

Beyond Behavioural Compliance: A Structured Critical Narrative Review of Sensory Regulation, Self-Regulation, and Classroom Participation in Early Childhood

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Abstract

Young children's movement, withdrawal, sensory seeking, or difficulty sustaining classroom involvement may be interpreted too quickly as poor behavioural control, although these behaviours can reflect interactions among sensory demands, developing regulatory capacities, and classroom conditions. This review examined sensory regulation, self-regulation, and classroom participation as interconnected developmental processes. A structured critical narrative review synthesised peer-reviewed literature identified through ERIC, PsycINFO, CINAHL, and PubMed, using combinations of terms related to sensory processing and regulation, self-regulation, executive function, engagement, classroom participation, preschool, kindergarten, and early childhood. Eligible publications were published or first available online between January 2024 and August 2026 and were substantively relevant to the focal constructs and early childhood contexts. The final corpus comprised 30 publications mapped across eight overlapping analytical clusters. Findings indicated that sensory-processing characteristics were associated with self-regulation and participation, but did not support a simple causal pathway or universal sensory-based interventions. Self-regulation was multidimensional and context-sensitive, while participation depended on child–activity–environment fit and relational, pedagogical, and environmental support. The synthesis positions meaningful participation, rather than physical stillness or behavioural compliance, as the educationally relevant outcome.

Keywords: *classroom participation; developmental classroom ecology; early childhood education; self-regulation; sensory regulation*

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Introduction

Participation in an early childhood classroom asks a great deal of young children. They move between play and teacher-directed activities, listen and respond to instructions, share space and materials with peers, manage transitions, wait when necessary, and adjust their attention and behaviour as activities change. When these demands become difficult, the difficulty is often visible first in behaviour. A child may repeatedly leave a group activity, move continuously, seek particular sensory experiences, become overwhelmed during transitions, or struggle to remain involved. Such behaviour can easily be interpreted as poor attention, weak behavioural control, or an inability to “sit still.” Yet what is visible does not necessarily reveal what the child is trying to manage. Recent repeated-observation evidence reinforces this distinction. Kunz and Oeri (2026), for example, observed 201 kindergarten children repeatedly across classroom activities and found substantial within-child variability in attention and inhibitory control. Self-regulation, therefore, cannot be understood adequately as a fixed capacity that a child either possesses or lacks.

This distinction matters because behavioural stillness is often treated, implicitly or explicitly, as evidence of successful regulation. Self-regulation is broader: it involves children's developing capacity to manage attention, emotion, cognition, and action in relation to situational demands. Executive function contributes to these processes but is not synonymous with self-regulation. In a longitudinal study of 767 children across the Pre-K year, Turnbull et al. (2024) found that executive functioning at preschool entry was associated with gains in school-readiness skills, while behavioural engagement helped account for parts of this relationship. Regulation is therefore educationally important not because it necessarily produces quiet behaviour, but because it can support children's capacity to remain involved, respond to changing demands, and make use of opportunities to learn. Remaining seated may be appropriate in some activities, but stillness alone does not establish that a child is attentive, comfortable, or meaningfully engaged.

Sensory processing forms one part of this developmental picture, but it should not become a single explanation for children's behaviour. Children differ in how they register and respond to sound, movement, touch, visual information, proximity, and other sensory features of everyday environments. These differences may influence how manageable particular classroom demands become, while the behavioural expression of those demands may also depend on children's regulatory, social, and contextual resources. Recent kindergarten evidence illustrates this complexity. Gündoğmuş et al. (2026) found that greater sensory-processing difficulties were associated with lower self-regulation-related social skills and lower participation, including participation at school. Sensory processing and social skills also jointly contributed to variation in participation. Evidence from preschool children with sensory modulation disorder similarly indicates that sensory difficulties, behavioural challenges, social skills, and social participation are interconnected rather than reducible to a direct sensory-to-behaviour pathway (Zaguri-Vittenberg et al., 2026). These findings make sensory functioning relevant to participation, but they do not establish that sensory differences alone cause poor self-regulation or that increasing sensory input will necessarily improve classroom behaviour.

The classroom context further complicates any simple child-level explanation. Early childhood settings vary in noise, movement, activity structure, transitions, opportunities for play, expectations for independence, interpersonal demands, and adult support. The same child may therefore participate successfully in one situation and struggle in another. Kunz and Oeri's (2026) repeated classroom observations demonstrated that children's attention and inhibitory control varied not only between children but also within the same child across observations and activities. Such variability shifts attention from asking only whether a child "has" sufficient self-regulation towards examining the conditions under which regulation and participation become more or less manageable. It also places activity demands, peer interactions, teacher support, and the sensory and physical environment within the developmental account rather than treating them merely as background conditions.

How adults interpret visible behaviour consequently matters. Frequent movement, withdrawal, sensory seeking, inconsistent engagement, or difficulty transitioning can invite responses aimed primarily at reducing the visible behaviour when it is interpreted as non-compliance. A participation-oriented interpretation asks a different set of questions: what was the activity requiring, under what conditions did difficulty emerge, what support was available, and what helped the child enter, remain in, or return to the activity? This shift does not mean that behavioural difficulty should automatically be attributed to sensory processing, nor does it imply that sensory-based strategies are universally appropriate. Recent reviews of sensory-based interventions report differentiated rather than uniform effects across strategies and outcomes, with stronger support for some approaches and limited or inconsistent evidence for others (Piller et al., 2025). The relevant educational question is therefore not simply whether an intervention makes behaviour look calmer, but whether it supports functional involvement and participation.

Despite growing research across these areas, the contemporary evidence remains distributed across disciplinary traditions. Occupational therapy and clinical research have examined sensory processing, sensory modulation, and sensory-based support; developmental research has investigated self-regulation, executive function, attention, and inhibitory control; and early childhood research has examined engagement, teacher-child interaction, classroom conditions, and developmental outcomes. Individual connections are increasingly visible. Sensory-processing characteristics have been associated with self-regulation-related functioning and participation, while executive functioning has been linked with behavioural engagement and school-readiness development (Gündoğmuş et al., 2026; Turnbull et al., 2024). However, these relationships are more commonly examined in parts than as components of the same developmental classroom process. Consequently, what remains insufficiently developed is an integrated account of how sensory regulation, developing self-regulation, and classroom participation relate to one another within the everyday ecology of early childhood classrooms.

This gap has practical as well as conceptual consequences. When the relevant literatures remain separated, sensory behaviour can be reduced to a deficit requiring sensory intervention, self-regulation to individual behavioural control, and participation to outward compliance. Bringing these literatures together allows a different question to be asked: under what combinations of child capacities, activity demands, relationships, and environmental conditions does meaningful participation become possible? The contribution of this review therefore lies not in proposing another linear pathway from sensory processing to behaviour, but in integrating these fragmented bodies of evidence into a developmental classroom ecology that distinguishes sensory regulation, developing self-regulation, and meaningful participation while examining how their relationships are shaped by activity, relational, and environmental conditions.

