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REVIEW

Neuromyths, Teacher Literacy, and Classroom Neuroscience: A Cross-Cultural Comparative Review of Western and East Asian Research

Seung-Hyuk Kwon

Department of Science Education, Gongju National University of Education, Gongju 32553, Republic of Korea

ABSTRACT

The purpose of this study was to comparatively examine how educational neuroscience and brain-based education literature have developed in Western contexts (Europe and the United States) and East Asian contexts (China, Hong Kong, Korea, and Japan). This study employed a comparative narrative review guided by the PRISMA 2020 statement and PRISMA-S. Literature searches conducted up to February 21, 2026, included Web of Science, Scopus, ERIC, PsycINFO, PubMed, CNKI, KCI/RISS, CiNii Research, and J-STAGE. The findings show that Western literature has primarily focused on establishing disciplinary identity, building translational bridges between education and neuroscience, addressing neuromyths, and strengthening methodological rigor. In contrast, East Asian studies more frequently emphasize teachers' neuroscience literacy, professional development, contextual adaptation within school systems, and the practical application of neuroscience-informed approaches in classroom instruction. Recent studies increasingly use portable EEG, functional near-infrared spectroscopy (fNIRS), and hyperscanning methods to investigate classroom interaction and teacher–student inter-brain synchrony, reflecting a shift toward research with greater ecological validity in real classroom settings. However, across both regions, robust causal evidence linking improvements in teachers' knowledge or attitudes to measurable gains in students' academic achievement or well-being remains limited. Overall, the review suggests that the key difference between Western and East Asian research traditions lies not in whether neuroscience should inform education, but in the types of questions that organize the field. Future research should incorporate cross-cultural comparative designs, regional-language

*CORRESPONDING AUTHOR:

Seung-Hyuk Kwon, Department of Science Education, Gongju National University of Education, Gongju 32588, Republic of Korea;
Email: masonkwon@gjue.ac.kr

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literature, and frameworks linking teacher education with student outcomes.

Keywords: Educational Neuroscience; Neuromyth; Teacher Neuroscience Literacy; Classroom Neuroscience; East Asia; Comparative Review

1. Introduction

In recent years, efforts to connect the neural mechanisms of learning, memory, attention, and emotion regulation with educational practice have rapidly expanded in the field of education. Often referred to as "educational neuroscience" or "neuroeducation", this emerging interdisciplinary domain seeks to bridge neuroscience, psychology, cognitive science, and education in order to translate discoveries about the neural basis of learning into educational practice and policy. However, strong interest in brain science within educational settings has not necessarily led to rigorous application. Instead, conceptual ambiguities and overgeneralizations have contributed to the persistent reproduction of various neuromyths. Accordingly, research in this area must address not only the educational potential of neuroscience but also the conceptual and methodological tensions that arise when neuroscientific knowledge is translated into classroom practice [1, 2].

In the international literature, terms such as "educational neuroscience", "neuroeducation", and "mind, brain, and education" are most commonly used, whereas "brain-based education" has often been employed as a broader and sometimes ambiguous practical discourse. In this study, the term "brain-based education" is used as a broad analytical concept encompassing educational neuroscience and its attempts at educational translation, while distinguishing it from commercial program promotion or popular discourse lacking scientific evidence. Clarifying this terminology is necessary to move beyond viewing brain-based education as a vague debate about support or opposition, and instead reframe the discussion around the types of evidence that can meaningfully inform educational practice and at what level such connections are justified.

The development of this field has also varied across regions. In Europe and the United States, the literature has primarily emphasized the construction of bridges between education and neuroscience, the conditions for meaningful translation, critiques of neuromyths, and the importance of methodological rigor. In contrast, studies from East Asia—including China, Hong Kong, Korea, and Japan—have shown stronger interest in teachers' neuroscience literacy, teacher professional development, the practical applicability of neuroscience-informed approaches within school contexts, and the emotional and relational dimensions of classroom interaction. Nevertheless, existing reviews often either summarize the general possibilities and limitations of educational neuroscience or focus on specific topics such as neuromyths or teacher training. As a result, comparatively few studies have synthesized Western and East Asian research traditions within a common analytical framework.

