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Neuroconstructivism in Thai Education: Rethinking Early Childhood and Primary Learning

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Abstract

Neuroconstructivism presents an integrative perspective on education, viewing learning as a dynamic, context-sensitive process shaped by the ongoing interaction of genetic, neural, cognitive, social, and cultural influences. Drawing on both global research and the lived realities of teaching in Thailand, this article explores how neuroconstructivist ideas can guide curriculum design, instructional strategies, assessment, and policy. The discussion highlights the complexity of real classrooms, where each child's developmental pathway is woven from community, language, tradition, and personal experience as much as from formal instruction. While recent advances in neuroscience and educational research underscore the value of personalized, multimodal, and context-responsive environments, putting these ideals into practice remains challenging. Persistent neuromyths and structural disparities in resources and opportunities continue to complicate the translation of scientific insight into classroom realities particularly in diverse and resource constrained settings. This review addresses two underarticulated gaps: (1) the lack of an integrated synthesis in the Southeast Asian context and (2) the limited translation of neuroconstructivism theory into curriculum and classroom practice in Thailand's early childhood and primary education.

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Keywords

Neuroconstructivism, Context Sensitivity, Thai Education, Neurodiversity

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ทฤษฎีการสร้างความรู้ในเชิงประสาทวิทยาในบริบทการศึกษาไทย: พลิกมุมคิดการเรียนรู้ในเด็กปฐมวัยและประถมศึกษา

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บทคัดย่อ

ทฤษฎีการสร้างความรู้ในเชิงประสาทวิทยา เสนอกรอบมุมมองเชิงบูรณาการต่อการศึกษา โดยมองว่าการเรียนรู้เป็นกระบวนการที่เกิดขึ้นอย่างต่อเนื่อง มีความอ่อนไหวต่อบริบท และถูกกำหนดจากปฏิสัมพันธ์ระหว่างปัจจัยทางพันธุกรรม ระบบประสาท กระบวนการคิด ความสัมพันธ์ทางสังคม และวัฒนธรรม บทความนี้เชื่อมโยงองค์ความรู้จากงานวิจัยระดับสากลเข้ากับประสบการณ์จริงของการจัดการเรียนการสอนในบริบทประเทศไทย เพื่อพิจารณาว่าแนวคิดของทฤษฎีการสร้างความรู้ในเชิงประสาทวิทยาสามารถนำมาใช้เป็นกรอบในการออกแบบหลักสูตร การจัดการเรียนรู้ การประเมินผล และนโยบายทางการศึกษาได้อย่างไรในทางปฏิบัติ ซึ่งสะท้อนให้เห็นถึงความซับซ้อนของห้องเรียนจริง ที่พัฒนาการของผู้เรียนแต่ละคนไม่ได้ก่อตัวจากการเรียนการสอนอย่างเป็นทางการเพียงอย่างเดียว หากแต่สัมพันธ์อย่างใกล้ชิดกับชุมชน ภาษา ประเพณี และประสบการณ์ชีวิต งานวิจัยร่วมสมัยด้านประสาทวิทยา และการศึกษาได้ชี้ให้เห็นถึงความสำคัญของสภาพแวดล้อมการเรียนรู้ที่คำนึงถึงความแตกต่างระหว่างบุคคล ใช้รูปแบบการเรียนรู้ที่หลากหลาย และตอบสนองต่อบริบทเฉพาะของผู้เรียน อย่างไรก็ตาม การนำหลักการเหล่านี้ไปใช้ในห้องเรียนยังเผชิญกับข้อจำกัดหลายประการ ทั้งความเข้าใจที่คลาดเคลื่อนเกี่ยวกับสมองในวงการศึกษา และความเหลื่อมล้ำเชิงโครงสร้างด้านทรัพยากรและโอกาส ซึ่งส่งผลให้

การเชื่อมโยงองค์ความรู้ทางวิทยาศาสตร์กับการปฏิบัติจริงเป็นไปได้อย่างจำกัด โดยเฉพาะในบริบทที่มีความหลากหลายและข้อจำกัดสูง บทความชิ้นนี้ชี้ให้เห็นถึงช่องว่างสำคัญสองประการ ได้แก่ (1) การขาดการสังเคราะห์องค์ความรู้เชิงบูรณาการในบริบทเอเชียตะวันออกเฉียงใต้ และ (2) ข้อจำกัดในการนำทฤษฎีการสร้างความรู้ในเชิงประสาทวิทยาไปสู่การออกแบบหลักสูตรและการจัดการเรียนรู้ในระดับปฐมวัยและประถมศึกษาของประเทศไทย