Accordingly, this structured critical narrative review examines how sensory regulation, self-regulation, and classroom participation can be understood together through a developmental lens. Rather than asking whether a particular sensory strategy makes children calmer or more compliant, the review critically integrates evidence across occupational therapy, developmental psychology, and early childhood education to clarify where these bodies of evidence converge, where their claims require qualification, and what their intersection means for children's participation in everyday classroom life. The review is guided by the following question: How can sensory regulation, self-regulation, and classroom participation be understood as interconnected developmental processes in early childhood?

Methods

Review Design and Search Strategy

This study used a structured critical narrative review to examine sensory regulation, self-regulation, and classroom participation as related developmental processes in early childhood. A narrative approach was appropriate because the relevant evidence comes from several research traditions, including early childhood education, developmental psychology, occupational therapy, and sensory-processing research, with substantial variation in terminology, measures, and study design. The purpose was therefore to compare and interpret relationships across this literature rather than estimate a pooled effect.

Searches were conducted in ERIC, PsycINFO, CINAHL, and PubMed for peer-reviewed publications published or first available online between January 2024 and August 2026. Search terms combined concepts related to sensory processing and regulation, self-regulation and executive function, engagement and participation, and preschool, kindergarten, or early childhood settings. Terms were adjusted across databases where disciplinary terminology differed. Database searches were supplemented by citation and reference-chain searching of relevant publications.

Eligibility and Study Selection

Publications were eligible when they were peer-reviewed journal articles or substantive peer-reviewed reviews, involved preschool, kindergarten, early childhood, or a closely relevant early-school population, and contributed directly to understanding sensory processing or regulation, self-regulation, executive function, engagement, participation, or related classroom conditions. Studies were excluded when these constructs were incidental to the research, the population or educational context was too distant from the focus of the review, the publication type was ineligible, or the findings made little substantive contribution to the review question. Studies involving clinical populations or older children were retained selectively when they addressed relationships that were poorly represented in preschool research and were interpreted as boundary evidence rather than as directly representative of typically developing preschool populations.

The search identified 430 records: 412 through database searching and 18 through citation and reference-chain searching. After 82 duplicates were removed, 348 records underwent title and abstract screening and 271 were excluded. Seventy-seven reports were sought for full-text assessment; three could not be retrieved. Of the 74 full-text reports assessed, 44 were excluded because of insufficient population relevance ($n = 15$), inadequate alignment with the focal constructs or relationships ($n = 11$), insufficiently relevant educational or developmental settings ($n = 7$), ineligible publication type or study design ($n = 5$), or insufficient contribution to the conceptual synthesis ($n = 6$). The final corpus comprised 30 contemporary peer-reviewed publications. Figure 1 presents this process using a PRISMA-informed flow. The flow was used to make study selection transparent; the review remained a structured critical narrative review rather than a systematic review.

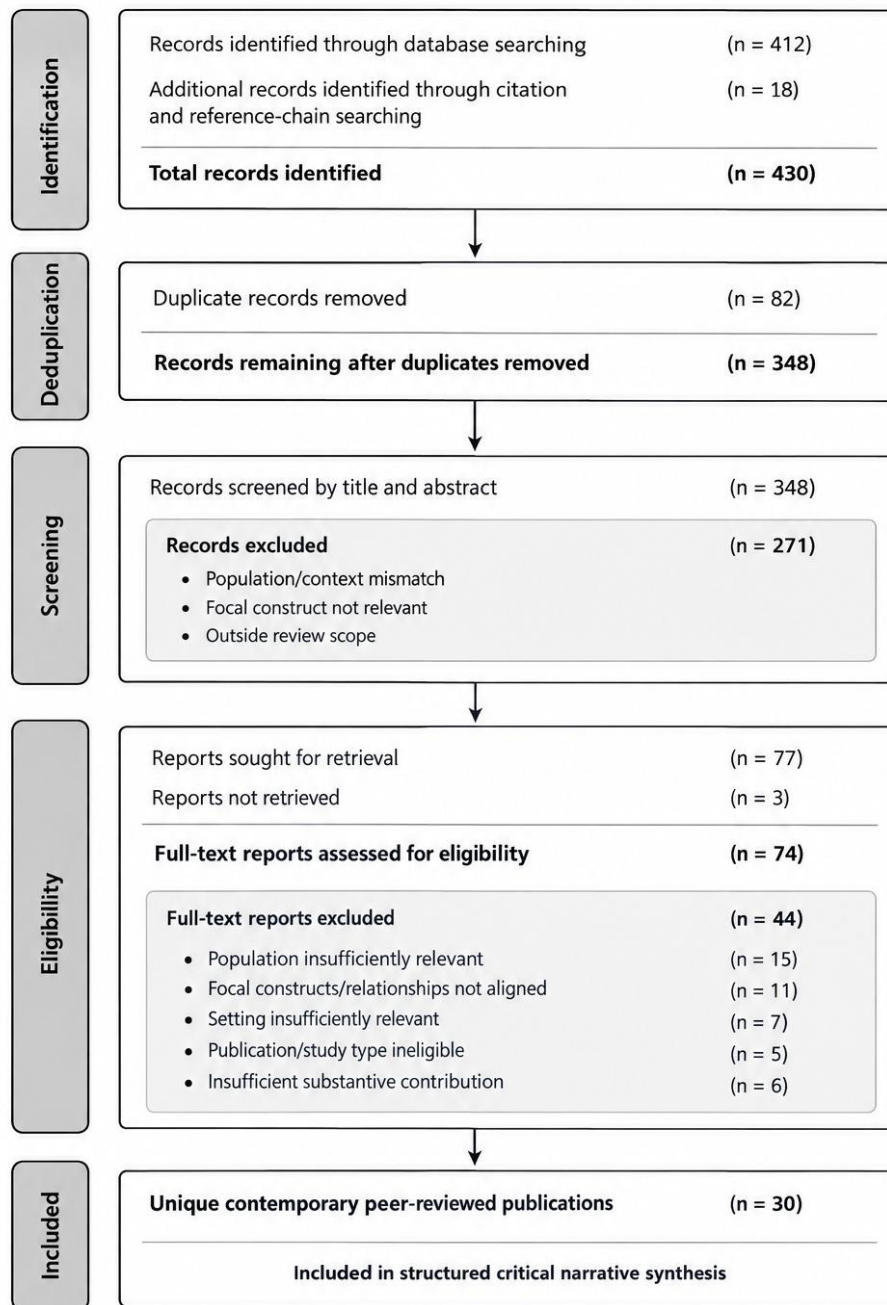


Figure 1. PRISMA-informed study selection flow for the structured critical narrative review

Evidence Mapping and Synthesis

For each included publication, information was charted on the population and context, study design, focal constructs, measures or sources of evidence, principal findings, methodological limitations, and contribution to the review question. The 30 publications were then mapped across eight overlapping areas: sensory processing and regulation; sensory regulation and self-regulation; executive function, attention, and inhibitory control; self-regulation or executive function in relation to engagement and participation; sensory processing and participation; intervention or developmental support; teacher, classroom, and environmental context; and studies connecting the three focal domains. A publication could contribute to more than one area when its findings addressed several relationships. This preserved distinctions among related constructs while allowing findings from different research traditions to be considered together.

