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From Yogic Psychology to Educational Practice: A Conceptual Framework Linking Chitta-Vritti-Nirodha, Attention Regulation, and Meaningful Learning

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Review Article

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Abstract

The possibility that contemplative disciplines can strengthen attention and thereby support learning has attracted interest across educational psychology, cognitive neuroscience and school-based yoga research. Yet the classical formulation yogaś citta-vṛtti-nirodhaḥ addresses an ethical and soteriological project, not a validated theory of academic performance. This critical narrative review examines the conceptual distance and potential connections between Pātañjala yoga psychology, experimentally studied attention regulation and meaningful learning. Relevant philosophical analysis, cognitive and educational theory, intervention trials and research syntheses were evaluated with particular attention to construct correspondence, comparison conditions, developmental context, educational outcomes and ethical implementation. The evidence supports a conditional, rather than direct, link: contemplative exercises may sometimes improve proximal attentional or emotional-regulatory processes, but improved performance on attention tasks does not establish durable understanding, conceptual change or transfer. School-based syntheses report heterogeneous and generally small benefits, with weaker or absent advantages against active controls and inconsistent effects on achievement. The proposed framework therefore distinguishes philosophical orientation, trainable regulatory practices, cognitive mediators, task-specific engagement, pedagogical mechanisms and learning outcomes. It treats curricular quality, learner agency, developmental suitability and sociocultural context as necessary moderators rather than incidental details. Four falsifiable pathways are advanced, while a competing explanation attributes some observed gains to movement, structured pauses, adult attention or

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expectancy. The review concludes that contemplative attention training is best understood as an optional enabling condition for well-designed learning activities, not as an alternative to explanation, retrieval, feedback, conceptual discussion or equitable teaching. Research should test mechanisms, potential harms and durable transfer through preregistered active-comparator studies using both attentional and curriculum-aligned measures.

Keywords: *Pātañjala yoga; contemplative education; executive attention; metacognition; cognitive engagement; conceptual change; self-regulated learning; educational equity.*

1. Introduction

Educational practice involves a persistent tension between two legitimate aims: inviting learners to sustain attention long enough to work with difficult ideas and preserving the flexibility required to question, revise and connect those ideas. Concentration is therefore neither the whole of learning nor a trivial prerequisite. In classrooms, students must notice task-relevant information, inhibit competing responses, monitor confusion, relate new content to prior understanding and revisit an explanation when it fails. Work on executive functions identifies partly separable capacities for inhibitory control, working-memory updating and cognitive flexibility, while research on self-regulated learning places these processes within motivation, planning, feedback and social context (Diamond, 2013; Miyake *et al*., 2000; Panadero, 2017). The educational challenge is to understand which capacities can be taught, how they become available during real academic tasks and whether strengthening them changes more than performance on a proximal test.

Classical yoga offers a different starting point. In the Yoga Sūtra, the expression yogaś citta-vṛtti-nirodhaḥ (I.2) is conventionally approached as the restraint, stilling or cessation of the fluctuations of citta. The precise interpretation is shaped by Sanskrit terminology, commentary and the philosophical commitments of the text. It cannot be reduced without loss to the modern injunction to concentrate harder. The discipline described in the Pātañjala tradition concerns repeated practice, detachment, sense withdrawal, meditative absorption and ultimately liberation; ordinary academic attention is not its final objective (Paranjpe, 2021; Raveh, 2015). A defensible educational engagement with this tradition therefore requires both interpretive respect and clear restrictions on what can be inferred from it.

Interest in yoga, mindfulness and school-based contemplative programmes has produced substantial but uneven evidence. Models of focused-attention and open-monitoring meditation offer plausible connections to sustained attention and meta-awareness; integrative models of yoga also consider breath, movement, interoception and stress regulation (Gard *et al*., 2014; Lutz *et al*., 2008; Vago & Silbersweig, 2012). Such models often concern adults or laboratory situations, however, rather than instructionally meaningful outcomes in school lessons. Meanwhile, syntheses of school interventions reveal that apparent benefits depend on outcome type, study quality, comparison group and follow-up interval (Dunning *et al*., 2022; Maynard *et al*., 2017; Mettler *et al*., 2023). These differences are substantive evidence about the limits of translation, not merely statistical inconvenience. A meta-analysis of randomised trials reported improvements in selected cognitive measures following mindfulness-based interventions, although these measures are not direct assessments of curriculum-based understanding (Zainal & Newman, 2024). A nationwide school trial found no statistically significant improvement in its primary mental-health outcome after a teacher-delivered mindfulness programme, illustrating the importance of educational context and outcome selection (Juul *et al*., 2025).

A second conceptual difficulty concerns the phrase meaningful learning. In Ausubelian and subsequent educational traditions, meaningful learning involves relating new propositions non-arbitrarily to relevant existing knowledge, reorganising conceptual relationships and showing understanding beyond immediate reproduction. Neither tranquillity nor attentive silence demonstrates those accomplishments. Mayer (2002) distinguishes retention from transfer, Novak (2002) locates learning in conceptual reconstruction, and Chi and Wylie (2014) show why constructive and interactive engagement cannot be equated with quiet attention. A student might be calm and compliant yet fail to understand a scientific explanation. Conversely, productive disagreement, emotionally salient inquiry and exploratory conversation may appear mentally unsettled while supporting profound learning. A recent meta-analysis found a small positive association between trait mindfulness and academic performance; this correlational result does not establish an intervention effect or demonstrate conceptual transfer (Mao *et al*., 2024). Another synthesis found differing associations between dimensions of student engagement and educational outcomes, supporting the need to distinguish attentional regulation from the forms of engagement through which learning is assessed (Reeve *et al*., 2025).

Several relevant reviews already exist, but they largely answer different questions. School-based reviews have estimated the effects of mindfulness or yoga on executive function, stress, wellbeing and selected academic indices; some have assessed moderators or risk of bias (D'Souza & Smyth, 2025; Dunning *et al*., 2019; Sun *et al*., 2021; Wilkin *et al*., 2024). Philosophical scholarship has examined Pātañjala concepts and the relation between yoga psychology and contemporary models of mind (Paranjpe, 2021; Raveh, 2015; Tripathi & Bharadwaj, 2021). Yet neither stream by itself establishes a conceptual bridge from the normative goal of nirodha to observable attention regulation and further to understanding. The risk is a misleading chain of equivalences: yoga is identified with mindfulness, mindfulness with attention, and attention with learning. Each step contains choices and assumptions that require separate examination.

The key interpretive question is therefore not whether an ancient text anticipated cognitive science. It is whether a carefully bounded reading of selected yogic practices can inform hypotheses about trainable regulation while retaining independent educational accounts of knowledge construction. Such an approach also guards against importing a spiritual end-state into compulsory curricula or treating physiological relaxation as a substitute for teaching. The value of the proposed synthesis lies in specifying where the traditions converge pragmatically, where their aims remain irreducibly different, and what evidence would count against the suggested educational pathways.

1.1 Scope, Research Gap and Objectives

This review considers Pātañjala yoga psychology as an interpretive source, modern theories of attention and metacognition as candidate explanatory mechanisms, and meaningful learning as a distinct educational outcome. It focuses on formal education from primary school to university, drawing on adult experimental studies only to clarify mechanisms and on school trials to judge ecological relevance. It does not evaluate yoga as a treatment for psychiatric disorders, present religious instruction as an educational requirement, or equate meditation with any specific form of yoga. The unresolved gap is the absence of an explicitly conditional account that links the philosophical source, a measurable regulatory mechanism, a well-designed learning activity and a demonstrable outcome without collapsing these categories. The objectives are to map conceptual correspondences and discontinuities, critically appraise intervention evidence, formulate a testable framework and derive proportionate principles for ethically defensible educational use.

2. Methods for Literature Selection

2.1 Review Design and Rationale

A critical narrative design was adopted because the central problem concerns the correspondence between concepts embedded in different intellectual traditions as much as it concerns intervention effectiveness. A single pooled estimate could not determine whether nirodha, attentional orienting, working-memory control and semantic integration describe the same construct; they do not. The review combines interpretive textual scholarship, cognitive theory, educational mechanisms, controlled studies and relevant systematic reviews, explicitly preserving differences in what each kind of evidence can establish. The SANRA framework informed attention to the review's significance, stated aims, literature identification, referenced reasoning, evidence levels and outcome specificity, without using an unperformed numerical appraisal or claiming systematic-review completeness (Baethge *et al*., 2019).

2.2 Information Sources

Relevant records were identified through targeted searches of ERIC, PubMed, OpenAlex and the Directory of Open Access Journals, supplemented by scholarly search results, publisher and DOI landing pages, and backward examination of references in authoritative reviews. Philosophical articles were sought by title and Sanskrit terminology as well as contemporary English transliterations. Educational studies were traced through their journal records and linked abstracts where available. Bibliographic identity, outlet, publication year, DOI and pertinence to the associated claim were checked against accessible publisher records, scholarly indexes or biomedical records. The search did not assume access to subscription-only bibliographic exports or unobserved full texts.