คำสำคัญ

ทฤษฎีการสร้างความรู้ในเชิงประสาทวิทยา, ความไวทางบริบท, การศึกษาไทย, ความหลากหลายทางระบบประสาท

Introduction

The landscape of educational theory and practice in the twenty-first century has undergone a profound transformation, shaped by rapid advances in cognitive science and neuroscience. These interdisciplinary developments have led to an unprecedented integration of brain science and educational research, fundamentally altering how educators and scholars conceptualize learning and development (Thomas et al., 2019). Where earlier generations relied upon longstanding dichotomies most notably the divide between nature and nurture contemporary research increasingly points toward dynamic, multilayered frameworks that recognize the intricate interplay among biological, experiential, and cultural influences (Johnson, 2011; Karmiloff-Smith, 2018).

Within this evolving landscape, neuroconstructivism has emerged as a particularly influential paradigm. Rather than regarding cognitive development as a predetermined sequence or as the sole product of environmental input, neuroconstructivism positions it as an active, ongoing, and deeply context-sensitive process. The development of the mind is understood to be constrained and shaped by multiple interacting levels genetic, neural, cognitive, behavioral, and environmental each exerting reciprocal influence (Farran & Karmiloff-Smith, 2012; Karmiloff-Smith, 2009; Mareschal et al., 2007). Notably, this perspective moves beyond the notion of the brain as a passive recipient, instead conceptualizing neural structures as continually sculpted through the child's repeated and reciprocal engagement with their surroundings. Here, biological endowment and lived experience are not oppositional, but co-constructive and mutually reinforcing (Karmiloff-Smith, 2018; Westermann et al., 2007).

Appreciating this complexity brings with it significant implications for educational practice. If cognitive development is neither entirely preordained nor infinitely malleable, then the environments we create for children's learning must be both thoughtfully structured and sufficiently adaptable. Only in this way can education respond to the unique strengths, needs, and developmental trajectories of individual learners (Al Dahhan et al., 2016; Guarini et al.,

2019; Kolb et al., 2017; Trautmann, 2014). Emerging research especially that leveraging longitudinal neuroimaging, computational modeling, and large-scale educational data underscores how neural plasticity, sensitive periods, and individualized experience collectively shape academic achievement and learning pathways.

From my own experience as a professional teacher in Thailand, I have often observed how deeply context-sensitive development truly is. For instance, in small rural schools, children's learning trajectories are not only shaped by genetics or classroom instruction but also by subtle factors in their home and community environments such as language dialects, intergenerational caregiving practices, and local cultural values. I have encountered students whose cognitive growth was catalyzed not by direct instruction alone, but by their active participation in community festivals or traditional crafts, illustrating how neuroconstructivist principles are vividly at play in our local context. These observations underscore the necessity for educational models in Thailand to move beyond standardized, one-size-fits-all approaches, and instead adopt frameworks that honor each child's unique blend of biological and experiential factors.

Yet, the promise of neuroconstructivism is, in practice, only partially realized. Translating its insights into policy and classroom action remains a formidable challenge. Persistent neuromyths among educators, the slow adaptation of policy frameworks to developmental science, and enduring debates over the practical design of curriculum and assessments have all contributed to a gap between theory and practice. In the Thai context, I have personally witnessed how misconceptions such as the belief that intelligence is fixed or that "left-brain" and "right-brain" learners require fundamentally different teaching strategies continue to influence classroom practices and hinder the adoption of research-based innovations.

Against this backdrop, scholarship on the learning sciences in Southeast Asia is dispersed across fields. Reviews to date are largely oriented to global contexts or confined to single disciplines, yielding neither a regional synthesis nor actionable directions for Thai context. This article will integrate Southeast Asian evidence, offers an in-depth Thai analysis, and develops curriculum-ready guidance for early childhood and primary education.

Objectives

(1) To examine how principles of neuroconstructivism can inform educational policy, curriculum design, instructional strategies, and assessment practices in Thai early childhood and primary education.