Therefore, this study compares literature from Western contexts (primarily Europe and the United States) and East Asian contexts (China, Hong Kong, Korea, and Japan) in order to examine (1) the conceptual frameworks and research questions through which educational neuroscience has developed in each region, (2) the similarities and differences across regions in relation to neuromyths, teacher neuroscience literacy, teacher professional development, classroom application, classroom neuroscience, and levels of evidence, and (3) the implications of these differences for future research in educational neuroscience and the design of teacher education programs. In this paper, the categories "Western" and "East Asian" do not refer to fixed cultural essences but are used as analytical categories for comparing different publication ecosystems, research traditions, and teacher education contexts.

This review further draws on perspectives from the sociology of knowledge and Science and Technology Studies (STS) to interpret how publication ecosystems, teacher education systems, and institutional contexts shape the development and translation of educational neuroscience across regions [3]. Rather than treating neuromyths solely as misconceptions, this review considers them as socially and institutionally situated phenomena shaped by educational discourse, professional training systems, and the circulation of scientific knowledge.

2. Materials and Methods

This study is a comparative narrative review designed to synthesize literature from Western contexts (primarily Europe and the United States) and East Asian contexts (China, Hong Kong, Korea, and Japan). PRISMA [4] and PRISMA-S [5] were used to enhance transparency in literature identification and screening, rather than to conduct a formal systematic review or meta-analysis. While the search and screening procedures followed procedures commonly used in systematic reviews, the final synthesis was conducted using qualitative and narrative approaches. The purpose of this review was not to aggregate effect sizes but rather to compare how educational neuroscience and brain-based education literature have been conceptualized, framed, and translated into educational contexts across different regions. A narrative synthesis approach was adopted because the included studies were highly heterogeneous in research design, theoretical orientation, and educational context.

The literature search was initially conducted on December 13, 2025, using Web of Science, Scopus, ERIC, PsycINFO, PubMed, CNKI, KCI/RISS, CiNii Research, and J-STAGE. An updated search was planned for February 21, 2026 if necessary. The search period covered January 1990 to December 13, 2025. Search terms were developed in English, Korean, Chinese, and Japanese. The core search block included terms such as "educational neuroscience", "neuroeducation", "mind, brain, and education", "brain-based education", and "brain-based learning", along with their equivalents in each language. The extended search block included related terms such as "neuromyth", "teacher neuroscience literacy", "teacher education", "professional development", "classroom neuroscience", "hyperscanning", and "inter-brain synchrony". To maximize search sensitivity, regional terms were not included in the initial search queries; instead, regional relevance was determined during the screening and data extraction stages.

The inclusion criteria were peer-reviewed journal articles that addressed explicit educational contexts such as schooling, teacher education, classroom instruction, learning processes, curricula, or educational policy. Eligible studies needed to be directly related to educational neuroscience, neuroeducation, mind-brain-education, brain-based education, neuromyths, teacher neuroscience literacy, or classroom neuroscience. Articles written in English, Korean, Chinese, or Japanese with accessible full texts were considered. Studies were excluded if they focused solely on basic neuroscience or general psychology without educational relevance, clinical or medical research not directly connected to schooling, or publication types lacking a full analytical text, such as editorials, commentaries, book reviews, theses, or conference abstracts.

After removing duplicate records, the search results were screened in two stages: title–abstract screening and full-text review. For the final set of included studies, information including authors, year of publication, country or region, language, research type, sample characteristics, educational level, key concepts, main themes, research methods, forms of educational application, and major findings and limitations were recorded in a structured data extraction matrix. Thematic coding categories included field identity/bridge, neuromyth, teacher neuroscience literacy, teacher professional development or training, classroom neuroscience, emotion or self-regulation, evidence or methodology, cultural or contextual adaptation, and policy or curriculum. The results of this review are presented by examining how these themes intersect with regional research traditions. Accordingly, the review aimed to provide an interpretive comparative synthesis rather than a quantitative aggregation of findings.