Analysis involved comparison within and across these areas. Attention was given to findings that converged, findings that differed across populations or contexts, and conclusions that needed qualification because of study design or measurement. Associations were not treated as evidence of causality, and findings from specialised or clinical populations were not assumed to apply directly to typically developing preschool

children. The synthesis was used to examine whether the literature supported a simple sequence from sensory regulation to self-regulation and participation, or whether these processes were better understood in relation to activity demands, relationships, classroom conditions, and child–activity–environment fit. The resulting framework was treated as an interpretation of the available evidence rather than a tested causal model.

SANRA (Scale for the Assessment of Narrative Review Articles; Baethge et al., 2019) informed the reporting and critical appraisal of the review, particularly the justification of the review question, description of the literature search, use of references, scientific reasoning, and presentation of evidence. SANRA was used as a quality framework for the narrative review, not as a study-level risk-of-bias tool.

Results and Discussions

Overview of the Evidence and Cross-Study Patterns

The final corpus comprised 30 contemporary peer-reviewed publications spanning sensory-processing research, self-regulation and executive-function studies, classroom engagement and participation research, intervention evidence, and studies addressing relational or environmental conditions. Because individual publications could contribute to more than one analytical cluster, the eight clusters were used as overlapping mapping devices rather than mutually exclusive categories. Across this heterogeneous evidence base, three cross-study patterns were particularly salient.

First, sensory-processing characteristics were repeatedly associated with regulatory functioning and participation, but the form and strength of these relationships varied across populations, sensory patterns, outcomes, and study designs. Evidence from specialised populations supported associations between sensory responsiveness and self-regulatory difficulty, while kindergarten and longitudinal studies extended these relationships to participation. However, the predominance of observational and cross-sectional evidence did not support a simple causal sequence from sensory-processing difficulty to poor self-regulation and subsequently to reduced participation.

Second, self-regulation emerged as a multidimensional and context-sensitive developmental process rather than a stable behavioural characteristic. Executive function, attention, inhibitory control, emotional and behavioural regulation, and social functioning overlapped across studies without being interchangeable. Longitudinal and classroom-observation evidence further indicated that regulatory functioning was related to engagement and developmental outcomes while also varying within children across activities and occasions.

Third, participation was more adequately understood when child characteristics were considered together with activity, relational, pedagogical, and environmental conditions. Evidence concerning teacher–child interaction, peer relationships, play, classroom environments, and sensory-informed support indicated that regulation occurs within classroom contexts rather than independently of them. Across the corpus, the strongest convergence therefore concerned neither a single sensory mechanism nor a universal intervention, but the importance of child–activity–environment fit in understanding when children can access, sustain, or return to meaningful classroom participation.

Table 1 summarises how these patterns were distributed across the eight analytical clusters and identifies the principal evidentiary qualifications that shaped the synthesis. The thematic discussion that follows then examines sensory regulation and its evidentiary limits, its intersection with developing self-regulation and meaningful participation, and the relational, pedagogical, and environmental conditions through which these processes become consequential in everyday classroom life.

Table 1. Cross-study synthesis across the eight analytical clusters

Cluster	Primary focus	Cross-study pattern	Evidentiary qualification	Contribution to synthesis
C1. Sensory processing and regulation	Sensory responsiveness, sensory seeking, modulation, and sensory-processing differences	Sensory characteristics varied across children and were associated with differences in adaptive functioning and classroom-related outcomes.	Sensory patterns were heterogeneous and could not be treated as a single form of difficulty with a uniform consequence.	Sensory functioning was positioned as one component of children's classroom experience rather than a sufficient explanation of behaviour.

Cluster	Primary focus	Cross-study pattern	Evidentiary qualification	Contribution to synthesis
C2. Sensory regulation and self-regulation	Relationships between sensory characteristics and regulatory functioning	Sensory-processing difficulties were associated with aspects of dysregulation, self-regulatory difficulty, and social-regulatory functioning.	Much of the evidence was observational or cross-sectional and included specialised or clinical populations; causal direction could not be established.	Sensory regulation and broader self-regulation were interpreted as intersecting but distinct developmental processes.
C3. Executive function, attention, and inhibitory control	Developing regulatory capacities underlying classroom functioning	Executive function, attention, and inhibitory control were related to developmental and classroom outcomes but showed conceptual and measurement differences across studies.	Executive function was not equivalent to the broader construct of self-regulation, and performance could vary across measures and contexts.	Supported a multidimensional account of developing self-regulation rather than a single behavioural capacity.
C4. Self-regulation or executive function in relation to engagement and participation	Regulatory capacities and children's involvement in classroom activity	Developing regulatory capacities were associated with behavioural engagement, learning behaviours, and school-related functioning.	Engagement and participation were related but non-equivalent constructs, and the evidence did not establish a single developmental pathway.	Positioned participation as educationally consequential while allowing participation itself to provide opportunities for regulatory development.
C5. Sensory processing and participation	Sensory characteristics in relation to social, school, or broader participation	Sensory-processing characteristics were associated with participation outcomes, sometimes alongside social and regulatory functioning.	Relationships differed by sensory pattern, population, and outcome; sensory characteristics alone did not account for participation.	Supported the possibility of both direct and intertwined relationships between sensory demands and participation.
C6. Intervention or developmental support	Sensory-based approaches, classroom supports, movement, and developmental intervention	Some approaches showed potential benefits or classroom feasibility, but findings were uneven across strategies and outcomes.	Evidence was heterogeneous in intervention type, population, design, and outcome, with limited support for universal prescriptions.	Shifted evaluation of support from visible calmness toward functional access, involvement, and participation.
C7. Teacher, classroom, and environmental context	Teacher–child interaction, peers, play, movement, pedagogy, routines, and physical or sensory conditions	Regulatory functioning varied with classroom relationships, activity demands, environmental conditions, and opportunities for support.	Contextual factors were rarely examined together, and associations did not imply that classroom conditions alone determined regulation.	Established classroom ecology as part of the explanation of regulation and participation rather than as background context.
C8. Direct or near-direct connections among sensory regulation, self-regulation, and participation	Evidence linking the three focal domains	The closest connecting studies supported interdependence among sensory characteristics, regulatory functioning, and participation rather than a fixed linear sequence.	No included evidence directly tested the complete proposed developmental framework as a causal model.	Provided the basis for integrating the corpus through child–activity–environment fit and reciprocal, context-sensitive relationships.

Clusters were overlapping analytical mapping devices; individual publications could contribute to more than one cluster. The table therefore represents patterns of evidence rather than mutually exclusive study categories or quantitative effect estimates.

Sensory Regulation: Beyond Sensory Input

Sensory processing offers one way of understanding why the same classroom may be manageable for one child and demanding for another. Young children take part in classroom activities while registering and responding to sound, movement, touch, visual information, proximity to others, and changes in activity. Children differ in these responses, including in patterns of heightened responsiveness, reduced responsiveness, and sensory seeking (Chen et al., 2025; Uygun et al., 2025). The important issue is not simply how much

sensory input a child receives, but how sensory demands are experienced and managed while the child is trying to participate.