(2) To identify practical instructional strategies and professional development approaches that can effectively bridge the gap between neuroscience research and classroom practice within the Thai educational context

Theoretical Background

Neuroconstructivism stands as a powerful theoretical lens that has significantly deepened our contemporary understanding of cognitive development. At its core, this framework emphasizes the intricate and constantly evolving interactions among biological, cognitive, and environmental factors a viewpoint increasingly supported by recent empirical research (Karmiloff-Smith, 2018; Mareschal et al., 2007). The roots of neuroconstructivism run deep in both the constructivist traditions of Piaget and the developmental systems approach, yet it also incorporates remarkable insights from the rapid growth of cognitive neuroscience and genetics (Astle et al., 2023; Johnson, 2011; Tokuhama-Espinosa & Borja, 202 3). What distinguishes neuroconstructivism, in my experience as both educator and researcher, is its insistence that cognitive growth cannot be reduced to any single dimension but must instead be understood as an emergent product of multilevel and reciprocal influences.

Core Assumptions

The emergence of neuroconstructivism was, in many respects, a reaction against the limitations of reductionist theories. Older models frequently forced us to choose between nativism where learning is seen as genetically predetermined and empiricism, which assigns developmental outcomes wholly to environmental shaping. In my teaching career, I have seen firsthand the drawbacks of such dichotomous thinking, especially when curriculum are designed as if children arrive as "blank slates" or, conversely, as if their destinies are already inscribed by heredity. Neuroconstructivism, however, advances a richer understanding: it posits that cognitive development is best described as progressive specialization. Neural, cognitive, and behavioral systems are continually constructed and reconstructed through active engagement with the world, each shaped by multiple, layered constraints (Karmiloff-Smith, 2018; Mareschal et al., 2007). A hallmark of this framework is its principle of multilevel constraint, which asserts that development is not solely a function of genes and brain maturation, but is also decisively influenced by contextual factors sensory input, social relationships, and cultural tools (Johnson, 2011; Mareschal et al., 2007). These factors operate recursively: changes in neural circuits influence cognition, which in turn shapes behavior, further modifying neural pathways in a continual feedback loop (Thomas et al., 2019).

Distinction from Traditional Theories (Piaget & Vygotsky)

Piaget and Vygotsky laid the groundwork by showing that children actively build knowledge through interaction whether with materials, ideas, or other people. Neuroconstructivism keeps that insight, but pushes it further. It treats development as a continuous, context-sensitive process of progressive specialization in which genetic, neural, cognitive, and cultural factors are in constant dialogue. Rather than setting nature and nurture in opposition, it shows how everyday experience sculpts the brain's pathways and how those pathways, in turn, channel future. This systems lens also helps explain what earlier stage-based or purely social accounts

cannot: the way micro-level neural change is braided together with the macro-level realities of classrooms, policies, and local culture learning (Astle et al., 2023; Tokuhama-Espinosa & Borja, 202 3). Neuroconstructivism doesn't replace Piaget or Vygotsky; it extends them into a framework that better fits the layered complexity and diversity of real classrooms.

Developmental Processes

Central to neuroconstructivism is the notion of progressive specialization. Early in life, children's neural and cognitive systems are broad and adaptable, equipped with remarkable potential. Through repeated engagement with diverse tasks and environments, these systems gradually become more differentiated and specialized a process sometimes described as "interactive specialization" (Johnson, 2011; Kolb et al., 2017). My own classroom observations resonate with this concept; for instance, students who are consistently exposed to rich linguistic or mathematical contexts often exhibit accelerated development in those domains, reflecting the brain's capacity for adaptive change. Yet, as neuroconstructivist theory cautions, plasticity is a double-edged sword: while it presents extraordinary opportunities for learning, there are sensitive periods during which particular skills are most easily acquired. Missing these windows may have lasting consequences, a point that underscores the need for timely, context-rich interventions something that is often a challenge in the varied and resource-constrained settings of Thai education

Another defining feature of neuroconstructivism is its recognition that cognition is always context-sensitive, arising from the individual's ongoing engagement with their physical, social, and cultural environment (Mareschal et al., 2007; Thomas et al., 2019). I am continually reminded of this in Thai classrooms, where local dialects, community values, and unique family structures shape not only what children learn, but how they process and integrate new knowledge. Learning is thus not simply a matter of individual capacity, but is deeply embedded in the fabric of relationships,

language, and cultural practices (Karmiloff-Smith, 2018; Mareschal et al., 2007). Moreover, drawing from embodied cognition, neuroconstructivism highlights that sensory, perceptual, and motor experiences are not peripheral, but fundamental they scaffold the development of abstract thinking and leave lasting imprints on the architecture of the brain itself (Astle et al., 2023; Tokuhama-Espinosa & Borja, 2023).

