

An Embedded-Intervention Approach to Tactile Function Training for Students with Autism Spectrum Disorder in Inclusive Classrooms

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Abstract: *In inclusive classrooms, students with autism spectrum disorder (ASD) commonly exhibit atypical tactile processing, manifesting as tactile hypersensitivity (tactile defensiveness) or tactile seeking. These differences can directly undermine classroom adaptation, leading to frequent behaviors such as refusing to touch learning materials, leaving one's seat in agitation, and avoiding peer interaction. Given the limited special education resources in many mainstream schools and the practical constraints on providing intensive, one-to-one rehabilitation, an urgent challenge for inclusive education is to translate specialized sensory interventions into feasible everyday teaching routines. Drawing on tactile function training practices with six students with ASD placed in regular classrooms, this study proposes an embedded intervention framework. The framework integrates tactile support into four dimensions of routine schooling: environmental design, schedule and routines, instructional activities, and interpersonal interaction. Concrete operational procedures are provided for each dimension, and typical cases are used to illustrate intervention effects and implementation reflections. The practice indicates that embedded tactile function training can effectively improve students' classroom adaptation, offering front-line teachers a low-cost, high-yield, and operationally actionable set of strategies for inclusive classrooms.*

Keywords: Inclusive placement, Autism spectrum disorder, Tactile function training, Embedded intervention, Classroom adaptation.

1. Introduction

With the continued implementation of policies such as the Special Education Enhancement Plan (Phase II, 2017–2020), inclusive education has become a key direction in the development of special education in China, and an increasing number of children with ASD are placed in regular schools for learning in regular classrooms [5]. According to the Statistical Bulletin on National Education Development 2022, the scale of students learning in regular classrooms has continued to expand, and the depth and breadth of inclusive education are facing new challenges as well as opportunities [6].

Existing studies report that many students with ASD experience substantial difficulties in classroom adaptation [1]. In daily classroom life, some students refuse to touch learning materials such as glue and paint; some become distressed due to tactile discomfort from clothing tags; some seek sensory input through hitting and rocking and thereby disrupt classroom order; others react strongly to accidental touch by peers. A common underlying contributor to these behaviors is atypical tactile processing.

Tactile sensation is among the earliest-developing sensory systems and is distributed widely across the body. It plays a central role in emotion regulation, body scheme formation, and environmental exploration [2]. Many children with ASD show tactile dysfunction, often described as tactile defensiveness (over-responsivity and avoidance of touch) or tactile seeking (persistent touching and stimulation seeking). In classroom contexts, students with tactile defensiveness may experience emotional meltdowns when required to tolerate physical contact in group activities, whereas students with tactile seeking may gain sensory input by manipulating stationery or touching walls, presenting as distractibility and excessive fidgeting.

In mainstream schools, special education resources are often

insufficient to provide individualized, intensive tactile training for each student with ASD. Translating professional tactile function training into feasible “micro-interventions” embedded in daily classroom routines is therefore critical for improving the quality of inclusive education. Based on intervention practices with six students with ASD learning in regular classrooms, this study proposes embedded strategies for tactile function training. The approach integrates tactile support across classroom environments, schedules and routines, instructional activities, and interpersonal interactions so that specialized intervention can occur naturally within everyday educational activities.

2. Core Strategies for Embedded Tactile Function Training

2.1 Strategy 1: Creating an Environment-Embedded Tactile Experience Area

A “tactile exploration corner” can be set up in a safe and accessible area of the classroom. The corner provides a variety of tactile materials that are safe, diverse, and easy to manipulate. With guidance from the homeroom teacher and the resource teacher, students can choose to use the materials during breaks or when experiencing emotional fluctuations. The corner functions both as a “safe island” for sensory regulation and a “training site” for gradual tactile desensitization.

Operational examples are as follows.