2.3 Search Strategy and Search Period

The principal eligibility window was 1 January 2000 to 23 August 2026. Earlier primary texts and theoretical antecedents were used when essential to explain a construct, whereas the modern empirical synthesis was organised around this window. Search concepts were combined in variants of: ("citta" OR "chitta" OR "vṛtti" OR "vrtti" OR "nirodha" OR "Patanjali" OR "Pātañjala") AND (attention OR mind OR psychology OR education); (yoga OR mindfulness OR meditation OR "contemplative practice") AND (school OR classroom OR student OR university) AND (attention OR "executive function" OR "self-regulation" OR achievement); and ("meaningful learning" OR "conceptual change" OR metacognition OR "cognitive engagement") AND (attention OR regulation OR transfer). Additional searches combined intervention terms with active control, adverse effects, implementation, cultural context, equity and teacher training. The searches were deliberately interdisciplinary; a psychology-only strategy would miss philological disagreement, and a yoga-only strategy would fail to detect negative school findings.

2.4 Eligibility Criteria

Eligible works were peer-reviewed conceptual analyses, relevant educational or cognitive experiments, school or tertiary intervention evaluations, and methodologically informative reviews. For intervention evidence, preference was given to randomised or controlled designs with described comparators and recognisable outcome measures; high-quality syntheses were prioritised over isolated positive reports. Philosophical works were selected for direct engagement with Pātañjala terminology and commentator-informed interpretation. Studies were considered across countries and educational stages rather than restricted to a single jurisdiction. English-language publications were used where their bibliographic details and claims could be checked. Promotional essays, unverified sources, programme testimonials and studies treating self-reported relaxation as direct evidence of learning were not accepted as evidence of educational effectiveness.

2.5 Screening, Duplication and Selection

Potentially relevant titles and summaries were examined against the conceptual boundaries, followed by scrutiny of available abstracts, full texts or publisher descriptions when a paper informed a substantive inference. Multiple indexed copies of the same article were treated as one publication using title, author list, year and DOI. Existing systematic reviews were used to contextualise study designs and uncertainty, but their reported study counts were not added to one another as though they represented independent participants. A source was retained only where the information accessible for the present task supported its use. No claim of exhaustive capture, dual independent screening, a completed database export or invented record-flow counts is made; these would misrepresent the conduct of a critical narrative review.

2.6 Critical Appraisal and Thematic Synthesis

Evidence was appraised by inferential proximity to the proposed educational pathway. Interpretive texts were assessed for faithful conceptual analysis; laboratory attention studies for design and task specificity; intervention studies for allocation, comparator credibility, blinding possibilities, measurement quality and follow-up; and educational theory for its explanation of learning rather than merely concentration. Findings from uncontrolled studies, active-comparator trials, school-level randomisation and pooled syntheses were not assigned equal causal weight. When reviews disagreed, priority was placed on the specificity of outcomes, risk of bias, active comparisons and recency rather than on the largest favourable estimate. Themes were developed around the philosophical construct, cognitive candidate mechanisms, educational mediation, intervention evidence, practical conditions and falsifiable alternatives. Formal risk-of-bias scores and quantitative synthesis were not undertaken.

3. Interpreting Citta-Vṛtti-Nirodha without Conceptual Reduction

3.1 What is Being Regulated?

The Sanskrit citta is often rendered as mind or the field of mentation, but it should not be mapped mechanically onto a contemporary psychological faculty. Its relevant functions range across cognition, impression, affective colouring and modes of awareness, depending on the textual setting and interpretive school. Vṛtti refers to modifications or operations rather than merely intrusive distractions, while nirodha denotes a discipline of restraint or stilling whose meaning is inseparable from yoga's larger purpose. Paranjpe (2021) describes the breadth of mental processes at stake, and Raveh (2015) demonstrates that the scheme of practice and detachment remains philosophical rather than simply a protocol for performance enhancement. Translating the compound as an injunction to remove 'bad thoughts' is inadequate: the classical account addresses even ordinarily useful mental modifications within its pursuit of liberation.

The five classes of vṛtti described in the Yoga Sūtra include valid cognition, error, conceptual construction, sleep and memory. This range matters because modern attention regulation generally seeks to improve selectivity, flexibility and responsiveness while preserving and using memory and conceptual thought. Academic reasoning depends precisely on activities that the classical framework may classify as modifications of citta. Consequently, the most defensible correspondence is functional and local: some preparatory exercises might cultivate deliberate noticing or disengagement from distraction. It does not follow that an educational activity aims at complete cessation of mentation, nor that the achievement of such a state would improve the generation of explanations (Paranjpe, 2021; Tripathi & Bharadwaj, 2021).

Differences in textual tradition also caution against presenting a single modern operational definition as the original Sanskrit meaning. The Yoga Sūtra is concise and interpreted through commentarial traditions, while contemporary health and classroom adaptations selectively emphasise movement, stress reduction and wellbeing. McKibben (2025) shows how pratyāhāra can be reinterpreted within modern postural yoga and shaped by the institutional assumptions of contemporary practice. The resulting plurality does not make all readings equally defensible. It makes explicit translation and disclosure of the chosen meaning indispensable whenever traditional terms enter educational research or curricula.

3.2 Practice, Detachment and the Difference Between Agency and Suppression

In Pātañjala analysis, abhyāsa and vairāgya are often paired as repeated practice and dispassion or non-attachment. This pairing offers a productive contrast with conventional academic concentration. Practice suggests that attentional stability is cultivated rather than commanded, while non-attachment suggests a changed response to arising thought rather than frantic effort to prevent its occurrence. Raveh (2015) interprets these notions as involving reflective agency as well as discipline, avoiding a picture of yoga as thoughtless inhibition. In a classroom adaptation, the closest tentative counterpart would be noticing a distraction, declining to follow it and voluntarily returning to an agreed task. This is an interpretation and a design hypothesis, not a demonstration that classical nirodha and experimentally measured inhibitory control are identical.

Suppression, regulation and non-reactivity must be separated. A learner who attempts never to think about unrelated worries may experience increased struggle or self-criticism. A learner who recognises worries without letting them determine every action may be able to continue a task. Mindfulness models distinguish attentional orientation from an accepting stance towards experience, and theoretical accounts of yoga integrate behavioural, interoceptive and autonomic regulation (Gard *et al*., 2014; Shapiro *et al*., 2006). Yet this does not establish a uniform direction of effects across individuals. For some children, attention to breathing or internal sensation may be aversive, inaccessible or distracting. Ethical application begins with voluntary engagement and alternative ways of achieving the same classroom purpose.

The educational meaning of vairāgya cannot be a demand that learners become detached from their studies, emotions or social concerns. Interest, intellectual commitment and an emotionally significant question are often conditions for sustained engagement. The appropriate distinction is between less automatic capture by a competing impulse and indifference towards valued learning goals. Such a distinction preserves students' legitimate motivation and challenges the idea that visible stillness is necessarily an educational good. It also limits the authority a teacher may claim: an intervention can invite a self-regulatory strategy but should not measure spiritual attainment, diagnose a student's state of mind or reward an appearance of inner quiet.

3.3 The Eight-Limbed Context and Selective Educational Use

The eight-limbed framework is commonly organised around yama, niyama, āsana, prāṇāyāma, pratyāhāra, dhāraṇā, dhyāna and samādhi. Its historical architecture has a normative and contemplative coherence that is lost when a school programme claims that a

few stretches reproduce the psychological effects of the whole path. Dhāraṇā, commonly associated with stabilising attention, and dhyāna, sustained meditation, provide an intelligible reference point for modern accounts of focused attention. Pratyāhāra invites discussion of sensory salience and selective disengagement. Yet the practices should not be represented as interchangeable experimental treatments, and samādhi should not be used as an educational achievement target (Paranjpe, 2021; Tripathi & Bharadwaj, 2021).

Modern interventions labelled yoga range from movement-heavy physical education to combined movement, breathing and meditation sessions, sometimes with reflection or classroom games. Gard *et al*. (2014) articulate plausible bottom-up and top-down regulatory processes, but their model itself acknowledges that mechanisms are hypotheses requiring tests. Posture, paced breathing and focused attention can vary independently, and each can interact with exercise, rest, expectancy and supportive instruction. Consequently, an intervention labelled 'yoga' is a bundle that needs precise description. Without component specification, the inference that a positive result confirms a proposition about citta or nirodha is unwarranted.

There is also a cultural and educational asymmetry: Sanskrit ideas may be mined for secular therapeutic functions while their philosophical context is denied, or conversely philosophical authority may be used to justify interventions whose benefits have not been independently demonstrated. Both strategies are problematic. A scholarly translation can acknowledge the Indian intellectual history of yoga while evaluating educational practices by publicly accessible learning criteria. The relevant empirical question is not whether participants endorse a metaphysical claim, but whether an optional practice changes a specified regulatory behaviour and whether that change improves the quality of disciplinary engagement. Such a distinction is particularly important in plural classrooms where students and families hold different religious commitments.