Individual Differences

Perhaps one of neuroconstructivism's most progressive contributions is its nuanced understanding of individual differences. Rather than pathologizing atypical development or regarding it as a deviation from some idealized norm, this framework positions all developmental trajectories whether typical or atypical on a broad spectrum shaped by a constellation of interacting constraints and opportunities (Mareschal et al., 2007; Thomas et al., 2019). As a teacher, I have found this perspective invaluable: it encourages a move away from "deficit" thinking and invites us to design educational environments that genuinely respect and respond to neurodiversity, challenging the persistence of "one-size-fits-all" solutions in mainstream schooling.

Methods

An integrative narrative review was conducted and PRISMA-aligned elements are reported to enhance transparency. Searches (Scopus, Wiley, and Google Scholar) from 2000–2025 used terms spanning neuroconstructivism, neuroconstructivist, and neuromyths. Inclusion captured empirical/theoretical works connecting neural/cognitive development to instructional or curricular implications; exclusion removed purely clinical studies without educational relevance. The PRISMA flow diagram, search strings, screening counts, and study table appear in Figure 1.

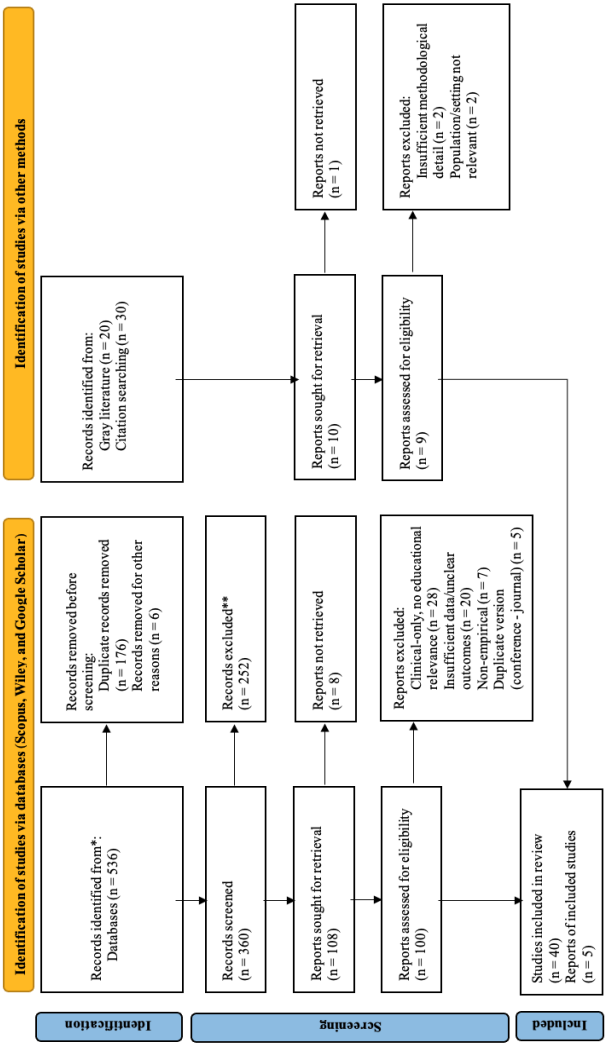


Figure 1. PRISMA flowchart

Current Research

In recent years, neuroconstructivist research has rapidly accelerated, thanks in large part to methodological breakthroughs in neuroimaging, computational modeling, genetics, and the analysis of large-scale educational data. These advances have allowed researchers to probe more deeply than ever before into the ways neural, cognitive, and contextual factors come together to shape each child's unique developmental pathway with findings that carry immediate implications for educational practice. As someone engaged in both classroom teaching and research, I have found it striking how quickly ideas once confined to the laboratory are beginning to inform and sometimes challenge everyday decisions in education.

Learning Pathways and Plasticity

One of the clearest insights from recent scholarship is the wide variability in how children develop. Even small differences in early experience such as home language, caregiver involvement, or the richness of literacy and numeracy activities at home can set learners on markedly different developmental pathways (Filipe et al., 2023; Thomas et al., 2019). These early variations often interact with broader social and cultural factors, shaping how children approach learning tasks and build academic skills over time. From my own experience teaching in rural Thai classrooms, I have observed that students with even modest additional support at home, whether through storytelling, simple arithmetic practice, or active participation in community traditions, often progress at a noticeably faster pace than their peers. Such observations confirm that early differences, however small, can expand over time into significant gaps in classroom performance, underscoring the need for individualized and context-responsive approaches to instruction.