Example 1: Introducing a “Mystery Touch Box” into the Classroom

Place an opaque touch box at the back of the classroom (with circular openings on the sides). Fill it with objects made from different materials (e.g., velvet, sandpaper, silicone balls, soft

brushes, cold gel packs, and plush toys). The resource teacher first explains the tactile profiles of students with ASD to the homeroom teacher, enabling regular-class teachers to use the touch box appropriately. The homeroom teacher then introduces it to the class as a regulation tool, for example: “This is our ‘magic box.’ When you feel nervous, irritated, or want to calm down, you can come here and touch it to find a texture that feels comfortable.” Students take turns using the box, with each turn limited to 7 minutes.

Materials: a lidded box with a 10 cm circular opening; 15 items of different textures (rotate 3 items weekly); texture picture cards.

Implementation notes: (1) Provide teacher guidance at the initial stage and establish rules (one student at a time; handle gently). (2) Observe each student’s tactile preferences to inform individualized support. (3) Integrate the corner with classroom management by treating its use as a legitimate self-regulation option rather than as punishment or reward.

Example 2: Individualized Support with a “Seat Tactile Pad”

For students with tactile seeking (e.g., Case LZH who prefers grasping and pressing), provide a tactile pad on the student’s seat. One side can be smooth leather and the other a textured silicone surface, with strips of different fabrics sewn along the edges. During instruction, the student can naturally touch or press the pad to meet tactile needs without disturbing others.

Materials: a 30 cm × 40 cm tactile pad (homemade by sewing two fabrics together, adding sponge filling, and attaching fabric patches of different textures).

Implementation notes: (1) Communicate with parents for materials and production. (2) Explain to the class that this is a “tool to help concentration” to avoid stigmatization. (3) Clean and replace regularly.

2.2 Strategy 2: Embedding Routine Training into the Schedule

Design tactile regulation activities as fixed components of classroom routines. Use brief, high-frequency sessions before class, during breaks, and after class to help students adjust their arousal level and readiness to learn.

Example 1: A Two-Minute “Tactile Readiness Routine” before Class

After the preparatory bell, the whole class completes a two-minute routine. With assistance when needed, students with ASD focus on: rubbing hands to warm them; gently pressing the cheeks (deep pressure touch); crossing hands and pulling gently left and right (proprioceptive input); pinching and rubbing fingertips (fine tactile input); and taking three deep breaths (emotion regulation).

Implementation notes: (1) Use a visual sequence chart to display the steps. (2) During the first two weeks, the resource teacher leads in class; thereafter, the homeroom teacher continues. (3) Students with ASD may complete the routine

seated; standing is not required.

Example 2: A Five-Minute “Tactile Regulation Game” during Breaks

Set up rotating tactile game stations during longer breaks. Students with ASD participate with priority, and the stations are also open to the whole class. For example: Monday—“ball pit treasure hunt” (find target-colored balls in a pool of plastic balls); Wednesday—sand tray drawing (draw in sand with fingers); Friday—paired ball carrying (two students hold a ball between their bodies and move sideways).

Implementation notes: (1) Locate stations in a corridor area outside the classroom or in the resource room. (2) Student volunteers can serve as “helpers.” (3) Provide scaffolding for students with ASD and fade support gradually.

Example 3: After-School “Put Away and Reset” Tactile Practice

During end-of-day organization time, guide students with ASD through tactile integration tasks: sorting learning materials of different textures into designated baskets (e.g., plush items into a soft basket, blocks into a hard box); wiping desks with wet wipes (experiencing moisture and resistance); and fastening zippers and buckles (fine motor practice).

Observed effect (Case WBL): after three months of practice, the student progressed from being unable to organize materials to independently categorizing learning tools, with gradually stabilized emotions during the process.

2.3 Strategy 3: Instruction-Embedded Individualized Support

Embedding individualized tactile support into instruction based on students’ tactile profiles has been shown to reduce classroom problem behaviors for students with ASD [3]. Across subject areas, teachers can provide tactile materials and tools that both regulate sensation and align with learning tasks.

Example 1: Tactile Desensitization Support in Art Class

Case WBL showed strong aversion to sticky textures such as paint and liquid glue and would scratch arms and pull hair during art lessons. Supports included: a pre-class progression from dry clay to moist clay and then to paint (systematic desensitization); tool substitution (silicone brushes instead of finger painting; glue sticks instead of liquid glue); process support (a small tray of dry beans on the desk to grasp when uncomfortable); and natural reinforcement (after tactile contact, allowing the student to touch a soft towel that the student preferred).