3.4 Consequences for Construct Validity

The interpretive work yields three levels of description. The philosophical level concerns a discipline and ultimate aim established through tradition and commentary. The psychological level concerns operational capacities such as orienting, sustained attention, noticing lapses and returning to task. The educational level concerns using those capacities in the acquisition, integration, critique and transfer of knowledge. Claims crossing levels require additional evidence. For example, changes in response time on a computerised attention task may support an attentional mechanism but do not validate the interpretation of nirodha; a higher history-exam score may support an instructional benefit but cannot, by itself, identify the attentional process responsible.

Table 1 locates potential correspondences alongside the differences that prevent conceptual overreach. It is intended as an interpretive map, not an assertion that Sanskrit constructs already possess psychometric equivalence with modern cognitive variables. The comparison indicates that regulated reorientation is a more defensible educational target than suppression of thought or spiritual attainment.

Table 1. Conceptual distinctions between Pātañjala constructs and educational analogues

Classical concept	Interpretive function	Tentative educational analogue	Critical boundary	Supporting references
Citta	Field or substrate of mental operations in a philosophical system.	Dynamic cognitive–affective processing; not a unitary measurable faculty.	No direct identity with working memory, executive function or consciousness scales.	(Paranjpe, 2021; Tripathi & Bharadwaj, 2021)
Vṛtti	Modifications or modes of mentation, not only distracting thoughts.	Changes in focus, images, appraisal and elaboration.	Productive reasoning also involves conceptual activity; not all vṛttis are educational errors.	(Paranjpe, 2021; Raveh, 2015)
Nirodha	Restraint or stilling within a liberative discipline.	A bounded hypothesis about deliberate reorientation or less reactivity.	Neither thought suppression nor attainment of liberation can be inferred from attention tests.	(Paranjpe, 2021; Raveh, 2015)
Abhyāsa and vairāgya	Sustained practice and non-attachment form a paired discipline.	Repeated orienting practice with willingness to release distraction.	Habit rehearsal may transfer incompletely; non-attachment is not low motivation.	(Lutz *et al*., 2008; Raveh, 2015)
Pratyāhāra	Withdrawal or reorganisation of the relation to sensory objects.	Selective handling of environmental distraction.	Modifying sensory input is not identical to shutting down classroom engagement.	(McKibben, 2025; Paranjpe, 2021)
Dhāraṇā and dhyāna	Concentration and meditation in a wider discipline.	Focused and sustained attentional monitoring.	Contemplative states and cognitive task scores differ in purpose and validation.	(Lutz *et al*., 2008; Tripathi & Bharadwaj, 2021)

Note. The correspondences are interpretive proposals, not translations validated as equivalent psychometric constructs

4. Attention Regulation as a Candidate, not a Guaranteed, Mechanism

4.1 Distinguishing Attentional Components

Attention is not a unitary resource that an exercise can simply increase. Contemporary models differentiate alerting, orienting and executive control, while executive-function research separates inhibition, updating and shifting even where these share variance (Diamond, 2013; Miyake *et al*., 2000). A learner can be alert but attend to the wrong information, sustain attention yet

misunderstand a task, or demonstrate good inhibitory control while lacking background knowledge. Interventions must therefore specify whether the intended change involves fewer off-task episodes, shorter latency to return after a lapse, better resistance to irrelevant conflict, more strategic allocation of effort or stronger awareness of comprehension failures. These are empirically distinct claims with different assessment requirements.

Focused-attention practices deliberately select an object such as breathing and repeatedly restore attention after distraction. Open-monitoring practices give greater emphasis to recognising events without sustained selection of one object. Lutz *et al*. (2008) use this distinction to motivate candidate cognitive processes rather than identify every meditative tradition with a single mechanism. In laboratory research, Jha *et al*. (2007) reported different patterns across attention-network components after contrasting forms of mindfulness training. The results are informative about mechanism specificity but are not a direct test of a school curriculum. Differences in age, prior practice, task demands and the nature of the control group restrict the extent to which such findings can be generalised to ordinary learners.

Neuroscientific accounts identify plausible changes in control networks, monitoring and interoceptive processing, yet these remain many-to-one explanations rather than biomarkers proving that a particular classroom practice works. Tang *et al*. (2015) explicitly note uncertainty in neural mechanisms, and Vago and Silbersweig (2012) frame self-awareness, self-regulation and self-transcendence as an integrative model rather than a validated causal chain for academic achievement. Reverse inference is especially tempting here: the fact that attention and meditation can recruit overlapping systems does not show that a brief breathing exercise causes improvement in every task requiring those systems. The disciplined formulation is that some shared operations make transfer biologically and cognitively plausible, pending behavioural confirmation.

4.2 Mind Wandering, Monitoring and Flexible Return

Mind wandering is often treated as attention's opposite, yet it can involve planning, autobiographical reflection or creative incubation as well as disruptive task-unrelated thought. Smallwood and Schooler (2015) show why its significance depends on the current task and its coupling with meta-awareness. In a mathematics lesson, spontaneous thoughts can undermine a multistep calculation; in a literature lesson, associative reflection can generate a useful interpretation. Educational attention regulation should therefore target the learner's capacity to notice and manage an attentional episode relative to a chosen goal, rather than the elimination of all spontaneous thought.

An often-cited randomised study with university students found that a brief mindfulness course improved working-memory performance and a reading-based standardised test while reducing task-related mind wandering (Mrazek *et al*., 2013). Its strengths include an experimental comparison and analysis of attentional mediation. Its limits are equally important: the sample consisted of adults in a particular educational setting, the intervention was short, and the outcomes were not evidence of conceptual learning across subjects or sustained transfer over years. Even a plausible mediation effect in one trial cannot establish that attention is the unique active ingredient of yoga programmes in schoolchildren. It remains possible that expectancy, effort, novelty or changes in general wellbeing help explain some results.

There is a useful distinction between reactive recovery and rigid concentration. A classroom does not benefit from students who stare at a worksheet despite not understanding it. A more educationally relevant competence is noticing the breakdown: recognising that the current explanation is inconsistent, seeking clarification, switching strategy and returning to the task. That is a form of metacognitive control embedded in instruction. Attention training could assist the noticing and returning stages, but the learner still requires disciplinary knowledge and feedback to know what to do after returning. This illustrates why an attentional theory cannot substitute for an instructional theory.

4.3 Stress, Interoception and Readiness to Engage

Yoga is sometimes justified through a stress-reduction pathway rather than through attention training narrowly defined. Regulated breathing, moderate movement and a supported pause may change arousal or the subjective experience of stress, which in turn could make sustained cognitive work easier. Gard *et al*. (2014) describe a system of top-down and bottom-up pathways involving attention, interoception and autonomic function. Diamond (2013) likewise emphasises that stress, sleep, physical wellbeing and emotional context matter to executive functioning. The resulting educational hypothesis is plausible: a learner who is less overwhelmed may have greater opportunity to engage with instruction.

The causal pathway is not established by showing only that both stress ratings and a cognitive score change after the same programme. A genuine mediational test requires appropriate temporal sequencing, an active comparator, credible repeated measurement, and analysis that addresses shared causes such as teacher relationships or classroom climate. Physiological variables, when used, require validated interpretation and cannot be equated simply with meaningful learning. Interoceptive exercises may also increase attention to unpleasant bodily sensations. If the intervention imposes inward focus in a vulnerable or reluctant learner, the same mechanism could reduce rather than improve readiness to engage (Lee *et al*., 2024; Van Dam *et al*., 2018).

A pedagogically sound interpretation therefore places regulation in the service of learning opportunities, not as a demand for permanent calm. An active debate may be emotionally arousing and cognitively productive; a quiet room may conceal confusion. The proper criterion is whether a learner can recruit a strategy to remain, re-enter or productively redirect engagement when the particular task requires it. Whether such skill is developed through yoga-inspired practice, ordinary movement breaks, predictable routines, supportive teaching or a combination is an empirical comparison, not a matter of theoretical loyalty.

4.4 Operational Measures and Competing Explanations

Construct-valid assessment needs both laboratory and classroom measures. Selective or executive attention can be studied through established reaction-time paradigms, but repeated testing can produce practice effects, and an isolated score may have weak correspondence with academic functioning. Experience-sampling or thought probes can characterise lapses but may themselves alter concentration. Teacher reports introduce expectancy and relationship effects, whereas observations of on-task behaviour may classify active discussion as distraction. A defensible evaluation combines multiple methods selected for the educational purpose and reports their limitations, rather than treating one convenient scale as an adequate stand-in for attention.

Comparison conditions deserve equal care. Breathing instruction may be compared with slow movement, an engaging reading break, ordinary physical education or structured rest. These alternatives can offer social attention, novelty, a predictable pause and changes in arousal. A passive or wait-list control cannot distinguish their contributions. Adult studies and theoretical papers make component-specific mechanisms worth examining, but they do not show that yoga terminology or a spiritual frame is required to achieve the hypothesised effect (Jha *et al*., 2007; Tang *et al*., 2015; Van Dam *et al*., 2018).

Table 2 separates proposed mediators, feasible measures and alternative accounts. Its central lesson is that the pathway from contemplative exercise to attentional performance becomes more credible only when improvements are specific, replicated, sustained and distinguishable from matched non-contemplative activities.