Recent studies indicate that sensory-processing characteristics and self-regulatory functioning can be related, although the evidence does not support a uniform developmental pathway. Preschool children with sensory over-responsivity showed greater self-regulatory difficulties than comparison children in Uygun et al. (2025). Among preschool children with autism, Lee et al. (2026) also reported associations between sensory-processing difficulties and dysregulation or deficient self-regulation. The convergence is noteworthy, but both studies concern children with identified sensory or developmental characteristics. They support a relationship between sensory responsiveness and regulation; they do not establish that sensory differences cause poor self-regulation in young children generally.

Evidence concerning participation broadens the picture. In a kindergarten sample, Gündoğmuş et al. (2026) found that greater sensory-processing difficulties were associated with lower self-regulation-related social skills and lower participation. Sensory processing and social skills jointly contributed to the prediction of participation, suggesting that sensory functioning does not operate independently of children's developing social and regulatory capacities. (Zaguri-Vittenberg et al. (2026) reached a related conclusion in preschool children with sensory modulation disorder, where behavioural and social functioning were implicated in the relationship between sensory difficulties and social participation. These studies point towards an interaction among sensory experience, regulation, and participation rather than a direct sensory-to-behaviour explanation.

Longitudinal evidence adds a developmental dimension. Chen et al. (2025) examined early patterns of sensory hyperresponsiveness, hyporesponsiveness, and sensory seeking in autistic and non-autistic children and related these trajectories to later adaptive, maladaptive, and participation outcomes. Associations differed according to sensory pattern and child characteristics. That variation matters: "sensory difficulty" cannot be treated as a single condition with a predictable consequence. Different patterns may matter differently, at different points in development, and under different environmental demands.

The intervention literature requires even greater restraint. Reviews of sensory-based approaches report uneven evidence across strategies and outcomes. Piller et al. (2025) found support for some approaches but insufficient or contradictory evidence for others. Latifi et al. (2026) reported possible benefits of sensory activity schedules for some aspects of school performance among students with sensory-processing differences, but the evidence base was weak and relied heavily on single-subject studies. Unwin et al. (2024) likewise found considerable variation in the evidence supporting school-based sensory approaches. An association between sensory processing and functioning, therefore, should not be translated into the assumption that adding sensory stimulation will improve attention, behaviour, or participation.

The preschool literature gives similar reason for caution. Hockey et al. (2025) identified a limited and heterogeneous evidence base for sensory-based practices in preschool settings. Smaller classroom studies have begun to explore how support might be incorporated into everyday routines. Abou-Eid (2026), for example, examined teacher-mediated sensory activities within preschool routines and transitions, while Kincs et al. (2026) described the use of sensory corners within two preschool classrooms. These studies are useful because they locate sensory support within children's ordinary classroom lives rather than only within specialist settings. Their designs, however, do not warrant broad claims of effectiveness. At this stage, they are more informative about feasibility and possible forms of support than about what works consistently across children.

The evidence also makes it useful to distinguish sensory input, sensory processing, and sensory regulation. Sensory input is the information available through sensory systems. Sensory processing concerns how that information is registered and responded to. In this review, sensory regulation refers to the management of sensory demands in ways that permit adaptive involvement in ongoing activity. This working definition places functioning at the centre. It does not assume that a particular amount or type of sensory input is inherently regulating, nor that a visible behaviour reveals its sensory function.

This distinction matters in an early childhood classroom because the same behaviour can have different meanings. A child who leaves a crowded group activity may be responding to sensory demands, losing interest, finding the task too difficult, seeking movement, or reacting to something entirely different. A child who repeatedly touches materials may be exploring, seeking sensory information, or simply participating in a way expected at that developmental stage. Behaviour can alert an educator that something deserves closer attention, but it cannot by itself identify the underlying process. Sensory-informed interpretation is therefore most useful when it expands the questions adults ask rather than providing a quick label for what a child does.

Seen this way, sensory support is less about making children quieter and more about examining whether particular sensory demands are interfering with participation. For one child, a predictable transition or an opportunity to move may make an activity more manageable; another child may need no such adjustment. The

relevant test is functional: whether the support helps that child access, remain involved in, or return to an activity. This child–activity–environment fit is more consistent with the evidence than a universal prescription for sensory stimulation.

Across these studies, the theoretical significance of sensory regulation for early childhood education shifts away from a child-deficit or input-based model. Sensory characteristics appear to matter not because they determine behaviour directly, but because they alter the demands children encounter while attempting to participate in particular activities and environments. This interpretation also helps reconcile apparently different findings across sensory-processing, intervention, and classroom studies: associations between sensory characteristics and functioning can coexist with inconsistent intervention effects because participation depends on more than sensory input alone. For early childhood education, sensory regulation is therefore better positioned as one component of child–activity–environment fit, interacting with developing regulatory capacities and classroom conditions rather than operating as an independent mechanism for producing compliant behaviour.

Sensory regulation alone, however, cannot account for classroom participation. Across the studies reviewed here, attention, inhibitory control, emotional and behavioural regulation, executive functioning, and social competence repeatedly appear alongside sensory processes. These capacities belong to the broader developmental domain of self-regulation. The next section therefore considers how sensory regulation intersects with the emerging capacities through which young children organise attention, emotion, cognition, and action.

From Sensory Regulation to Developing Self-Regulation

Sensory regulation addresses one part of what young children manage as they participate in classroom life. Self-regulation is broader, involving developing capacities to organise attention, emotion, cognition, and behaviour as demands change. Executive functions such as inhibitory control, working memory, and cognitive flexibility contribute to this process, but executive function and self-regulation are not interchangeable terms. Ross and Aschetta (2025) found considerable overlap in the terminology and measures used across early childhood research on self-regulation, executive function, and behavioural regulation. Rather than treating these labels as different names for a single ability, this review uses self-regulation as the broader developmental domain and considers executive functions among the processes that contribute to it.

The connection with sensory regulation is plausible but not yet sufficiently established to be arranged as a developmental sequence. Uygun et al. (2025) reported poorer self-regulatory functioning among preschool children with sensory over-responsivity, while Lee et al. (2026) found associations between sensory-processing difficulties and dysregulation among preschool children with autism. Gündoğmuş et al. (2026) also identified a relationship between sensory-processing difficulties and lower self-regulation-related social functioning in a kindergarten sample. Findings across these different populations point to an intersection between sensory and self-regulatory processes. Most of the evidence, however, is observational or cross-sectional, and the studies do not measure regulation in identical ways. It would therefore be premature to conclude that sensory-processing differences lead to poorer self-regulation.

A more cautious interpretation begins with what children are being asked to manage. A child may need to cope with noise and proximity to others while listening to an instruction, inhibit an immediate response while waiting for a turn, or shift from an enjoyable activity to a less preferred one. Sensory, attentional, emotional, and behavioural demands can occur at the same time. For a child who finds particular sensory conditions difficult, managing those conditions may become part of the regulatory work required to stay involved. Emerging self-regulatory capacities may, in turn, help the child respond more flexibly when the situation changes. Current evidence supports this interaction more readily than a one-way pathway from sensory regulation to self-regulation.