These differences in developmental pathways are closely connected to the brain's inherent plasticity, which enables children to adapt and respond to their environments most effectively during specific sensitive periods. Another important line of research highlights the brain's remarkable plasticity and the existence of

sensitive periods in development. Longitudinal neuroimaging studies show that children's brains are highly adaptable in the early years, particularly when learning occurs in meaningful, enriched environments (Johnson, 2011; Kolb et al., 2017). In my own classroom practice, I have often observed how timely support in areas such as language or numeracy can produce dramatic gains, even among students who previously struggled. Conversely, missing these developmental windows may result in lasting difficulties. This evidence points to the importance of well-timed interventions whether through formal lessons or everyday practices that can reshape learning trajectories and offer new opportunities for children at risk of falling behind.

Research Approaches and Innovations

Recent work in educational neuroscience increasingly relies on research designs that combine multiple levels of analysis. Rather than focusing only on isolated factors, multilevel and multimodal approaches integrate genetic data, neuroimaging, classroom observations, and large-scale educational assessments to provide a richer picture of learning processes (Thomas et al., 2019). These studies reveal that developmental outcomes cannot be explained by any single variable; instead, they emerge from the dynamic interplay of biological, cognitive, and environmental influences. For educators, this means that a small adjustment in classroom practice when aligned with the right developmental window can interact with neural and cognitive systems in ways that significantly alter a child's learning trajectory. Such findings strengthen the case for evidence-based practices that honor the complexity of development while remaining grounded in real classroom contexts.

At the same time, innovations in educational technology and translational research are extending these insights into everyday practice. Adaptive learning platforms, learning analytics, and other digital tools now allow teachers to monitor student progress in real time, opening possibilities for what has been described as "precision

education" (Liu, 2022). In Thailand, where class sizes are often large and resources unevenly distributed, I have observed how thoughtfully implemented technologies such as simple formative assessment apps can support more individualized instruction even in resource-constrained schools. Translational studies, especially those targeting language and executive function, provide further evidence that interventions grounded in neuroconstructivist principles can be both practical and effective (Sharif & Atif, 2024; Taran et al., 2024). Together, these approaches illustrate how research innovations can bridge the gap between theory and practice, helping educators respond more flexibly to the diverse needs of learners.

Teacher Knowledge and Neuromyths

Despite advances in educational neuroscience, misconceptions about the brain commonly referred to as *neuromyths* remain widespread among teachers. Studies have shown that beliefs such as the effectiveness of tailoring instruction to "learning styles," the dominance of left or right-brain processing, or the idea that intelligence is fixed, continue to circulate in schools worldwide (Dekker et al., 2012; Schmied & Jamaludin, 2023). These misconceptions are not trivial; they can shape classroom practices in ways that limit opportunities for learners, particularly when teachers unknowingly rely on myths instead of evidence-based strategies.

In the Thai context, I have often encountered colleagues who still organize lessons around supposed "visual" or "auditory" learners, or who assume that students who struggle in the early years cannot catch up later. Such practices reflect the persistence of neuromyths in teacher training and highlight the urgent need for sustained professional development that integrates contemporary neuroscience (McMahon et al., 2019). Addressing these gaps requires more than isolated workshops; teachers need ongoing opportunities to critically engage with research and to translate scientific insights into classroom practices that genuinely support diverse learners. By dispelling neuromyths and strengthening neuroscience literacy,

teacher education can help ensure that evidence not misconception guides educational decision-making.

Educational Implications

The practical implications of neuroconstructivism in education are best understood through a multilevel perspective, where genetic, neural, cognitive, social, and environmental factors are seen as dynamically interwoven to shape the developmental trajectory of every child (Johnson, 2011; Thomas et al., 2019). This approach challenges any attempt to reduce effective educational practice to a single factor, insisting instead on a nuanced understanding of how multiple levels of influence intersect and interact. In my own practice, I have seen time and again how real learning seldom results from isolated interventions; it is the ongoing, complex interplay of relationships, context, and structured support that makes the greatest difference. As a result, decisions about curriculum, instructional methods, assessment, and educational policy must be intentionally responsive to the inherent complexity and variability of human growth.

In practical terms, this means that educators must move beyond simply "differentiating" lessons. Instead, the classroom environment itself needs to be alive to the changing needs, abilities, and interests of each learner. For example, when working with mixed-age classes in rural Thai schools, I have learned that flexibility sometimes even improvisation is essential to keep learning meaningful and developmentally appropriate. A neuroconstructivist lens encourages us to view every classroom as a living system, where equity and adaptation are not afterthoughts but central principles.