Observed effect: after eight weeks, WBL could tolerate fingertip dot painting, and arm-scratching behavior decreased by 70%.

Example 2: Tactile Support for Pencil Grip in Writing Lessons

Case LZH pressed the pencil tip forcefully, often tearing paper, and frequently left the seat to seek tactile stimulation. Supports included: a weighted pencil grip (to increase proprioceptive input and stabilize the hand); a choice of writing surfaces (sandpaper, glossy paper, and rough paper) so that the student could select a preferred texture; and an immediate reinforcement schedule (after every three characters written, the student could touch the seat tactile pad once).

Observed effect: LZH's continuous seated writing time increased from 2 minutes to 8 minutes, and paper-tearing due to excessive pressure largely disappeared.

Example 3: Tactile Integration Activities in Physical Education

During warm-ups, design tactile integration activities for students with ASD: "animal walks" (bear crawl with palms on the ground; crab walk with hands and feet on the floor); "paired ball carrying" (two students hold a ball between their bodies, practicing functional peer contact); and a "tactile obstacle run" (walking barefoot across different surfaces such as mats, grass, and sand).

Implementation notes: (1) Communicate with the PE teacher about purposes and procedures. (2) Arrange peer volunteers for support. (3) Respect student willingness; participation is not forced.

2.4 Strategy 4: Interaction-Embedded Social Tactile Activities

Use structured games and cooperative tasks that involve mild tactile contact. Within a safe and enjoyable atmosphere, students with ASD can gradually tolerate functional physical contact and learn social rules.

Example 1: The "Cooperative Transport Team"

Every Friday afternoon during the second activity period, the resource teacher organizes a "cooperative transport team" game in class, pairing students with ASD with 23 peers. Tasks include: (1) Two students hold a yoga ball between their chests/abdomen and move sideways to the finish line (requires body contact). (2) Four students each hold one corner of a blanket, place soft blocks on it, and transport them cooperatively (coordination). (3) "Train through a tunnel": students place hands on the shoulders of the person in front and move through a tunnel formed by chairs (accepting touch).

Before the activity, provide advance information about rules and procedures to reduce anxiety and defensiveness. Suggested scripts include: saying "Let's move it together" before departure; high-fiving after success; and saying "It's okay, let's try again" when the ball drops. Peer interaction in a game context increases opportunities for social communication.

Observed effect (Case LWH): after six weeks, the student moved from avoiding contact to voluntarily holding hands with peers when lining up, with markedly reduced social

avoidance behaviors.

Example 2: The Break-Time "Triple Greeting"

Case ZHY tended to touch classmates with saliva-covered fingers. A replacement social tactile routine was designed: each morning after arriving at school, the student completed a "triple greeting" with a designated peer: wave → high five → fist bump. The teacher modeled appropriate force and technique, and the peer responded with a smile. Completion earned a sticker.

Implementation notes: during the first two weeks, the teacher accompanied the routine; afterwards, the peer completed it independently. The number of interaction partners increased gradually (from 1 to 3 peers). After three months, saliva-touching behaviors decreased by 90%, and the student began to greet others through waving and high fives.

Example 3: A "Take Turns Massage Station"

Before the midday rest, set up a "take turns massage station" that provides deep pressure input through tools such as massage balls and soft brushes. Deep pressure has been reported to help reduce anxiety and stereotyped behaviors in individuals with autism [7]. Each turn lasts 2 minutes and is controlled with a timer. Use social scripts such as "May I start?" before the massage and "Thank you" afterwards. Offer tool choices (e.g., a textured massage ball, a soft brush, a smooth massage stick).

Observed effect: Case DZY (tactile seeking) met sensory needs through massage and showed reduced self-stimulatory head tapping in class; Case ZHY learned waiting and turn taking, with improved quality of social interaction.