Development also matters because the capacities involved are still taking shape during the preschool and kindergarten years. Turnbull et al. (2024) found that executive functioning at the beginning of Pre-K was related to later classroom engagement and gains in school-readiness skills. Across the transition to kindergarten, executive functioning has also been associated with subsequent social and academic adjustment (Memba & Ostrov, 2025). Wyatt et al. (2025) reported relationships among hot and cool executive control, on-task involvement, and later classroom learning behaviours. Regulation is therefore not best understood as something children must first acquire before they are ready to participate. Children bring emerging capacities into classroom activities, use them there, and encounter further opportunities to develop them.

What children demonstrate in the classroom may also differ from what a single assessment suggests about their regulatory ability. Maloney et al. (2025) showed that measures of executive functioning and self-

regulating behaviour capture different aspects of children's functioning. More importantly for classroom interpretation, Kunz and Oeri (2026) documented substantial within-child variation in attention and inhibitory control across repeated kindergarten observations. A child who manages one activity successfully may struggle in another. Even within familiar routines, regulatory performance can change from one occasion to the next.

This variability makes broad descriptions such as “well regulated” or “poorly regulated” less informative than they first appear. Whole-group instruction, free play, peer negotiation, transitions, waiting, and unfamiliar tasks do not ask the same things of a young child. Nor do they provide the same forms of support. What matters is not uninterrupted control across the school day but the child's growing ability to adjust attention, emotion, and action sufficiently for different situations. Difficulty in one context should therefore invite closer examination of that context rather than immediately becoming a judgement about the child's general capacity for self-regulation.

Regulation also develops with other people. Gavrilova et al. (2024) reported associations between teacher–child interaction quality and aspects of executive functioning, and Bai et al. (2025) found that teacher-related factors and teacher–child relationships were associated with children's self-regulation. Weiss et al. (2026) located regulatory development within peer relationships, emotional support, and opportunities for free play. Nilfyr and Ewe (2025), approaching emotional self-regulation from an interactionist perspective, similarly emphasised that regulation in preschool is embedded in relationships. The child is doing the regulating, but not in social isolation.

This point is especially important in early childhood, where adult support remains part of the developmental landscape. Teachers structure routines, give cues, respond when children become overwhelmed or frustrated, and adjust the amount of help children receive. Peers create another set of demands and opportunities: children wait, negotiate, disagree, change plans, repair interactions, and try again. Studies of educator professional learning and structured play further suggest that everyday classroom practice can provide opportunities for children to exercise regulatory and executive capacities (Etokabeka, 2025; Muir et al., 2024). Such evidence does not identify one teaching method that produces self-regulation. It shows why self-regulation cannot be understood apart from the activities and relationships in which children are learning to manage themselves.

Self-regulation in early childhood is therefore better understood as developing, multidimensional, and context-sensitive. Sensory regulation intersects with it because sensory demands are among the many demands children may need to manage. Executive functions contribute to it without accounting for the whole process. Relationships and classroom experiences provide conditions in which regulation is supported, challenged, and practised. None of these elements alone explains how a child participates.

This brings the argument to its educational consequence. The value of regulation is not that it makes children's behaviour look controlled; it is that regulation can help children remain involved, adapt when circumstances change, and return to activity after difficulty. The next section therefore turns from the development of regulation itself to the outcome that matters in the classroom: children's participation.

Beyond Sitting Still: Regulation and Meaningful Classroom Participation

The educational importance of self-regulation becomes clearer when attention shifts from how children's behaviour looks to what their regulation allows them to do. Participation in an early childhood classroom involves entering activities, staying involved long enough to take part, responding to other people, managing changes in demand, and returning after moments of difficulty. The form this takes depends on the activity. Listening during a story, negotiating a role in pretend play, working alongside peers, joining an action song, and waiting while another child speaks may all involve regulation, but they do not require children to behave in the same way.

Research connecting self-regulatory capacities with classroom functioning supports this emphasis on involvement. Turnbull et al. (2024) found that behavioural engagement helped account for relationships between executive functioning and gains in school-readiness skills across the Pre-K year. Wyatt et al. (2025) likewise reported prospective relationships among executive control, on-task involvement, and later classroom learning behaviours, while Memba and Ostrov (2025) linked executive functioning across the transition to kindergarten with later social and academic outcomes. These studies use different measures and should not be read as evidence of a single pathway. They do, however, place children's engagement with classroom experiences between regulatory capacity and broader developmental outcomes.

Engagement and participation are closely related without being identical. Engagement describes the quality or degree of children's involvement, whereas participation also concerns their access to and involvement in the activities and relationships that make up classroom life. The distinction is useful because

regulation does not simply precede participation. Classroom experiences give children opportunities to practise the very capacities they are still developing. Waiting for a turn, sustaining a shared game, adjusting when a peer changes the plan, persisting with a difficult task, or returning after frustration all call upon regulation while also providing occasions to exercise it. Alamos et al. (2025), for example, showed that regulatory development unfolds alongside other developmental capacities within preschool classroom contexts. Participation can therefore be both supported by regulation and part of the experience through which regulation develops.

Sensory-processing research points in the same direction. Gündoğmuş et al. (2026) found associations among sensory-processing difficulties, lower self-regulation-related social functioning, and lower participation in kindergarten children. Zaguri-Vittenberg et al. (2026) similarly identified links among sensory modulation difficulties, behavioural and social functioning, and social participation in preschool children. Chen et al. (2025) further showed that early sensory-response patterns were associated with later adaptive and participation outcomes. None of these studies establishes a simple sensory-to-participation pathway. Their importance lies in showing that sensory characteristics can matter for children's functioning while regulatory, social, and developmental processes remain part of the picture.

This is where behavioural stillness becomes an unreliable shorthand. A child sitting quietly during a group activity may be listening closely and participating successfully. Another child in the same posture may be uncertain, disengaged, or overwhelmed. Movement is similarly open to interpretation. It may interrupt participation, but it may also occur within purposeful engagement or help a child remain involved. Evidence from movement research is relevant here. Pacheco et al. (2025), in a systematic review of randomised controlled trials, found that cognitively engaging physical activity could support aspects of executive functioning, including attention and inhibitory control. Studies of preschool physical activity and movement patterns also show that movement and self-regulation are not opposing categories (Aadland et al., 2024; Lemos et al., 2026). These findings do not make movement inherently beneficial. They simply give little reason to use stillness alone as evidence that regulation has been achieved.

The same caution applies to compliance. Young children need to learn to follow safety instructions, listen when others are speaking, wait for turns, participate in shared routines, and inhibit actions that interfere with other people. These are legitimate parts of classroom life and can require considerable regulation. The difficulty begins when compliance becomes the principal measure of successful participation. A child can follow an instruction without being meaningfully involved in the activity, just as a child can be deeply involved while speaking, moving, manipulating materials, or asking for help. Compliance may therefore be required within participation, but it does not define participation.

For this review, meaningful classroom participation is used to describe adaptive involvement that allows a child to access, contribute to, or benefit from the social and learning activity at hand. The word *meaningful* does not imply that activities must be child-led, freely chosen, or enjoyable at every moment. Teacher-directed activities, collective routines, and expectations for waiting or listening remain part of early childhood education. What distinguishes participation from mere behavioural conformity is that the child is able to be involved in the purpose of the activity rather than only producing the expected outward behaviour.