By grounding educational decision-making in this framework, schools position themselves to provide truly personalized, equitable, and adaptive learning experiences. This is especially vital in contexts like Thailand, where diversity in language, culture, and life experience among students is the norm rather than the exception.

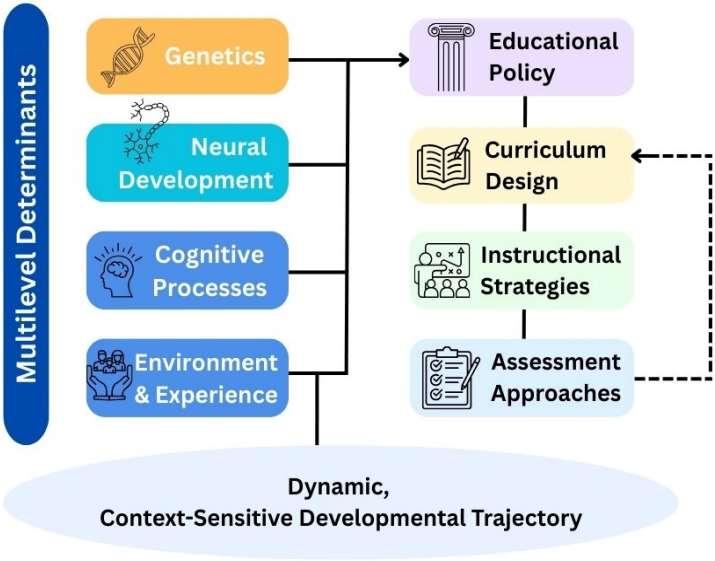


Figure 2. Educational Implications of Neuroconstructivism

Note. Adapted from neuroconstructivist and developmental-systems perspectives discussed in Rinaldi & Karmiloff-Smith (2017), Sirois et al. (2008), and Westermann et al. (2007) by Ittikorn Bunnag.

Equity, Policy, and Early Intervention

A neuroconstructivist perspective places equity at the center of educational debate. Equity, in this sense, does not mean providing every child with the same resources, but rather ensuring that each learner receives the kind of support that matches their developmental needs. Without this, small initial gaps can widen into large and persistent inequalities the so-called "Matthew Effect[1]."

Policy responses must go beyond guaranteeing access to schooling. They should invest in high-quality early learning opportunities, provide continuous support for neurodiverse learners, and work systematically to reduce environmental disparities (Paris & Alim, 2017; Van Dongen et al., 2018). This might include targeted funding for under-resourced schools and flexible curriculum that allow teachers to adapt to individual differences.

From my own experience in resource-limited Thai schools, I have seen how children facing the toughest circumstances often benefit the most when education systems are designed to be flexible and inclusive. In rural multi-grade classrooms, for instance, students may lack technology, receive less home support, and have fewer chances to engage with books. Yet, when teachers provide timely scaffolding and meaningful activities, these same students can make remarkable progress. Such experiences remind me that equity is not an optional value it is a structural requirement if we are serious about translating neuroconstructivist principles into everyday practice.

[1] The Matthew Effect refers to the cumulative amplification of early advantages or disadvantages over time, resulting in widening achievement gaps. Originating from Matthew 25:29, the concept is widely used in education to explain how small initial differences in learning opportunities particularly in literacy can develop into substantial disparities as children grow older (Merton, 1968; Stanovich, 1986).

Curriculum Design

One of the most direct implications of neuroconstructivist theory is the call for curriculum that are both structured and flexible. Rather than adhering strictly to rigid grade-level expectations, educators are encouraged to recognize and respond to the unique developmental paths of individual students (Farran & Karmiloff-Smith, 2012; Karmiloff-Smith, 2009; Kolb et al., 2017).

In my experience, the most powerful curriculum are those that draw upon multimodal learning engaging children through sensory, linguistic, motor, and social domains to support the brain's natural tendency toward progressive specialization. Integrated learning experiences, where reading is combined with movement and collaboration, consistently yield stronger academic and neural outcomes than narrow, isolated instruction (Al Dahhan et al., 2016; Guarini et al., 2019; Trautmann, 2014). I have witnessed this firsthand when incorporating local traditions such as music, dance, or storytelling into classroom activities. Not only do these approaches align with research on brain plasticity, but they also deepen student engagement and help sustain a love of learning.

Moreover, context-rich environments that connect with students' cultural backgrounds, languages, and lived experiences provide more than engagement; they actually help "wire" the brain for learning, reinforcing the idea that meaningful education cannot be separated from the cultural context in which it takes place (Paris & Alim, 2017; Thomas et al., 2019).