3. Results

3.1. Western Literature: Field Identity, Translational Bridges, and the Emphasis on Rigor

Early foundational studies in Western contexts primarily focused on establishing the disciplinary identity of educational neuroscience. Ansari and Coch [6] argued that the relationship between education and cognitive neuroscience should not be understood as a simple model of application. Instead, they emphasized the need for multiple bridges between the two domains, including teacher education, researcher training, and mechanisms for interdisciplinary translation. Similarly, Carew and Magsamen [7] characterized neuro-education as an emerging interdisciplinary field that integrates neuroscience, psychology, cognitive science, and education in order to inform more effective pedagogical practices, curriculum design, and educational policy. Thomas et al. [8] further clarified the pathways through which neuro-

science may contribute to education by distinguishing between direct routes, such as research on brain health, and indirect routes mediated through psychological theory [1]. They cautioned against approaches that attempt to translate neuroimaging findings directly into classroom practices without adequate theoretical mediation. In this sense, Western scholarship has tended to prioritize the question of "how educational neuroscience can be epistemically justified and translated into educational contexts", rather than simply asking "what neuroscientific findings should be applied".

This framing of the field also led to strong attention to neuromyths and methodological rigor. Howard-Jones [9] suggested that persistent neuromyths in educational settings are reinforced by gaps between scientific terminology and the language used in schools, fragmented consumption of neuroscience-related information in popular media, and exaggerated claims about brain research. Similarly, the systematic review by Torrijos-Muelas et al. [10] showed that neuromyths have remained widespread among teachers for decades and are closely related to limited scientific knowledge as well as insufficient communication between researchers and educators. Consequently, Western educational neuroscience has increasingly framed the issue not merely as a matter of "knowing about the brain," but as a broader question of scientific literacy—specifically, the ability to distinguish between empirically supported findings and misconceptions.

Research on teacher professional development has also been closely connected to this emphasis on rigor and translation. In a scoping review, Privitera [11] reported that empirical studies examining neuroscience training for teachers remain limited and that considerable heterogeneity in research design makes strong generalization difficult. Nevertheless, Hachem et al. [12] demonstrated that professional development programs co-designed by researchers and schools can positively influence educators' understanding of educational neuroscience, their interpretations of instructional strategies, and their perspectives on student engagement. At the same time, these studies reported only limited evidence of direct effects on students' academic achievement or long-term well-being. Taken together, these findings suggest that Western literature continues to emphasize the conditions under which neuroscience can be meaningfully translated into education, as well as the level of evidence required to support such translation. The main trajectories of Western scholarship are summarized in **Table 1**. These patterns may reflect the historical emphasis in Western educational neuroscience on disciplinary legitimacy and scientific rigor within highly specialized disciplinary and publication structures.

Table 1. Representative Western literature on educational neuroscience.

Study	Study Type/Context	Key Findings	Relevance for This Review
Ansari and Coch (2006) [6]	Conceptual review	Argued that the relationship between education and cognitive neuroscience is not a simple application model but requires multiple bridges, including teacher training, researcher training, and interdisciplinary collaboration.	Illustrates that Western literature first focused on establishing field identity and translation bridges.
Carew and Magsamen (2010) [7]	Conceptual commentary	Defined neuro-education as an emerging interdisciplinary field integrating neuroscience, psychology, cognitive science, and education to inform pedagogy, curriculum, and policy.	Represents efforts to legitimize educational neuroscience as a distinct research domain.
Thomas et al. (2019) [8]	Annual research review	Distinguished direct routes (e.g., brain health) and indirect routes (psychology-mediated translation) through which neuroscience may contribute to education.	Emphasizes the importance of translation logic rather than direct application of brain imaging findings.
Howard-Jones (2014) [9]	Review article	Neuromyths persist due to gaps between scientific language and school discourse, fragmented media exposure, and exaggerated brain claims.	Demonstrates how neuromyth critique became a central theme in Western research.
Privitera (2021) [11]	Scoping review	Studies of neuroscience training for teachers remain limited and methodologically heterogeneous, preventing strong generalization.	Highlights the limited evidence base for teacher training interventions.
Hachem et al. (2022) [12]	Co-designed professional development program in Western Canada	Collaborative PD improved teachers' understanding of educational neuroscience and their interpretations of classroom engagement.	Shows the potential of research–practice partnerships, though student-level effects remain limited.