Table 2. Hypothesised attentional mechanisms, measurement choices and rival accounts

Candidate mechanism	Near-term prediction	Indicative measure	Alternative explanation or limitation	Supporting references
Attentional orienting	Faster return to teacher-directed or self-chosen task after distraction.	Cued task-switching and observed re-engagement latency.	Novelty, external prompts or reward can also speed re-entry.	(Jha *et al*., 2007; Lutz *et al*., 2008)
Sustained control	Fewer attention lapses under comparable cognitive demand.	Continuous performance with error and speed trade-offs.	Practice effects, fatigue and motivational differences can mimic gains.	(Diamond, 2013; Tang *et al*., 2015)
Meta-awareness	Earlier recognition of attentional drift without punitive self-monitoring.	Experience sampling paired with performance-based validation.	Self-report is susceptible to demand and vocabulary acquisition.	(Lutz *et al*., 2008; Smallwood & Schooler, 2015)
Stress-related readiness	Improved ability to resume demanding work after stress or transition.	Affect ratings plus subsequent learning-task behaviour.	Movement, predictable pauses and supportive interaction may act similarly.	(Gard *et al*., 2014; Van Dam *et al*., 2018)
Inhibitory control	Reduced prepotent or competing responses when they impede tasks.	Age-appropriate inhibition tasks with repeated follow-up.	Better inhibition need not imply flexible problem-solving or deeper knowledge.	(Diamond, 2013; Miyake *et al*., 2000)

Note. Each mechanism requires an active comparator and pre-specified outcome; no single task is a definitive measure of contemplative skill

5. From Attentional Availability to Meaningful Learning

5.1 Meaning Is Constructed, Not Simply Received

Meaningful learning is best understood as a qualitative relation between new information and a learner's conceptual structure, not as the amount of material noticed. Novak (2002), drawing on assimilation theory, emphasises active linkage between prior and new knowledge, while Mayer (2002) distinguishes retaining information from using it in a changed context. A student may accurately repeat a definition after concentrated study yet fail to recognise its applicability in an unfamiliar problem. Conversely, a learner who reconstructs a misconception, articulates a causal relation and explains why an alternative answer fails shows evidence of knowledge transformation. A credible bridge from attentional regulation to meaningful learning must therefore specify what cognition takes place while attention is available.

Attention can be necessary for initial encoding without being sufficient for semantic integration. Working memory has constraints, and interruptions can disrupt the maintenance of relevant relations, making reduced task-unrelated capture potentially useful. Yet instructional explanations must also be well organised, calibrated to prior knowledge and followed by opportunities to elaborate and retrieve information. Dunlosky *et al*. (2013) distinguish learning strategies with stronger evidence, including practice testing and distributed practice, from strategies that feel fluent but often produce limited durable gain. A contemplative pause cannot replace these mechanisms. Its most plausible role is to help learners carry out an effective strategy with less avoidable interruption, provided that the strategy is actually taught.

This distinction also changes the outcome hierarchy. Immediate quietness or self-reported focus is a proximal regulatory outcome; recall is a performance outcome; delayed transfer and conceptual revision are stronger indicators of the review's substantive educational claim. Between these levels are additional mechanisms such as goal selection, error detection, explanatory talk,

feedback use and persistence after difficulty. The chain can break at any point. If learning tasks demand only verbatim reproduction, greater attention may improve examination scores without demonstrating a change in the structure of understanding. Thus a framework that claims meaningful learning must incorporate measures designed to detect meaning rather than merely concentration.

5.2 Metacognition as the Connecting Process

Self-regulated learning theories place monitoring and control within a cycle of forethought, performance and reflection. The learner sets a goal, notices whether current activity is effective, adjusts strategies and evaluates the result against criteria. Zimmerman (2002) describes a cyclical model, Pintrich (2004) provides a motivational and regulatory framework, and Panadero (2017) compares models that integrate cognitive, affective and metacognitive processes. These traditions provide a more precise educational analogue for the practice of noticing an attentional lapse and returning deliberately than any claim that academic success requires emptying consciousness.

Yet metacognitive awareness can be inaccurate. A learner may feel highly focused or calm while using a poor strategy, or confuse familiarity with comprehension. The proper extension of a contemplative exercise is therefore not an invitation to report how peaceful the student feels, but an evidence-linked question such as whether a solution can be explained, whether an inference follows from the data, or whether a retrieval attempt reveals a gap. Self-regulation acquires educational value when monitoring is calibrated to external feedback and disciplinary standards, not merely to subjective experience (Dunlosky *et al*., 2013; Panadero, 2017).

A possible sequence is to begin with a brief voluntary orienting exercise, identify the upcoming task goal, work on a problem, notice distraction or confusion, choose a strategy and compare the result with a criterion. The exercise could lower the entry cost of commencing work, but its added contribution should be tested against a matched routine without contemplative content. Such integration preserves a distinction between a regulatory aid and the act of teaching. It also allows the practice to be discontinued if it offers no advantage or alienates students, without disturbing the essential pedagogical sequence.

5.3 Cognitive Engagement Requires More than Stillness

The interactive-constructive-active-passive framework differentiates cognitive engagement by the kind of knowledge-building behaviour learners perform. Chi and Wylie (2014) argue that producing inferences, explanations and co-constructed ideas can be more generative than simply attending to presented material. These activities may involve talk, visible disagreement, movement and occasional redirection; they are not well described by an ideal of unbroken quiet concentration. Attention regulation is compatible with constructive engagement when it helps learners maintain the thread of reasoning, but an insistence on silence or non-reactivity could suppress questions that reveal conceptual change.

Concept mapping offers a concrete way to see the difference. Novak and Cañas (2010) describe concept maps as representations of propositions and relationships among ideas, building on assimilation theory. Asking students to construct, compare and revise such maps can make prior knowledge and misunderstandings visible. Attention may help a learner persist with the revision, but it is the comparison of conceptual relationships, the explanatory dialogue and corrective information that drive meaning-making. Treating the map as a calmness exercise would confuse the tool's educational purpose. Equally, requiring students to complete a map quietly may remove the peer challenge that helps them reconsider an initial explanation.

Transfer is especially demanding because it requires recognising structural similarity across surface-different tasks. A learner trained to return attention to breathing may become better at that practice without improving the ability to apply a scientific principle in an unfamiliar setting. Such an outcome would not refute the value of attentional training, but it would refute the stronger educational claim. Controlled studies should include delayed, content-aligned transfer tasks and distinguish improvements in task initiation, persistence, understanding and generalisation. The transfer hypothesis becomes more credible only when better regulation predicts, or experimentally mediates, performance on these distinct outcomes beyond the effects of effective instruction alone.

5.4 Motivation, Emotion and Learner Agency

Sustained attention is partly shaped by whether a task matters to a learner. The four-phase interest model distinguishes triggered situational interest from more stable personal engagement and emphasises interactions between affect and cognition (Hidi & Renninger, 2006). Educational neuroscience likewise challenges accounts that treat emotional processes as detachable noise around 'pure' learning; emotion influences which experiences are attended to and how knowledge becomes relevant to decision-making (Immordino-Yang & Damasio, 2007). These perspectives complicate a simple equation between diminished mental fluctuation and better learning. Emotional investment, curiosity and uncertainty can support long-duration inquiry even when the learner's mental life is active.

Learner agency is therefore both an ethical and mechanistic condition. A student who chooses a brief orienting routine before tackling an intimidating problem may use it as an instrument of self-regulation. A student obliged to perform it as evidence of obedience may attend instead to embarrassment, cultural incompatibility or fear of evaluation. The same outward activity can have a different functional meaning. A framework drawn from yogic psychology must accordingly value the learner's choice to participate, modify or decline and must provide alternative routes to readiness, including physical movement, quiet reading or collaborative preparation (Lee *et al*., 2024; Wilkin *et al*., 2025).

The evidence for educational engagement also prevents attributing every outcome to attentional control. High-quality explanation, supportive relationships, familiar prior knowledge, material resources and opportunities for feedback can dominate whether a learner acquires a concept. Strong attention may even deepen an error if instruction reinforces a misconception. A non-reductionist model places regulation alongside these conditions and includes the possibility that its incremental benefit is small or zero once they are well provided. This is not an argument against contemplative pedagogy; it is a standard of causal attribution appropriate to any proposed educational aid.

Table 3 outlines the staged outcome logic. Its key distinction is that attention regulation is an enabling capacity, whereas meaningful learning must be demonstrated through knowledge structure, explanation and transfer; intermediate measures cannot simply be promoted to final outcomes.