Instructional Strategies

Insights from neuroconstructivism highlight the critical importance of teaching that is responsive in real time to students' changing abilities, interests, and needs. In my classroom, formative assessment and differentiated instruction are not mere "add-ons," but essential tools for creating optimal "zones of proximal development." Effective scaffolding ensures that every learner, regardless of starting point, is challenged and supported in just the right measure to promote

growth. The evidence is clear that early, targeted support particularly in foundational skills like executive function, language, and numeracy can dramatically alter the course of a child's development, especially for those who might otherwise fall behind (Filipe et al., 2023; Kolb et al., 2017; Pecukonis et al., 2022).

Assessment

Traditional assessments, which often provide only a static snapshot of performance, can miss the underlying dynamics of learning. Neuroconstructivist theory instead advocates for formative and longitudinal assessment models those that track growth over time and respond to individual progress (Sharif & Atif, 2024; Thomas et al., 2018). In my experience, ongoing assessment is particularly valuable in identifying sensitive periods or bursts of plasticity, making it possible to intervene at exactly the right moment. In my own teaching practice, the use of digital formative assessments such as simple online quizzes has enabled me to quickly identify students who need extra support and adapt lesson plans accordingly. This has proven especially valuable during times of remote learning, when traditional observation is not possible. For example, in the context of pandemic-related school closures in Thailand, digital formative assessments allowed me to identify gaps and adapt instruction more nimbly than would otherwise have been possible.

Teacher Preparation

Translating neuroconstructivist research into classroom practice is not possible without teachers who possess a strong foundational literacy in neuroscience and cognitive development. Effective professional development must go beyond content knowledge to address persistent "neuromyths" such as rigid learning styles or left/right-brain thinking that can hinder sound teaching (Dekker et al., 2012; Schmied & Jamaludin, 2023). In the Thai context, I have seen colleagues transformed by exposure to contemporary brain science, moving from outdated or simplistic views of learning to a more nuanced, evidence-based approach. But this transformation

requires sustained effort, reflective practice, and a willingness to challenge long-held assumptions.

Above all, teachers must learn to see and respond to the full diversity of students in their classrooms, recognizing the impact of neural, cognitive, social, and cultural factors on learning.

Challenges and Future Directions

Although neuroconstructivism holds tremendous promise for informing educational practice, the realities of the Thai education system reveal a number of persistent and context-specific challenges. In my years working with teachers and students in both urban and rural settings, I have witnessed how the ideals of developmental science can be difficult to translate into meaningful, equitable change particularly given Thailand's unique educational landscape.

Confronting Neuromyths and Misconceptions in Thai Classrooms

Neuromyths are strikingly prevalent in Thai education. The belief in "learning styles" is particularly widespread many schools still group students or design lessons around the supposed dominance of visual, auditory, or kinesthetic preferences, despite the lack of scientific support for such practices (Dekker et al., 2012; Schmied & Jamaludin, 2023). The myth of "critical periods" that after a certain age, children cannot learn new skills can also discourage both teachers and parents from supporting struggling students. A common refrain I hear from Thai colleagues is, "เด็กคนนี้ไม่เก่งภาษาอังกฤษตั้งแต่อนุบาลแล้ว สอนไปก็เปล่าประโยชน์" (This child was never good at English, since kindergarten, so further effort is pointless.) Such misconceptions can become self-fulfilling prophecies, limiting opportunities for intervention and growth. Addressing these beliefs requires more than isolated workshops. What is needed are sustained professional learning communities where teachers can engage with new research, share classroom experiences, and adapt insights to their local contexts. Such ongoing dialogue is essential to bridge the gap between neuroscience and everyday practice.

Ethical and Equity Challenges: The Rural-Urban Divide

Thailand's sharp urban-rural divide creates further equity challenges. As digital tools, AI-driven learning platforms, and individualized interventions become more central to education, there is a risk that well-resourced urban schools will advance rapidly while rural schools lag behind. I have visited remote schools where internet access is unreliable and technology is scarce, making the promise of "precision education" ring hollow. Moreover, concerns about student data privacy and the ethical use of emerging technologies are only beginning to be discussed in Thai policy circles.

The focus on personalization, while valuable, must not lead to further isolation of already marginalized learners. Instead, there is an urgent need for shared learning experiences that foster community something Thai schools, with their strong traditions of collective activity and peer learning, can uniquely offer.