3. Practice Outcomes and Reflections

3.1 Typical Case Illustrations

Case A: Student with Tactile Defensiveness — ZHY (male, 8 years old)

Pre-intervention characteristics: strong resistance to wearing shoes and removing them immediately upon arrival at school; sucking fingers and touching peers with saliva-covered fingers; crying and tantrums when class transitions did not occur on time.

Embedded strategies were implemented to address these adaptive problem behaviors. Environmental supports included a tactile pad next to the seat for foot stepping and regulation when barefoot. Schedule-embedded supports added a foot massage component to the pre-class tactile readiness routine. Instructional supports included providing papers with different textures in art class and sandpaper number boards in mathematics. To promote social interaction, the student was guided to participate in the "cooperative transport team," increasing spontaneous functional tactile activities and learning to accept contact.

After the embedded tactile function training, ZHY's tactile defensiveness decreased and classroom behaviors improved,

as shown in Table 1.

Table 1: Changes in ZHY's behaviors before and after the intervention

Indicator	Pre-intervention	Post-intervention (16 weeks)
Wearing shoes	Removed shoes immediately after arriving at school	Wore shoes throughout the day
Emotional outbursts (times/day)	3-5	0-1
Touching others with saliva (times/day)	10+	1-2
Initiated social interaction	None observed	Waving; high fives

Case B: Student with Tactile Seeking — LZH (male, 9 years old)

Pre-intervention characteristics: difficulty remaining seated for more than 5 minutes; frequent head tapping and grabbing of private parts to seek stimulation; inappropriate toileting; and running out of the classroom once class began.

Embedded strategies were implemented as follows. Environmental supports included a seat tactile pad and a weighted pencil grip. Schedule-embedded supports included the pre-class tactile readiness routine and the break-time "ball pit treasure hunt." Instructional supports included using rough paper during writing lessons, with access to the tactile pad after every three characters. In social interaction games, the student participated with support in the "take turns massage station."

Behavioral changes after 16 weeks are shown in Table 2.

Table 2: Changes in LZH's behaviors before and after the intervention

Indicator	Pre-intervention	Post-intervention (16 weeks)
Seated time per episode	< 5 min	15-20 min
Head tapping (times/day)	20+	3-5
Inappropriate toileting	9 times/week	1 time/week
Classroom elopement	Daily	1-2 times/week

Case C: Student with Weak Daily Living Skills — WBL (female, 10 years old)

Pre-intervention characteristics: urinary incontinence more than three times per week; inability to express physiological needs; hair pulling and arm scratching for stimulation; and strong aversion to sticky tactile sensations.

Embedded strategies were implemented as follows. Environmental supports included a tactile "safe corner" with a mystery touch box containing rotating textures. Schedule-embedded supports involved following peers to complete after-school "put away and reset" tactile practice. Instructional supports consisted of systematic desensitization and tool substitution during art class. Social interaction supports included participation in the "triple greeting" routine.

Behavioral changes after 16 weeks are shown in Table 3.

Table 3: Changes in WBL's behaviors before and after the intervention

Indicator	Pre-intervention	Post-intervention (16 weeks)
Incontinence	3-4 times/week	1-2 times/month

frequency		
Expressing physiological needs	Unable	Able to take an adult by the hand and go to the restroom
Hair pulling (times/day)	Continuous	Occasional (< 5)
Participation in art class	Refused	Able to participate for 15 min

Note: For readability, values originally recorded with concatenated numerals in the source manuscript (e.g., "1520") are presented here as ranges (e.g., 15-20). Please verify these values against the original observation records before submission.

4. Implementation Challenges and Coping Strategies

In inclusive education practice, teachers commonly face constraints such as limited time and insufficient professional support [4]. For example, teachers may worry that pre-class routines or break-time game stations will reduce instructional time and affect curricular progress.

4.1 Scheduling Conflicts

Pre-class readiness routines and break-time stations may compete with teaching time. Practical approaches include integrating tactile activities into existing necessary routines (e.g., end-of-day organization), keeping activities brief (2-5 minutes) and using fragmented time, coordinating with the homeroom teacher to rotate responsibilities, and opening some activities to the whole class so that all students benefit and the practices are not perceived as "special treatment."