This definition changes what counts as useful evidence when a child is struggling. Consider a child who repeatedly leaves a whole-group activity. Knowing that the child left the group is important, but it is not enough. Did the child remain involved longer when the activity was shorter? Was participation different when materials could be handled? Did difficulty emerge during waiting rather than during the activity itself? Could the child return with a cue from the teacher? Questions such as these locate behaviour within participation and may reveal conditions under which the child can manage more successfully. They are more informative than deciding from the outset that the child simply lacks self-control.

The same functional criterion should be applied to sensory-informed support. Reviews of sensory-based interventions report mixed findings for attention, behaviour, and school performance (Latifi et al., 2026; Piller et al., 2025; Unwin et al., 2024). A strategy should therefore not be judged successful merely because a child becomes quieter after it is introduced. A more relevant question is whether the support improves access to the activity, helps the child sustain involvement, makes a difficult transition manageable, or supports a return to participation after difficulty. Visible calm may accompany those changes, but it is not the outcome by which they should automatically be defined.

Participation also varies with what the classroom is asking of the child. The repeated observations reported by Kunz and Oeri (2026) showed substantial within-child variability in attention and inhibitory control across kindergarten contexts. A child who participates successfully during play but struggles during a prolonged group activity has not become a different child between the two situations. The regulatory demands

have changed. So, potentially, have the available supports, sensory conditions, social expectations, and reasons for being involved.

Meaningful participation is therefore neither a property of the child nor a synonym for engagement, compliance, or successful self-regulation. It is an outcome of the continuing encounter between children's developing capacities and the activities, people, and environments around them. Sensory regulation may affect how manageable those encounters are; self-regulation may help children adjust to their demands; participation gives those regulatory processes educational significance. To understand why participation becomes possible in one situation and difficult in another, however, the analysis must extend beyond the child. The next section turns to the developmental classroom ecology in which these encounters take place.

Regulation Within a Developmental Classroom Ecology

Young children do not regulate in a vacuum. They regulate while listening to a teacher, entering play, waiting for materials, moving through transitions, negotiating with peers, coping with noise, and trying to understand what an activity expects of them. The same child may manage these situations differently because each places different sensory, attentional, emotional, social, and behavioural demands on developing regulatory capacities. Regulation in the classroom is therefore better understood in relation to the situations in which it is required, rather than as something located entirely within the child.

Evidence from classroom observation gives strong support to this contextual view. Kunz and Oeri (2026) documented substantial within-child variability in attention and inhibitory control across repeated kindergarten observations. Martin et al. (2024), approaching regulation at classroom level, examined features of kindergarten environments that may support children's self-regulation. Although associations between individual environmental features and child outcomes were not uniformly strong, these studies make an important point when read together: what children demonstrate in the classroom reflects both their developing capacities and the conditions under which those capacities are being used. A regulatory difficulty observed in one setting should not automatically be assumed to describe how the child functions across the school day.

Relationships with adults are part of those conditions. Gavrilova et al. (2024) reported associations between the quality of teacher–child interactions and aspects of preschool children's executive functioning, while Bai et al. (2025) linked teacher-related characteristics and teacher–child relationships with children's self-regulation. Nilfyr and Ewe's (2025) review similarly situated emotional self-regulation within children's interactions rather than treating it solely as an internal capacity. These findings do not mean that teachers determine how well children regulate. They do suggest that children practise regulation in relationships where adults can make expectations clearer, provide support during difficulty, and gradually alter that support as children's capacities develop.

This is where co-regulation becomes especially relevant. A preschool child who cannot yet move smoothly from play to a teacher-directed activity may initially need a warning, a familiar cue, or an adult nearby to help complete the transition. Another child may need help naming what has happened after a conflict before being able to return to play. Such support is not the opposite of self-regulation. During early childhood, external support can provide the conditions in which children remain able to participate while more independent forms of regulation are still emerging. The developmental question is not how quickly adult support can be removed, but whether support is responsive to what the child can currently manage and changes as greater independence becomes possible.

Peers create a different regulatory context. Children have to coordinate their intentions with those of others, wait for access to materials, negotiate roles, tolerate disagreement, repair interactions, and sometimes abandon a plan they preferred. Weiss et al. (2026) examined self-regulatory development in relation to peer relationships, classroom emotional support, and opportunities for free play, illustrating how regulation develops within social experiences that adults cannot completely script. The regulatory work of early childhood therefore occurs during peer interaction as well as during teacher-directed tasks.

Play deserves particular attention for the same reason. In pretend play, construction, games, or collaborative activities, children may need to remember a shared idea, inhibit an immediate impulse, shift plans, communicate intentions, and adjust to what another child does. Etokabeka (2025) described preschool teachers' use of structured play to support executive-function skills, while Muir et al. (2024) showed how professional learning could strengthen educators' capacity to foster self-regulation and executive functioning through everyday practice. Movement can also involve regulatory work rather than interrupt it; cognitively engaging physical activity may recruit attention and executive processes (Pacheco et al., 2025). Play and movement are therefore among the contexts in which regulation can be exercised, although neither should be assumed to improve regulation simply by being present.

The sensory environment forms another part of the classroom ecology. Noise, visual complexity, proximity to other children, touch, movement around the room, transitions, materials, and the organisation of physical space create sensory demands that may be experienced differently from one child to another. A busy classroom does not become uniformly “overstimulating” simply because it contains considerable sensory activity. Nor is a quiet classroom necessarily optimal for every child. What matters is whether particular sensory conditions interfere with or support a child's ability to remain involved in what is happening.

Emerging classroom studies provide examples of how educators might respond when sensory demands appear relevant. Kincs et al. (2026) examined sensory corners that children could access within preschool classrooms, while Abou-Eid (2026) investigated teacher-mediated sensory activities incorporated into routines and transitions. The evidence remains too limited to establish these approaches as generally effective. Their relevance here is different: both locate possible support within the ordinary environment of the classroom. They illustrate how a response to difficulty may sometimes involve changing aspects of a routine or environment rather than attempting to change the child alone. Whether such a change is useful still has to be judged by what happens to the child's functioning and participation.

Classroom behaviour, however, rarely points to a single explanation. A child who repeatedly leaves group time may find the sensory conditions difficult, struggle with the attentional demands, misunderstand what is expected, lose interest, become distressed by a social interaction, or find the activity too long. Several of these may occur together. Similarly, difficulty during transitions can involve sensory change, emotional attachment to the previous activity, problems shifting attention, uncertainty about what comes next, or ordinary developmental variation. A developmental–ecological interpretation keeps these possibilities open long enough to examine the circumstances surrounding the behaviour.

Teacher interpretation matters precisely because different explanations invite different responses. Mills et al. (2025) illustrate the contribution of teacher ratings to identifying how sensory-processing characteristics are expressed in classroom contexts. Teachers see children across activities and over time and can notice patterns that may not appear in a brief assessment. Observation, however, is not diagnosis. Frequent movement can be interpreted as defiance, inattention, sensory seeking, immaturity, enthusiasm, or an attempt to remain regulated, and the behaviour itself cannot settle among these possibilities. Sensory-informed practice is most defensible when it helps educators ask better questions about what they observe without turning classroom observations into clinical conclusions.