Navigating Complexity in Thai Classrooms

The extraordinary diversity among Thai students ethnic, linguistic, socioeconomic means that developmental trajectories are even more variable than in many other contexts. In multi-grade classrooms in rural areas, for example, a single teacher might simultaneously support first-generation Thai speakers, children from minority language backgrounds, and students with undiagnosed learning needs. Implementing scalable but individualized approaches under such conditions requires robust assessment tools and professional flexibility that are not yet widely available. From my experience, teachers who succeed in these environments rely heavily on local communities, peer support, and creative adaptation rather than top-down directives.

From Research to Classroom Reality: The Thai Experience

Translating complex scientific insights into classroom action is a challenge everywhere, but is especially pronounced in Thailand. While neuroconstructivist frameworks advocate for nuanced, flexible pedagogy, the reality is that many Thai teachers, especially in small rural schools, are responsible for large, multi-grade classes with minimal resources. Professional development opportunities that meaningfully integrate neuroscience remain rare, and even when available, are often "one-off" workshops rather than sustained programs. I have seen dedicated teachers eager to innovate, but they lack both the time, and the ongoing support needed to adapt research findings to their own diverse classrooms. Although educational reforms in Thailand increasingly reference "21st-century skills" and "brain-based learning," I have found that, in practice, many of these ideas struggle to take root at the classroom level. Too often, teachers are expected to implement new policies without sufficient time or training to adapt them to the unique needs of their students and communities.

Moreover, collaboration between researchers, policy makers, and practitioners is still in its infancy. Academic work produced at leading Thai universities often remains isolated from everyday classroom realities, and there are limited mechanisms for sustained interdisciplinary dialogue.

Looking Ahead: Thai Opportunities

Despite these challenges, there are grounds for optimism in the Thai context. Some progressive schools and networks both public and private have begun experimenting with blended learning, adaptive assessment, and competency-based curriculum. The use of LINE groups and local online networks, for example, has helped create professional communities where best practices and new findings are shared in accessible ways.

At the national level, there is growing awareness of the need for reforms that center equity and neurodiversity in curriculum design, assessment, and resource allocation. As Thailand increasingly

participates in global educational research collaborations and expands digital infrastructure, there is a real opportunity to bridge the science-practice-policy gap provided reforms remain anchored in the lived realities and cultural strengths of Thai communities.

Ultimately, the success of neuroconstructivist-inspired reform in Thailand will depend not just on scientific rigor, but on our collective ability to listen, adapt, and innovate in ways that honor the extraordinary diversity of learners and contexts across the country.

Conclusion

As both a researcher and a classroom practitioner in Thailand, I have come to see neuroconstructivism not as a distant academic theory, but as a living framework that offers deep resonance with the realities of our educational landscape. Its insistence on the dynamic interplay of genetic, neural, cognitive, environmental, and cultural factors fundamentally challenges the old binaries nature versus nurture, ability versus disability, teacher-centered versus learner-centered that have long shaped educational debates. In my daily work, I have seen how recognizing this complexity can breathe new life into curriculum design, classroom instruction, assessment, and policy. The past decade's scientific breakthroughs in neuroimaging, computational modeling, and intervention research have made clear that education must be both personalized and multimodal. Yet, my experience also reveals that simply knowing this is not enough. The true test lies in translating these insights into practice within real schools, with real children, amidst all the constraints and richness of the Thai context. This requires more than resources; it calls for a new literacy among teachers in neuroscience and human development, and a willingness among all stakeholders to question inherited myths and assumptions, especially those that perpetuate inequity or low expectations.

Looking to the future, I am cautiously optimistic. The gradual integration of artificial intelligence, learning analytics, and transdisciplinary teacher education offers the possibility of making child-centered, precision-driven learning a reality not only

in urban, resource-rich schools, but eventually in the most remote corners of Thailand as well. However, this progress must be shaped by continual ethical reflection and an unshakeable focus on the lived needs and aspirations of our students and communities. Neuroconstructivism challenges educators and policymakers to rethink long-held assumptions about how children learn. By prioritizing context, collaboration, and individualized support, we can move closer to an educational system that recognizes and nurtures the unique potential of every learner transforming not only classroom practice, but also the broader culture of education in Thailand. For me, this means embracing the messiness and diversity of real classrooms, listening more carefully to children's voices, and working collectively to close opportunity gaps wherever they appear. If we do so, we may finally move toward an education system that not only prepares children for lifelong learning, but also nurtures the full richness of their human potential right here in Thailand, and beyond.

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