Table 3. Hierarchical distinction between regulatory indicators and meaningful-learning outcomes

Outcome level	Illustrative observation	What the result might support	What it cannot establish	Supporting references
1. Subjective state	Student reports calmer or more focused feelings.	Acceptability or short-term perceived readiness.	Attention change, conceptual understanding or transfer.	(D'Souza & Smyth, 2025; Van Dam *et al*., 2018)
2. Regulatory performance	Fewer lapses or faster reorientation after distraction.	Change in a specified near-term cognitive process.	Application of knowledge in authentic classroom activity.	(Jha *et al*., 2007; Miyake *et al*., 2000)
3. Cognitive engagement	Student generates explanations and tests alternatives.	Active task participation and potentially constructive processing.	A durable or correct mental model without content assessment.	(Chi & Wylie, 2014; Hidi & Renninger, 2006)
4. Conceptual integration	Explanation relates evidence to prior concepts, and revises misconceptions.	Meaningful construction of knowledge under explicit criteria.	Stable transfer beyond the taught problem without delayed testing.	(Mayer, 2002; Novak, 2002)
5. Delayed transfer	Success on new-context problems after sufficient delay.	Stronger evidence of durable and flexible learning.	A yoga-specific mechanism without mediator or comparator evidence.	(Dunlosky *et al*., 2013; Mayer, 2002)

Note. An outcome at one level is not a valid proxy for every subsequent level; levels are proposed for conceptual clarity, not as a newly validated scale

6. What Intervention Research Does and Does Not Establish

6.1 Divergent Signals from School Mindfulness Syntheses

Early syntheses created understandable interest by reporting favourable effects on cognitive and stress-related outcomes. Zenner *et al*. (2014), drawing on a relatively small and heterogeneous evidence base, reported an overall controlled effect of approximately 0.40 and a larger estimate in cognitive performance. The review also observed heterogeneity and possible small-study effects. Later syntheses that separated control conditions have generally offered more cautious interpretations. Dunning *et al*. (2019) found that advantages across several outcomes were more restricted when attention was paid to trials with active controls, a useful test of whether intervention-specific training outperforms time, attention and expectancy. Carsley *et al*. (2018) likewise reported small-to-moderate benefits for school mental-health outcomes, with variation by learner age and programme delivery; those outcomes are not interchangeable with curriculum-based understanding.

The updated meta-analysis by Dunning *et al*. (2022) included 66 randomised trials with 20,138 young participants. Compared with passive controls, mindfulness-based programmes yielded small benefits across selected outcomes, including attention and executive function; against active controls, clearer benefits were limited to mindfulness and anxiety or stress, and follow-up analyses did not establish persistent positive effects. The same review explicitly warned that programme enthusiasm had outpaced evidence. Maynard *et al*. (2017), considering school interventions with broader designs, reported small positive cognitive and socioemotional outcomes but no convincing improvement in academic achievement or behaviour and noted important limitations of study quality. The disjunction between cognitive performance and academic outcomes is directly relevant to the proposed conceptual bridge.

More recent evidence reinforces the need to discriminate outcomes rather than select the most favourable pooled estimate. Mettler *et al*. (2023) identified modest benefits for attention and some academic or adjustment indices among randomised studies spanning educational levels, but effects varied by programme and setting. The large school-focused review by D'Souza and Smyth (2025) found that many detected effects were small, heterogeneous and vulnerable to correction for multiple tests; after Holm–Bonferroni adjustment, self-reported mindfulness was the outcome most confidently changed. These results do not imply that no child can benefit. They do imply that a generic, dependable route from classroom mindfulness to better learning has not been demonstrated across the evidence base.

6.2 The Importance of Active Controls and Large Pragmatic Trials

A comparison with business-as-usual answers a different question from a comparison with a credible, engaging alternative. It can reveal whether implementing a programme changes outcomes under local conditions, but it cannot establish that meditation-specific

attention training is responsible. A programme may add structured rest, movement, a caring adult, predictable time, novel activities or more opportunities to discuss emotions. An active control that matches these elements estimates the incremental contribution of the purported contemplative component more directly. It may also expose the possibility that a simpler and cheaper classroom practice serves the same objective (Dunning *et al*., 2022; Van Dam *et al*., 2018).

The MYRIAD cluster-randomised study offers an instructive correction to unqualified advocacy. Kuyken *et al*. (2022) compared universal school-based mindfulness training with usual school provision in a large adolescent school sample and reported no superiority for its principal mental-health outcomes at one year. The trial concerns wellbeing, not a direct examination of deep conceptual learning, and should not be exaggerated into a verdict on every practice. Its significance is methodological: a coherent intervention can be implementable and theoretically plausible yet fail to improve outcomes beyond existing school provision when evaluated at scale. This result cautions against assuming that improvements in small controlled laboratory studies will translate automatically into ordinary institutions.

The distinction between universal and targeted provision also matters. A whole-school course may have diluted average effects because many pupils have little initial difficulty with attention, because delivery varies, or because the chosen outcome is poorly matched to the intervention. Conversely, selecting only initially distressed or inattentive learners can introduce regression to the mean if the comparison is weak. Trials should specify who is expected to benefit and why, test interaction effects with sufficient power and include outcomes that matter educationally. Without such detail, both favourable subgroup findings and disappointing overall averages are easily overinterpreted.

6.3 School Yoga: Components, Context and Mixed Results

School yoga is not identical to school mindfulness, despite overlap in movement, breathing and attention-focused instruction. Reviews of yoga and mindfulness among preschool children report promising findings for behavioural self-regulation and executive function but also notable heterogeneity and risk-of-bias concerns (Sun *et al*., 2021). A meta-analysis of school-based yoga for children aged three to seven estimated a small overall executive-function effect, while emphasising the small number of eligible studies, incomplete reporting of practice components and uncertainty about real-world educational implications (Wilkin *et al*., 2024). These publications support cautious inquiry into selected developmental skills, not a declaration that classical yoga philosophy has been empirically verified.

Studies with physical-activity comparison conditions are particularly informative. In a randomised investigation of schoolchildren from socioeconomically disadvantaged backgrounds in India, Chaya *et al*. (2012) found no significant difference in cognitive performance between yoga and physical activity at post-intervention after adjustment for grade. The result is compatible with benefit from participating in either structured activity and directly challenges claims of yoga's necessary superiority. By contrast, a large cluster-randomised study of Indian adolescents found improved attention and concentration measures and reduced stress after a standardised multicomponent yoga programme compared with a health-education condition (Ranjani *et al*., 2023). Its scale and school-based design strengthen ecological relevance, but the composite package, unequal embodied activity and proximal cognitive measurement do not isolate nirodha or establish deeper learning.

Smaller secondary-school trials have sometimes reported psychosocial advantages from yoga relative to ordinary physical education. Khalsa *et al*. (2012) observed selected changes in anger control and fatigue, and Noggle *et al*. (2012) reported favourable patterns in mood-related measures within a small trial. Their modest size, short duration, self-report outcomes and programme specificity require restraint in translating the findings into a general claim about achievement. These studies are valuable as feasibility and hypothesis-generating work, not as a substitute for curriculum-aligned, blinded assessments of learning. School yoga should be studied as a family of interventions with different components and plausible comparators, not as a stable exposure with a single dose or effect.

6.4 Evidence Gaps that Matter for Educational Claims

Across this literature, a recurring measurement problem is the promotion of intermediate or subjective outcomes into educational endpoints. Changes in reported calmness, awareness, teacher-rated behaviour or performance on a narrow executive task may improve classroom experience, but they do not necessarily demonstrate more coherent conceptual knowledge. Reviews differ in how they combine cognitive outcomes, grade levels, interventions and follow-up periods; pooling unlike constructs can make a summary effect difficult to interpret. The tendency to report multiple outcomes also heightens the need for preregistration and appropriate correction or cautious interpretation of exploratory findings (D'Souza & Smyth, 2025; Dunning *et al*., 2022; Maynard *et al*., 2017).

A second gap is the failure to compare candidate mechanisms explicitly. If a programme includes movement, rhythmic breathing, supportive teacher interaction, guided attention and reflection, improved performance cannot be ascribed to any one component without dismantling or factorial designs. A third gap concerns implementation: teacher training, fidelity, student preference, school climate and culturally appropriate framing may change both the experience and the measured outcome. Reviews of interventions from different regions do not automatically transfer to contexts with different educational pressures, religious expectations or material resources. The theoretical bridge should be strongest where proposed mediators are measured prospectively and weakest where interpretations rely only on the programme's name.

A final issue is adverse effects and opportunity cost. Reviews of mindfulness research have identified poor definitions, weaknesses in outcome assessment and insufficient reporting of unwanted experiences (Van Dam *et al*., 2018). In schools, time assigned to any

programme displaces another activity, and apparent benefits must be judged against credible alternatives. Lee *et al*. (2024) further warn that individual stress-management approaches can obscure structural conditions affecting students. The ethically and empirically defensible comparison is not between 'mindfulness' and 'nothing of value', but between feasible ways of enabling learning without making students responsible for institutional shortcomings.

Table 4 brings together representative bodies of evidence while keeping design strength and limits beside each inference. The pattern is more consistent with contingent proximal benefits than with universal improvements in meaningful learning.