Pedagogy is part of the ecology as well. Activities differ in length, novelty, complexity, social organisation, opportunities for movement, and the degree of independent control expected from children. Çakın and Sak (2025) examined relationships between preschool teachers' developmentally appropriate practice beliefs and children's self-regulatory skills, adding to evidence that regulatory functioning cannot be separated neatly from the educational conditions in which it is observed. When a difficulty occurs repeatedly in one type of activity, it is reasonable to examine what that activity asks of the child as well as what the child currently finds difficult.

A developmental–ecological account does not remove individual differences. Children vary in sensory responsiveness, executive capacities, communication, temperament, developmental histories, and many other characteristics. Nor does it imply that every difficulty can be solved by changing the classroom. Its contribution is more modest: individual characteristics acquire their functional significance in particular situations. A level of attentional control sufficient for a short hands-on activity may not be sufficient for a lengthy whole-group discussion. A sensory characteristic that causes little difficulty during outdoor play may become important during a crowded transition. Participation changes as the fit between child and situation changes.

Across the evidence reviewed here, four elements repeatedly meet in classroom participation: children's sensory and developmental characteristics; their emerging self-regulatory capacities; the demands and opportunities presented by activities and environments; and the relational and pedagogical support available around them. Their relationships are unlikely to run in one direction. Classroom conditions can increase or reduce what children need to manage; developing regulatory capacities influence how those demands are handled; and participation itself provides further experiences through which regulation can be practised.

The question is therefore no longer simply whether a child has enough self-regulation for the classroom. It is how the child's sensory and regulatory capacities meet the demands and supports of a particular classroom situation, and what that encounter means for participation. The following section brings these relationships together in a developmentally informed framework for classroom participation.

A Developmentally Informed Framework for Classroom Participation

The evidence reviewed across these literatures can be brought together in a developmental framework linking sensory regulation, developing self-regulation, and meaningful classroom participation (Figure 2). The framework is a conceptual synthesis rather than an empirically tested causal model. It does not propose a fixed sequence through which children move. Instead, it represents regulation and participation as related processes unfolding within the changing demands and supports of early childhood classrooms.

At its centre are three constructs that need to remain distinct. Sensory regulation refers to the management of sensory demands in ways that permit adaptive involvement in ongoing activity. Developing self-regulation encompasses the attentional, emotional, cognitive, and behavioural capacities through which children increasingly organise their responses to changing demands. Meaningful classroom participation refers to adaptive involvement that allows children to access, contribute to, or benefit from the social and learning activity at hand. Keeping these constructs separate matters because sensory behaviour cannot be read directly as regulatory competence, and regulatory competence cannot be inferred simply from the outward form of participation.

The relationship between sensory regulation and self-regulation is represented as interactive rather than sequential. Studies linking sensory-processing characteristics with aspects of self-regulatory functioning support an association between these domains (Gündoğmuş et al., 2026; Lee et al., 2026; Uygun et al., 2025), but they do not establish that sensory dysregulation precedes or causes difficulties in self-regulation. Sensory demands may alter what a child needs to manage in a particular situation, while developing attentional, emotional, and behavioural capacities may affect how flexibly the child responds. The framework therefore positions sensory regulation as one part of the child's regulatory experience, not as a developmental stage that must be resolved before broader self-regulation can occur.

Self-regulation and participation are also connected without being arranged as a one-way pathway. Evidence linking executive and regulatory capacities with engagement and classroom functioning indicates that developing regulation can support children's involvement in learning and social activity (Memba & Ostrov, 2025; Turnbull et al., 2024; Wyatt et al., 2025). Participation, however, gives children repeated occasions to exercise these capacities. During play, transitions, collaborative tasks, peer disagreements, and teacher-guided activities, children practise attending, waiting, shifting, persisting, communicating, and recovering when something becomes difficult. The framework therefore allows participation to feed back into regulatory development rather than treating it only as the final outcome of regulation.

Nor must sensory regulation always influence participation through self-regulation as a fixed intermediary. Sensory-processing characteristics have been associated with participation outcomes in both concurrent and longitudinal research (Chen et al., 2025; Gündoğmuş et al., 2026; Zaguri-Vittenberg et al., 2026). In some situations, sensory conditions may make an activity difficult to access or sustain directly; in others, their effects may be intertwined with attentional, emotional, behavioural, or social demands. For this reason, the framework permits several routes among its central processes rather than imposing a single *sensory regulation* → *self-regulation* → *participation* pathway.

These processes take place within what the framework describes as a developmental classroom ecology. Four contextual conditions recur across the reviewed evidence: activity demands and affordances; the sensory and physical environment; teacher interaction and co-regulatory support; and peers, play, movement, and pedagogical contexts. These are not background variables surrounding an otherwise self-contained child. They help determine what regulation requires at a particular moment and what support is available when those requirements become difficult. Their significance also changes from child to child and across development.

The framework uses child–activity–environment fit as an interpretive principle for understanding these encounters. Difficulty may arise when the sensory, attentional, emotional, social, or behavioural demands of an activity exceed what a child can currently manage with the support available. Participation may become more manageable as the child's capacities develop, when the activity or environment changes, when additional relational support is available, or through some combination of these conditions. This formulation does not place responsibility solely on either the child or the classroom. It asks instead how their characteristics meet in a particular situation.

Seen in this way, the framework moves away from an interpretation that can too readily become: sensory difficulty → poor self-control → disruptive behaviour → intervention to produce stillness and towards a developmental interpretation in which: sensory characteristics and demands ↔ developing self-regulatory capacities ↔ meaningful classroom participation. Operate within changing activity, relational, sensory, and pedagogical conditions.

The contrast is not intended to dismiss behavioural expectations. Early childhood classrooms depend on children gradually learning to listen, wait, inhibit unsafe actions, coordinate with others, and participate in collective routines. Nor does the framework suggest that every instance of movement is adaptive or that every participation difficulty requires environmental modification. Its claim is narrower: behavioural appearance alone is an insufficient basis for deciding whether regulation has been successful. What matters is how the child's response functions within the activity and whether it permits, restores, or constrains participation.

As a conceptual synthesis, the framework generates questions rather than causal conclusions. It proposes that sensory characteristics should be interpreted in relation to functional demands; that self-regulation is developing and context-sensitive; that participation is an educationally meaningful outcome through which regulation can also continue to develop; and that classroom conditions belong within explanations of children's regulatory functioning. These propositions provide the basis for considering what a developmental approach might mean for early childhood practice and for the research still needed to test the relationships proposed here.