3.2. East Asian Literature: Teacher Neuroscience Literacy, Contextual Adaptation, and Practical Implementation

In East Asian contexts, a relatively large number of empirical studies have examined teachers' levels of neuroscience knowledge and their beliefs about neuromyths. Pei et al.[13], for example, surveyed teachers in eastern China and found widespread endorsement of neuromyths similar to those reported in European studies, including beliefs related to learning styles, left-brain/right-brain dominance, and the "10% brain use" myth. At the same time, certain response patterns differed from those observed in European samples. In Hong Kong, Ching et al.[14] surveyed 968 preservice teachers and reported that overall knowledge about the brain was limited and that agreement with common neuromyths remained relatively high. Nevertheless, attitudes toward applying neuroscience to educational practice were generally positive. Similarly, Im et al.[15], in a study of Korean preservice teachers, found that coursework in educational psychology contributed to improvements in neuroscience literacy but was insufficient to substantially reduce beliefs in neuromyths. Taken together, these findings suggest that in East Asian contexts, a central challenge for educational neuroscience lies in establishing a foundational level of neuroscience literacy among teachers before meaningful classroom implementation can occur.

Research on teacher professional development and contextual adaptation within school environments has also been particularly prominent in East Asian literature. Cui and Zhang[16] reported that an educational neuroscience training program for 216 Chinese teachers improved participants' knowledge of educational neuroscience and showed correlations with their technological pedagogical content knowledge (TPACK). Liu and Yu[17], comparing preservice and in-service teachers in China, found that both groups expressed positive attitudes toward neuroscience and its potential educational applications, yet their levels of knowledge remained limited. In particular, in-service teachers often relied heavily on informal media sources due to a lack of systematic opportunities for formal training. In Hong Kong, Tsang et al.[18] examined teachers working in inclusive education contexts and found that the prevalence of neuromyth beliefs was relatively low and that there was no strong direct association between neuromyth endorsement and instructional practices. However, work-related stress emerged as a major barrier to the adoption of evidence-based practices. These studies suggest that East Asian scholarship tends to examine teachers' beliefs not merely as individual knowledge deficits, but as phenomena embedded within broader institutional contexts, including school organization, professional development opportunities, workload, and the conditions under which neuroscience-informed practices may be implemented.

In Japanese literature, another notable feature is the adaptation of Western socio-emotional learning and cognitive-behavioral approaches to local school contexts. Matsumoto et al.[19] developed the NICE program by redesigning cognitive-behavioral-based SEL to fit Japanese educational settings and reported improvements in students' perceived social support and prosocial behavior. Takizawa et al.[20] evaluated a neuroscience-informed mental health intervention training program for Japanese teachers and found improvements in teachers' knowledge, skills, self-efficacy, and acceptance of the program. However, quantitative changes in students' mental health indicators remained limited. These findings suggest that, even in East Asian contexts, the effects of teacher training tend to appear first in teacher-level variables, while the pathways linking these changes to student-level outcomes remain insufficiently established. The major trajectories of East Asian literature are summarized in **Table 2**. East Asian research appears more closely connected to teacher education systems and school implementation contexts, where the practical applicability of neuroscience-informed approaches within educational and school contexts is more strongly emphasized.

3.3. The Rise of Classroom Neuroscience and Ecological Validity

One of the most notable recent developments in educational neuroscience is the growing emphasis on studying learning processes directly within real classroom environments, often referred to as "classroom neuroscience". A systematic review by Tan et al.[21] and a scoping review by Zhang et al.[22] both reported that studies of teacher–student and student–student inter-brain synchrony are increasingly associated with indicators of learning outcomes, engagement, collaboration, and mutual understanding. These studies also suggest that neural synchrony may be modulated by instruc-

tional strategies, teaching styles, and the quality of social interaction in classroom settings. In this sense, classroom neuroscience represents a shift away from laboratory-based measurements of isolated individual cognition toward the investigation of teaching and learning as socially embedded interactive processes.

Table 2. Representative East Asian literature on educational neuroscience.