Table 4. Representative intervention findings and their inferential limits

Evidence	Design or setting	Finding germane to this review	Critical limitation	Supporting references
School mindfulness, earlier synthesis	Meta-analysis; mixed school studies.	Promising mean effects on selected cognitive and wellbeing measures.	Heterogeneous programmes and relatively small studies.	(Zenner *et al*., 2014)
Youth mindfulness, updated synthesis	66 randomised trials; 20,138 young participants.	Several small gains vs passive controls; much weaker evidence vs active controls or at follow-up.	Attention and distal academic understanding are distinct endpoints.	(Dunning *et al*., 2022)
School education synthesis	Controlled and non-randomised school studies.	Small cognitive and socioemotional benefits; academic effects not convincingly different from zero.	Bias, confounding and study-quality concerns.	(Maynard *et al*., 2017)
Contemporary school review	Meta-analysis of school-based interventions.	Many small and heterogeneous effects; only self-reported mindfulness withstood specified correction.	Multiplicity and outcome-reporting choices affect inference.	(D'Souza & Smyth, 2025)
Large pragmatic adolescent trial	Cluster randomisation, whole-school context.	Universal mindfulness not superior to ordinary school provision on key mental-health outcomes at one year.	Wellbeing outcome is not direct conceptual-learning assessment.	(Kuyken *et al*., 2022)
Indian school yoga, active movement comparator	Randomised children's intervention; yoga versus physical activity.	No significant adjusted post-intervention difference in cognitive performance.	Context- and measure-specific; similar benefits of activity possible.	(Chaya *et al*., 2012)
Indian adolescent yoga, cluster trial	Multicomponent yoga versus health-education condition.	Improvements in attention/concentration and stress measures.	Movement and teacher contact not closely matched; no test of meaningful learning.	(Ranjani *et al*., 2023)
Young-child school yoga synthesis	Meta-analysis of early-school executive-function outcomes.	A small pooled benefit, with uncertainty about components and external validity.	Limited studies and inconsistent implementation reporting.	(Wilkin *et al*., 2024)

Note. Selected studies and syntheses illustrate convergent and conflicting findings; entries are not independent units for pooling or an exhaustive evidence census

7. A Conditional Framework Linking Practice, Regulation and Learning

7.1 The Logic of Translation

The proposed framework is neither a reconstruction of Patañjali's metaphysics nor a claim that contemporary neuroscience has verified the Yoga Sūtra. It is an explanatory bridge with deliberately different kinds of links. The first connection, from selected Pātañjala ideas to a voluntary exercise, is interpretive: repeated practice and deliberate redirection offer a plausible educational analogy. The second, from specific exercises to attentional processes, is an empirical hypothesis informed by meditation and yoga research. The third, from improved regulation to sustained engagement, is conditional on an available task, a learner who finds the strategy acceptable and sufficient instructional support. The fourth, from engagement to meaningful learning, depends on established pedagogical mechanisms of explanation, elaboration, retrieval, feedback and transfer assessment (Chi & Wylie, 2014; Gard *et al*., 2014; Mayer, 2002; Raveh, 2015).

This layered interpretation guards against a common rhetorical shortcut. A conceptual resemblance between pratyāhāra and selective attention cannot establish that one is an early formulation of the other; overlap in behaviour does not establish identity of goals, ontology or evidence. Nor does an effect on executive function confirm that non-attachment or cessation of vṛtti has occurred. The value of the classical construct is heuristic rather than evidential: it can prompt precise questions about monitoring, reorientation and response to distraction that are then tested on their own psychological terms. Its historical and philosophical meaning remains independently discussable even if an educational trial fails.

The framework treats meaningful learning as an emergent outcome requiring at least two interacting conditions. One is the learner's capacity and opportunity to engage with a task; the other is the epistemic quality of that task and the feedback structure surrounding it. A small reduction in wandering attention may improve task continuity only where the learner knows how to use the recovered time. Poorly designed instruction may remain ineffective with attentive students. Conversely, strong pedagogy may work well enough that added contemplative practice provides no measurable incremental gain. This yields a stringent rather than permissive standard for intervention claims.

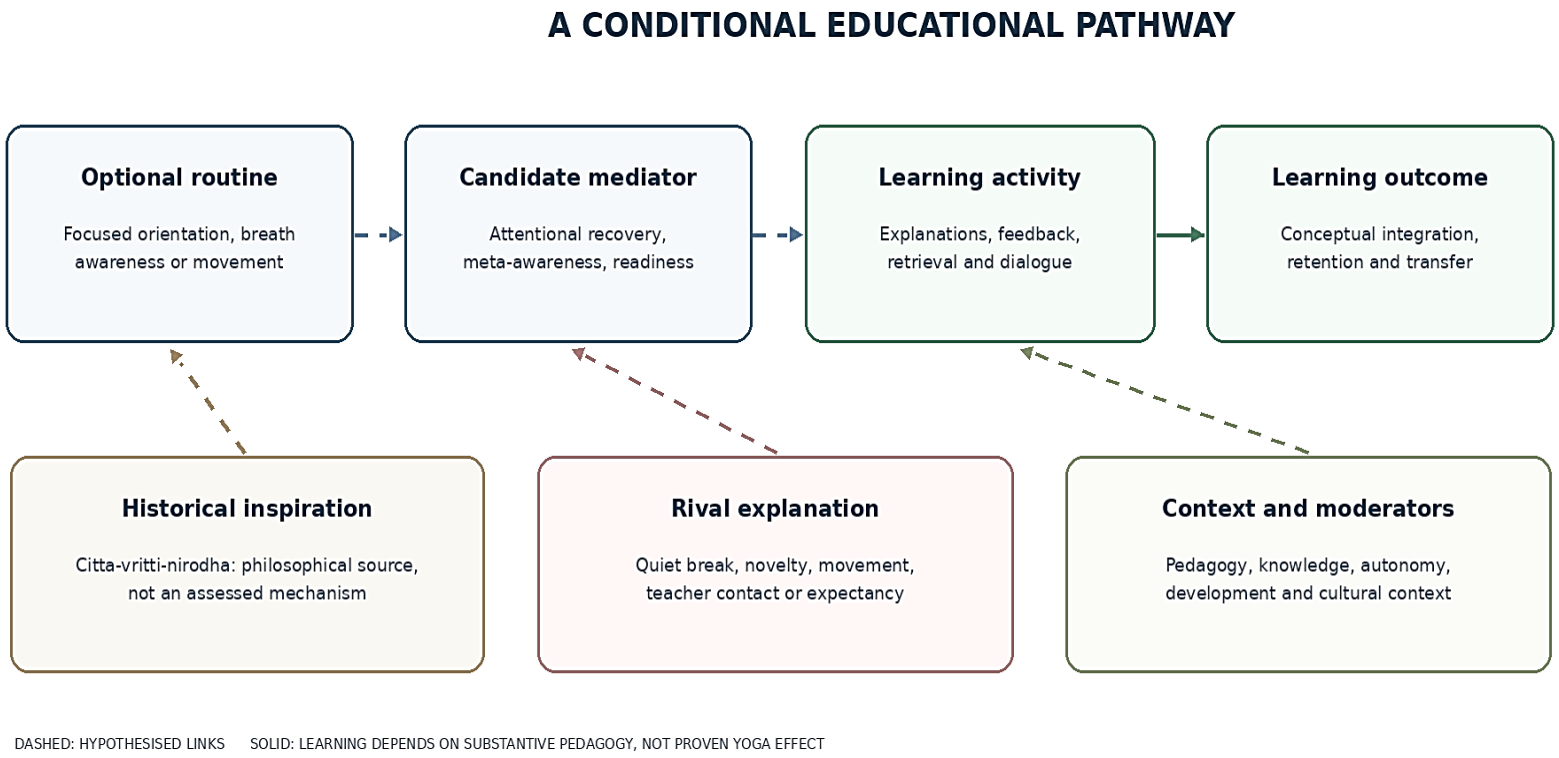

Fig. 1. A conditional pathway from a voluntary regulatory activity to demonstrable learning. The classical source supplies philosophical inspiration but does not empirically validate the hypothesised mediator. The solid link denotes the need for substantive pedagogical activity in the proposed account, not a measured causal effect of yoga. Diagram developed from the critical synthesis

7.2 Four Testable Pathways

The first hypothesised pathway is attentional recovery: structured voluntary practice increases the speed or reliability with which a learner notices task-unrelated capture and returns to work. Its observable signature would be fewer prolonged lapses during an authentic lesson, not merely higher scores on a practice-congruent breathing task. The second pathway is emotional readiness: a practice reduces disruptive arousal for some learners, enabling entry into demanding activity. This pathway is not presumed to operate when arousal is already appropriate or when inward focus provokes discomfort. A third pathway is metacognitive noticing: increased awareness of distraction becomes available for recognising confusion and selecting a new strategy. It requires training in task-specific monitoring, because noticing a feeling and diagnosing a conceptual error are not equivalent operations (Panadero, 2017; Shapiro *et al*., 2006; Vago & Silbersweig, 2012).

The fourth pathway is sustained epistemic engagement. Under supportive conditions, regulatory gains may allow more time for explanations, revision of concept maps, comparison of alternatives, self-testing and collaborative reasoning. This is the decisive pathway for meaningful learning, but it is also the weakest link in current intervention research. Few studies jointly measure a temporally prior regulatory change, a theoretically specified learning behaviour and a delayed transfer outcome using appropriate controls. The framework thus requires that evidence for each pathway be separately assembled before the entire chain is attributed to yoga-inspired practice (D'Souza & Smyth, 2025; Dunning *et al*., 2022; Novak, 2002).