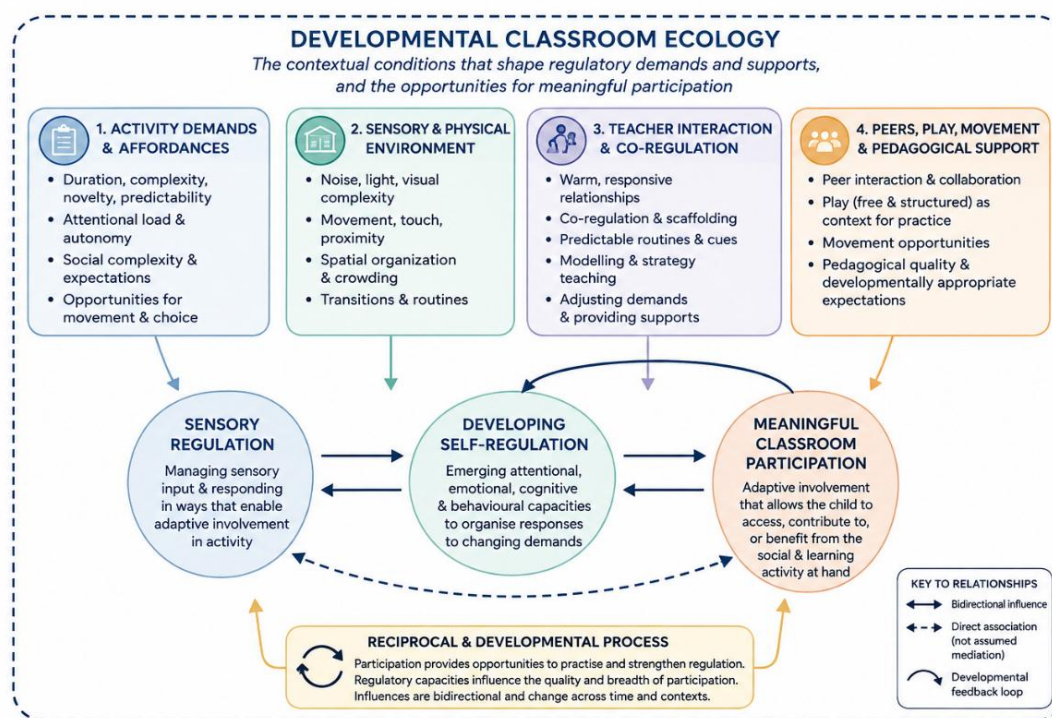


Figure 2. A developmentally informed framework linking sensory regulation, developing self-regulation, and meaningful classroom participation within the developmental classroom ecology.

Implications for Early Childhood Practice

A developmental interpretation of regulation shifts attention from stopping behaviour to understanding the conditions surrounding a child's difficulty in participating. Sensory-informed practice can support this interpretation, but classroom behaviour alone should not be used to diagnose sensory-processing difficulties, and sensory-based strategies should not be treated as universal solutions. Evidence remains uneven across approaches and outcomes (Hockey et al., 2025; Latifi et al., 2026; Piller et al., 2025; Unwin et al., 2024). Classroom adjustments should therefore be treated as responsive hypotheses whose value is judged by whether they improve children's access, involvement, recovery from difficulty, and increasingly independent participation.

Co-regulatory and pedagogical support remain equally important. Predictable routines, teacher cues, emotional support, opportunities for movement, and responsive assistance may help children participate while regulatory capacities are still developing (Bai et al., 2025; Gavrilova et al., 2024; Nilfyr & Ewe, 2025; Weiss et al., 2026). The practical implication is therefore not a new set of sensory techniques, but a broader basis for professional judgement: distinguishing observation from diagnosis, considering multiple explanations for behaviour, and evaluating support through meaningful participation rather than quiet compliance.

Implications for Research

Future research needs greater conceptual and methodological integration. Sensory processing, self-regulation, executive function, engagement, and participation are frequently examined through partially separate traditions and non-equivalent measures (Ross & Ascetta, 2025). Longitudinal and repeated-measures studies that examine these processes together within everyday classroom contexts are particularly needed, given the limited developmental evidence and substantial within-child variability identified across the literature (Chen et al., 2025; Kunz & Oeri, 2026; Turnbull et al., 2024; Wyatt et al., 2025).

Research should also define outcomes more functionally. Intervention studies should move beyond visible calmness or reduced target behaviour to examine access, sustained involvement, successful transitions, recovery from difficulty, and increasing independence. Designs combining sensory and regulatory measures with observations of participation, activity demands, relational support, and classroom conditions could also empirically test the proposed child–activity–environment framework. Until such evidence is available, the framework is best treated as a set of testable developmental propositions rather than a causal model.

Intervention research presents a related challenge. Existing reviews of sensory-based interventions describe heterogeneous approaches, populations, outcomes, and levels of evidence (Hockey et al., 2025; Latifi et al., 2026; Piller et al., 2025; Unwin et al., 2024). Future studies would benefit from clearer specification of what an intervention is expected to change and why. Outcomes should extend beyond visible calmness or reduction of target behaviour to include whether children gain access to activities, sustain involvement, navigate transitions, recover from difficulty, and participate more independently or effectively. This would align intervention evaluation more closely with the functional outcomes that matter in educational settings.

The framework proposed in this review is itself open to empirical testing. Its value will depend on whether the relationships it proposes can be observed and distinguished in real classrooms. Longitudinal and repeated-measures designs that combine child-level sensory and regulatory measures with observations of participation and classroom conditions would be particularly useful. Such research could test whether child–activity–environment fit explains meaningful variation in participation, whether participation contributes to subsequent regulatory development, and under what conditions sensory characteristics become consequential for classroom functioning. The framework should therefore be treated as a set of testable developmental propositions rather than a settled model of how regulation operates.

Limitations of the Review

This review has several limitations. As a structured critical narrative review, it was designed to integrate conceptually related evidence across disciplinary traditions rather than to provide exhaustive systematic coverage or pooled estimates of effect. Although the search and selection process was structured and transparent, the heterogeneity of populations, constructs, measures, settings, and study designs limited direct comparison across studies. In addition, studies involving clinical populations or older children were included selectively as boundary evidence and should not be generalised directly to typically developing children in early childhood classrooms.

The review also did not undertake a formal study-level risk-of-bias assessment. SANRA was used to strengthen the quality and transparency of the review process, but it does not substitute for appraisal of individual studies. Accordingly, the proposed developmental classroom ecology should be understood as an interpretive synthesis of the available evidence rather than an empirically validated causal model. Its relationships require further testing in longitudinal and classroom-based research.

Conclusion

Sensory regulation, self-regulation, and classroom participation are best understood as interconnected developmental processes rather than as a simple causal sequence. In response to the review question, the evidence suggests that their relationships emerge through the interaction of children's sensory characteristics and developing regulatory capacities with the activity demands, relationships, pedagogical support, and environmental conditions of early childhood classrooms. Sensory regulation may influence how manageable particular situations become, while developing self-regulation supports children's adjustment to changing demands; meaningful participation both reflects these processes and provides contexts in which regulatory capacities continue to develop.

This synthesis challenges the assumption that behavioural stillness necessarily indicates successful regulation or that movement signifies dysregulation. For early childhood education, meaningful participation provides a more developmentally relevant lens through which to interpret children's classroom functioning and the support they may need. Future longitudinal and classroom-based research should test the proposed child–

activity–environment relationships and clarify how sensory regulation, self-regulation, and participation influence one another over time.

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