4.2 Peer Acceptance and Imitation

Differences between students with ASD and their peers (e.g., using a tactile pad or being barefoot) may lead to misunderstanding, exclusion, or imitation. Classroom-level responses include holding a class meeting on diversity (e.g., "We are all different"), inviting peers to serve as helpers, opening the tactile corner and massage station to all students, and using neutral descriptions such as "tools for concentration" and "ways to regulate" to avoid labeling.

4.3 Teacher Workload

Implementation requires collaboration among the homeroom teacher, subject teachers, and the resource teacher. Regular-class teachers without special education training may perceive these activities as additional burdens. Practical coping strategies include: having the resource teacher model implementation for the first two weeks and then transferring responsibility to the homeroom teacher; preparing visual flow charts and task checklists to reduce operational difficulty; scheduling weekly brief communications to adjust strategies; and reinforcing the embedded-intervention logic—these supports are not extra add-ons but a more effective replacement for ineffective management practices.

4.4 Family Collaboration

Some parents may not understand the purpose of tactile training or may be unable to maintain support at home. Teachers can share photos and videos to show progress, provide simplified home versions (e.g., a homemade touch box using common household items), encourage "five-minute

home practice” through small tasks, and host a monthly parent salon to exchange methods and experiences.

5. Key Considerations for Effective Application

Collaboration among teachers. Embedded strategies require coordinated work among the resource teacher, the homeroom teacher, and subject teachers. The resource teacher typically designs the plan and provides initial demonstration, while the homeroom teacher carries out daily implementation and monitoring, and subject teachers provide supports within their lessons. Regular communication, clear division of labor, and mutual backup are central to sustained implementation.

Gradual progression. Developing tactile regulation capacity takes time. Intervention intensity can increase incrementally, starting with low-intensity stimuli and expanding step by step from a few embedded moments to wider integration. Support can be faded gradually. In the practice reported here, ZHY took about 10 weeks to move from refusing shoes to wearing shoes throughout the day, with fluctuations observed during the process.

Attention to individual differences. Tactile profiles differ substantially across students. Some benefit most from deep pressure for calming, others need appropriate tactile-seeking outlets, and others require systematic desensitization. Strategy selection should follow prior assessment and should match the student’s profile with precision. For example, DZY benefited from squeezing input, ZHY required desensitization supports, and WBL required fine tactile practice.

Natural reinforcement within routines. Tactile regulation can be paired with natural reinforcement in daily routines. Completing a task can lead to a preferred tactile experience or a participation opportunity, while tactile regulation can facilitate re-engagement with ongoing activity. In this logic, tactile supports are treated as part of normal classroom flow rather than as an additional reward.

Home-school continuity. Generalization and maintenance depend on continuation in the home context. Providing simplified home versions and engaging parents in the rationale and procedures can support transfer. In this practice, parents of LZH reported that the student began using the “tactile readiness routine” at home to regulate emotions and started organizing toys voluntarily, indicating internalization of the skill.

6. Conclusion

Based on intervention practices with six students with ASD learning in regular classrooms, this study proposes a system of embedded strategies for tactile function training. Across four dimensions—environmental design, schedule and routines, instructional support, and social interaction—the strategies translate specialized tactile intervention into feasible micro-interventions embedded in everyday classroom processes.

The practice indicates that embedded tactile function training can improve classroom adaptation. Students with tactile

defensiveness showed more stable emotions; students with tactile seeking extended seated participation time; students with weak fine tactile skills showed gains in daily self-care; and students who avoided social touch began to tolerate functional interactions. Importantly, these changes occurred within routine classroom activities, without requiring additional sites, intensive staffing, or interruption of normal teaching. This is consistent with findings that sensory integration interventions can be effective when implemented in natural contexts [8].

For resource-constrained mainstream schools, an embedded perspective emphasizes that professional support does not need to be confined to a resource room, and that special support does not necessarily require extra time; it can be integrated into the ordinary rhythms of the classroom. When tactile exploration becomes a normal break-time option, tactile regulation becomes a stable pre-class routine, and tactile interaction becomes a structured component of peer engagement, inclusive education shifts from an added burden to an everyday ecology of support.

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