There is a competing fifth explanation that does not require a contemplative-specific mechanism: scheduled, predictable, socially supported pauses may improve engagement by reducing fatigue and changing the rhythm of instruction. Ordinary movement, silent reading, a calming conversation or a teacher-guided transition might produce comparable gains. A strong experiment must make this alternative credible rather than merely mention it. In addition, any apparent benefit may arise from the teacher's enthusiasm or changes in classroom expectations. For this reason, interventions need matched controls, fidelity checks and, where feasible, blinded coding of work quality. The framework would be weakened if the hypothesised mediators failed to change or if comparable gains consistently followed a non-contemplative control.

7.3 Moderators and Boundary Conditions

Age and developmental stage shape what a learner can understand about attention, consent and metacognitive choice. A brief sensory-orienting activity with young children is not functionally the same as sustained introspective meditation among older students or adults. Baseline stress, neurodevelopmental profile, task difficulty, prior knowledge, cultural framing and teacher competence are plausible moderators. Reviews of school interventions suggest that heterogeneity is not simply random noise; programme content and facilitator characteristics can matter (Mettler *et al*., 2023; Sun *et al*., 2021; Wilkin *et al*., 2024). At the same time, moderator findings can be unreliable when subgroup analyses are underpowered or post hoc. They should generate preregistered hypotheses rather than excuses for every failure to replicate.

The social organisation of the classroom is also a boundary condition. An intervention that improves a student's ability to reorient attention cannot compensate for persistent noise, unsafe relationships, inaccessible materials or explanations delivered in an unfamiliar language. Treating these conditions as mere covariates would understate their causal importance. Teachers may legitimately address attention through lesson structure, movement, formative assessment and the pace of instruction without adding a contemplative programme. A fair evaluation examines incremental value under realistic school constraints and asks whether benefits are distributed equitably rather than concentrated among students already advantaged in the classroom.

7.4 Framework Interpretation and Falsifiability

Fig. 1 represents the proposed causal chain as a series of tentative links embedded within stronger evidence concerning effective learning activities. It deliberately distinguishes the source of conceptual inspiration from processes that might be measurable and from outcomes that must be demonstrated. The diagram includes a competing non-specific pathway and contextual moderators to prevent the visual structure from being read as an established causal sequence.

8. Educational Practice, Cultural Integrity and Implementation

8.1 Designing an Optional Regulatory Routine Around a Real Lesson

A practical translation starts with a specified learning objective rather than with a branded exercise. Suppose students are about to compare explanations for a scientific phenomenon. The teacher first clarifies the question and activates relevant prior knowledge. A brief, optional transition may then invite pupils to notice the classroom environment, settle posture comfortably or direct attention to an external visual anchor. Learners who do not want breath-focused or body-focused activity can choose a neutral alternative such as reading the task prompt. The session proceeds to explanatory work, comparison of evidence, feedback and subsequent recall. In this sequence, the regulatory step is explicitly subordinate to the learning task.

Implementation fidelity should refer to the actual educational mechanism rather than obedience to ritual form. The relevant question is whether students have a feasible way of starting, returning to and monitoring their work. A programme requiring a fixed posture, eyes closed or prolonged stillness is not necessary to test that hypothesis and may disadvantage students with physical disabilities, sensory differences, anxiety or trauma-related concerns. Teacher judgement can support adaptation, but excessive variation also

weakens research interpretability. Manuals should therefore define non-negotiable functional components and permissible accommodations separately. If interventions are trialled, the same instructional content, task duration, feedback opportunities and assessment procedures should be available across groups.

The apparent simplicity of brief classroom practices should not conceal staff workload. Teachers need to understand the difference between directing attention, evaluating learning and responding to distress. They should not be expected to diagnose mental states, teach metaphysical doctrine or become therapeutic practitioners through a short workshop. Early research on classroom yoga and mindfulness has highlighted variation in intervention content, and educator-focused work reports practical and cultural barriers to adoption (Sun *et al*., 2021; Wilkin *et al*., 2025). Such findings support careful training, communication and voluntary implementation rather than mandatory expansion ahead of stronger outcome evidence.

8.2 Religious Pluralism, Cultural Attribution and the Limits of Secularisation

A scholarly educational framework must neither appropriate Pātañjala terms as empty labels nor make assent to a tradition a condition of participation. A history or philosophy lesson may openly teach the Yoga Sūtra and its interpretive controversies as part of an intellectual tradition. An optional classroom regulation exercise, by contrast, should be justified in terms of observable functions and should not include ritual commitments or claims about spiritual attainment. These are different educational activities and require different forms of consent, explanation and assessment. Paranjpe (2021) underscores yoga psychology's distinctive goals, while McKibben (2025) illustrates how contemporary wellness contexts reshape the meanings of classical concepts.

Framing the programme as secular does not itself settle ethical issues. Breathing, postures, terminology, imagery and teacher explanations can still carry religious significance for some families or be perceived as such. Conversely, erasing origins can deny the cultural history from which the practice was selectively drawn. An honest approach attributes the intellectual source, presents divergent interpretations without claiming a universally authorised translation and allows learners to decline without penalty. Religious and non-religious students should have equivalent access to the instructional benefits the exercise is intended to support. The core public-school obligation is not to secure compliance with a contemplative worldview but to enable learning in a plural community.

Contemporary criticism also examines how mindfulness can shift responsibility for distress from institutional conditions to individual coping. Lee *et al*. (2024) warn that the social and political uses of school mindfulness require evaluation alongside questions of developmental appropriateness and possible harms. If academic pressure, exclusion or inadequate support is causing disengagement, teaching students to regulate their responses should not excuse the institution from addressing the source. In fact, equitably designed practice may be most defensible when embedded within supportive pedagogy, reasonable workload and meaningful student voice rather than offered as a compensatory technique for unchanged adverse conditions.

8.3 Safeguarding, Feedback and Proportionate Evaluation

Safeguarding requirements follow from the fact that inward attention does not feel uniformly safe or useful. Guidance should avoid insisting that learners close their eyes, disclose private experiences or remain with distressing sensations. Students should be able to stop, choose an external attentional anchor, request help or participate in an alternative activity. Adults should use age-appropriate, non-diagnostic explanations and follow established safeguarding pathways when unexpected distress arises. Van Dam *et al*. (2018) document the importance of systematic adverse-event assessment in contemplative research; in schools, the requirement is strengthened by unequal authority between educators and minors.

Evaluation should separate feasibility, proximal regulation, educational engagement and achievement. Acceptance ratings can identify whether a procedure is tolerable but cannot demonstrate efficacy. Brief attention measures may reveal a mechanism while requiring classroom observation to determine ecological value. Student work, scored independently with common rubrics, can assess whether the activity supports explanation and application, and delayed testing can reveal whether gains persist. Opportunity cost must be included: a five-minute activity has an educational price when repeated across an academic year, even if it is inexpensive in material terms. A programme should not be scaled solely because pupils enjoy it or because it produces a favourable immediate mood report (Maynard *et al*., 2017; Marshall *et al*., 2025).

Results should also be disaggregated with care. Aggregate means can conceal that students who dislike internal attention or face cultural barriers are underrepresented among those completing the intervention. Differential attendance, reporting and dropout may distort an apparently benign outcome. Qualitative feedback can identify unanticipated burden and competing explanations, but it should supplement rather than replace independently assessed learning. A fair trial permits the possibility that a flexible movement break or supportive classroom routine is equally effective and more acceptable. The aim is to improve educational decisions, not to establish a preferred tradition's superiority.

Table 5 translates these principles into design and evaluation choices. The central practical implication is that a contemplative-derived routine earns a curricular place only when it is acceptable, safe, transparent and demonstrably useful relative to accessible alternatives.

Table 5. A proportionate design and evaluation matrix for optional classroom routines

Design element	Practical implementation	Minimum evaluative indicator	Boundary or safeguard	Supporting references
Voluntary choice	Offer a brief orienting activity and an equally legitimate non-contemplative transition.	Uptake, opt-out and student acceptability.	No penalty, forced disclosure or implied spiritual assent.	(Lee *et al*., 2024; Wilkin *et al*., 2025)
Cultural transparency	Acknowledge roots and clarify the adapted educational purpose.	Comprehension of purpose; feedback from diverse families.	Avoid claiming the exercise reproduces classical attainment.	(McKibben, 2025; Paranjpe, 2021)
Instructional linkage	Place practice before explanation, retrieval or guided problem-solving.	Quality of subsequent content-specific participation.	Do not replace effective subject teaching or feedback.	(Chi & Wylie, 2014; Dunlosky *et al*., 2013)
Credible comparator	Compare with quiet reading, physical movement or neutral structured breaks.	Difference on pre-specified mediator and learning outcomes.	Account for contact, novelty and expectation.	(Dunning *et al*., 2022; Van Dam *et al*., 2018)
Safeguarding	Adapt for sensory needs; accept discomfort or non-participation.	Adverse experiences and accessible alternative uptake.	Avoid universal assumptions about comfort or cultural belonging.	(Lee *et al*., 2024; Sun *et al*., 2021)
Durability and value	Repeat curriculum-aligned tests after delay and examine resource costs.	Retention, conceptual transfer and teacher time.	Do not promote immediate calm into a claim of lasting achievement.	(Mayer, 2002; Maynard *et al*., 2017)

Note. This matrix proposes choices for evaluation; it is not a validated intervention manual or evidence of comparative effectiveness

9. Conditions for Stronger Explanatory Tests

A decisive study should begin with a causal model specific enough to fail. For example, in a unit requiring conceptual change, the primary educational endpoint might be delayed transfer on novel explanation problems scored blindly. The hypothesised mediator could be sustained on-task reasoning recorded through structured observation, preceded by an improvement in experimentally measured recovery after distraction. The intervention could be compared with an equally credible movement or neutral transition routine, with learning material, teacher contact and lesson time matched. Randomisation at class or school level would reduce contamination where peer routines are shared, while analyses should account for clustering and pre-existing differences. The design must not use self-reported mindfulness as the sole demonstration of academic benefit.

