). Sensory processing in children with and without autism: A comparative study using the Short Sensory Profile. American Journal of Occupational Therapy, 61(2), 190–200. https://doi.org/10.5014/ajot.61.2.190 [in English].

Матеріал надійшов до редакції 22.01.2026

Прорецензовано 26.02.2026

Схвалено до друку 30.03.2026