Measurement timing matters. If attentional recovery is the proposed mediator, it should be assessed before the educational outcome and ideally on repeated occasions, not inferred retrospectively from students who achieved the highest scores. The protocol should register a limited number of primary comparisons and specify how missing data, implementation fidelity and multiple outcomes will be handled. Teacher enthusiasm, learner preference and prior familiarity with the practice should be recorded because they can moderate adherence and bias subjective reports. An observational mediation analysis alone cannot exclude unmeasured mediator–outcome confounding; factorial or component-randomised designs would offer stronger evidence about active ingredients when feasible (Dunning *et al*., 2022; Van Dam *et al*., 2018).

Cross-disciplinary validity requires parallel but distinct instruments. Scholars of yoga can review whether the traditional terminology has been used accurately, and educational psychologists can determine whether a measure captures meaningful learning rather than perceived calm. Students, families and teachers can inform the acceptability of the procedure and the language used to explain it. These checks need not imply philosophical agreement. Their purpose is to prevent an intervention from gaining unwarranted authority merely because its components can be described in Sanskrit or mapped onto a brain-network diagram. A null result would be informative if it identifies a broken link in the proposed mechanism or demonstrates equal performance for a simpler comparator.

The framework also predicts situations where no benefit should be expected. When learners are already well engaged, a transition routine may add little. When unfamiliar content is poorly explained, extra attention should not repair missing prerequisite knowledge. When discussion and generative reasoning are inhibited by an excessive emphasis on silence, the practice might reduce the behaviours most relevant to conceptual learning. When students experience the exercise as compulsory or culturally alienating, its effect on engagement may be negative. A theory that anticipates these outcomes is more useful than one that interprets every result as evidence of hidden long-term transformation.

10. Future Directions

An immediate priority is to isolate regulatory mechanisms from bundled programme effects. School studies should compare focused-attention routines, neutral quiet transitions, moderate movement and well-matched instruction, holding teacher time and expectancy as constant as practical. Component-randomised designs can establish whether attention-focused elements add value beyond breathing or physical activity; dismantling designs can assess whether a change is lost when one component is removed. Preregistration and prospective monitoring of acceptability and adverse experiences would limit selective emphasis on favourable

outcomes. A useful contribution would be a replicable estimate of improved attentional recovery linked to a real learning task, not a proliferating catalogue of mood and wellness scales (Gard *et al*., 2014; Van Dam *et al*., 2018).

The second priority is to test educational mediation with outcomes worth improving. Trials should distinguish task initiation, duration of on-task reasoning, monitoring accuracy, quality of explanation, delayed retention and transfer. These measures should not be collapsed into an undifferentiated 'academic success' score. A preregistered temporal model could examine whether a practice changes attentional recovery early in the study, whether that change predicts more high-quality explanatory work and whether independently marked delayed assessments subsequently improve. Studies should control for prior knowledge and deliver equivalent teaching across conditions. The competing hypothesis, that learning gains arise from extra structure or adult support alone, should be specified before analysis (Chi & Wylie, 2014; D'Souza & Smyth, 2025; Novak, 2002).

Third, developmental specificity requires planned comparison rather than post hoc subgroup storytelling. Preschoolers may respond to movement and shared routines, whereas adolescents may have more capacity for reflective monitoring but different needs for autonomy and privacy. Studies should examine baseline attention difficulties and task-specific challenges while preserving sufficient power to detect moderation. Inclusion needs to be designed in from the outset: accessible versions should be available for learners with disabilities, language differences or sensory sensitivities, and disengagement should not automatically be coded as intervention failure within the student. Follow-up beyond immediate post-test is essential, particularly because existing reviews find inconsistent persistence of benefits (Dunning *et al*., 2022; Sun *et al*., 2021; Wilkin *et al*., 2024).

Fourth, research should address cultural and institutional validity. Comparative work in Indian and non-Indian educational contexts could examine how attribution, religious meanings, teacher expectations and family preferences influence participation and efficacy. Such research must not assume that all Indian learners relate to yoga similarly, nor that all Western programmes use a single secular interpretation. Community-informed adaptation, public documentation of practices and non-stigmatising alternatives would permit evaluation of both cultural respect and educational benefit. Qualitative accounts could reveal why apparently identical exercises support one learner but undermine another, while quantitative studies could test whether those experiences explain differential participation (Lee *et al*., 2024; McKibben, 2025; Wilkin *et al*., 2025).

A fifth priority is to evaluate trade-offs honestly. Programmes should be compared with proven learning supports and reasonable classroom transitions, not only with minimal-contact controls. Economic assessments need to consider teacher preparation, lost instructional time, accessibility adjustments and maintenance, in addition to any improvements in wellbeing or concentration. The size of an effect should be considered alongside uncertainty, consistency, durability and importance to students' lives. In settings with scarce resources, even a genuine small proximal benefit may be less valuable than strengthening foundational instruction, formative assessment or learning materials. Conversely, a low-cost voluntary routine may be reasonable where it improves participation without displacing such essentials. The question must remain comparative and context-sensitive.

Longer-term conceptual work should develop a disciplined vocabulary for comparing contemplative traditions and educational psychology without erasing their differences. Collaboration among Sanskrit scholars, historians, psychologists, teachers and students could define what is being translated, what is being adapted and what has actually been measured. Such work may clarify distinctions between attentional stability, equanimity, suppression, metacognitive awareness and reflective agency. Its value would be intellectual precision rather than the search for a timeless validation of modern cognitive science. The most ambitious research outcome would be a demonstrable, reproducible and ethically acceptable pathway from a defined voluntary practice through measurable regulation to high-quality learning in ordinary settings. Until then, the framework is a testable synthesis, not a settled educational intervention.

11. Conclusions

The central conceptual proposition is limited but useful: selected practices inspired by Pātañjala yoga can be interpreted as opportunities to rehearse deliberate attentional reorientation, yet citta-vṛtti-nirodha cannot be equated with executive attention or with the production of academic understanding. Classical yoga's normative and liberative horizon remains distinct from the aims and outcome criteria of formal education. Scientific models make attention regulation a plausible candidate mechanism, while school-based evidence supports only contingent, generally modest and inconsistently durable benefits. Improved concentration, even when reliably observed, is not proof of conceptual integration or transfer.

Meaningful learning requires a further, instruction-dependent sequence in which learners retrieve prior knowledge, construct explanations, evaluate alternatives, receive feedback and apply ideas beyond rehearsed tasks. The proposed conditional framework locates any contemplative-derived routine before or alongside these pedagogical processes, not in their place. The resulting claim is deliberately falsifiable: if the practice does not improve a specified regulatory capacity, if the regulatory change does not support task engagement, or if high-quality learning remains unchanged relative to credible alternatives, the asserted educational pathway is unsupported. Educational implementation should consequently remain voluntary, culturally transparent, developmentally appropriate and open to non-contemplative alternatives. The strongest contribution of the synthesis is not a prescription to adopt yoga in schools, but a clearer set of conceptual distinctions and empirical tests by which such decisions can be made responsibly.

12. Limitations

As a critical narrative review, this analysis is vulnerable to source-selection and interpretive bias despite transparent topic-specific searching, comparison of conflicting evidence and reference checking. It does not provide an exhaustive systematic search, duplicate independent study screening, formal risk-of-bias ratings or a new quantitative synthesis. Some research was accessible

only through abstracts and publisher metadata, restricting the granularity of trial-level methodological assessment. The English-language evidence base may underrepresent scholarship published in other languages, especially work engaging directly with Indian philosophical and educational traditions.

Further limitations arise from heterogeneity of intervention labels, ages, measures, implementation and comparison conditions. Some syntheses combine yoga, meditation and mindfulness programmes whose active ingredients differ, while available studies often measure wellbeing or proximal attention rather than delayed conceptual understanding. The conceptual framework therefore depends partly on extrapolation from adult laboratory evidence and educational theory. Its pathways and moderators have not been jointly validated in a single coordinated research programme. The review has aimed to mark those boundaries explicitly; conclusions about causal educational benefit must remain correspondingly provisional.

Declaration of AI Use

This manuscript was prepared through the intellectual contributions of the author(s) to the study design, data analysis, interpretation of results, and scholarly content. Grammarly and ChatGPT were used solely to assist with grammatical refinement and reference formatting during manuscript revision. The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

Competing Interests

Author has declared that he/she has no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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