Study	Study Type/Context	Key Findings	Relevance for This Review
Pei et al. (2015)[13]	Survey of teachers in eastern China	Neuromyths such as learning styles, left-brain/right-brain dominance, and the "10% brain use" myth were widely endorsed.	Demonstrates that teacher neuroscience literacy and neuromyth prevalence are central issues in East Asia.
Ching et al. (2020)[14]	Large-scale survey of Hong Kong preservice teachers (N = 968)	Overall neuroscience knowledge was limited, yet attitudes toward applying neuroscience to education were positive.	Suggests that improving teacher neuroscience literacy is a key priority in teacher education.
Im et al. (2018)[15]	Study of Korean preservice teachers	Educational psychology coursework improved neuroscience literacy but did not significantly reduce neuromyth beliefs.	Indicates that single-course exposure may be insufficient for correcting misconceptions.
Cui and Zhang (2021)[16]	Educational neuroscience training program for Chinese teachers (N = 216)	Training increased teachers' knowledge and showed correlations with TPACK, though improvements in well-being or satisfaction were limited.	Shows that training primarily affects teacher knowledge structures rather than broader outcomes.
Liu and Yu (2025)[17]	Comparative survey of preservice and in-service teachers in China	Both groups held positive attitudes toward neuroscience in education, but knowledge levels were limited; in-service teachers relied heavily on informal media.	Highlights the importance of institutional training opportunities and information ecosystems.
Tsang et al. (2024)[18]	Study of inclusive education teachers in Hong Kong	Neuromyth prevalence was relatively low, but work-related stress hindered adoption of evidence-based practices.	Shows that teacher beliefs are shaped by organizational and workload contexts.
Matsumoto et al. (2020)[19]	NICE school intervention program in Japan	A culturally adapted program improved students' psychological well-being, perceived social support, and prosocial behavior.	Demonstrates the importance of contextual adaptation of Western educational programs.
Takizawa et al. (2024)[20]	Online neuroscience-informed teacher training in Japan	Teacher knowledge, skills, and self-efficacy improved, but student mental health outcomes showed limited change.	Suggests that training effects often emerge first at the teacher level rather than the student level.

The early foundations of this research trajectory can be traced to real-world classroom EEG studies conducted by Dikker et al.[23] and Bevilacqua et al.[24]. These studies demonstrated that brain-to-brain synchrony among students, as well as between teachers and students, may be associated with engagement and information retention in authentic classroom contexts. Building on this foundation, recent research—particularly from East Asia, and especially from Chinese research groups—has expanded investigations into a wider range of classroom situations characterized by high ecological validity. Chen et al.[25], for instance, reported that different patterns of inter-brain coupling emerged during mathematics and language learning in real classroom environments. Li et al.[26] found that structured interaction in flipped classroom settings not only improved learning outcomes but also increased teacher–student inter-brain synchrony. Similarly, Zhang et al.[27] demonstrated that pedagogical approaches such as storytelling and storyboarding in early STEM instruction could influence neural synchrony between teachers and students.

Taken together, these studies suggest that East Asian researchers have recently begun to play a prominent role in advancing educational neuroscience at the level of classroom interaction. By employing portable EEG, functional near-infrared spectroscopy (fNIRS), and hyperscanning methodologies, this line of research seeks to capture the neural dynamics of teaching and learning within naturalistic educa-

tional environments, thereby contributing to a growing body of evidence with higher ecological validity. Recent classroom neuroscience studies have expanded beyond teacher–student interaction and synchrony by examining complex learning processes such as self-regulation, convergent thinking, and biomimicry-based problem solving using fNIRS and fMRI methodologies[28–31]. As shown in **Table 3**, recent classroom neuroscience studies have increasingly employed EEG and fNIRS hyperscanning methods to investigate teacher–student interaction.

Table 3. Representative studies in classroom neuroscience and inter-brain synchrony.

Study	Research Design/Method	Key Findings	Relevance
Tan et al. (2023)[21]	Systematic review of hyperscanning studies	Inter-brain synchrony (IBS) correlates with learning performance and behavioral engagement.	Provides field-level evidence for classroom neuroscience.
Zhang et al. (2024)[22]	Scoping review of interpersonal educational neuroscience	Teacher–student and student–student IBS predict learning performance and are influenced by instructional strategies.	Demonstrates that learning is increasingly studied at the interactional level.
Dikker et al. (2017)[23]	Real-world classroom EEG study	Student-to-student synchrony predicted classroom engagement and social dynamics.	Early demonstration of ecologically valid classroom neuroscience research.
Bevilacqua et al. (2019)[24]	Real-world classroom EEG study	Video instruction produced higher synchrony and retention than lecture-only conditions.	Shows how instructional format affects neural synchrony.
Chen et al. (2023)[25]	Wearable EEG study in Chinese classrooms	Different patterns of inter-brain coupling emerged in mathematics and language learning contexts.	Demonstrates disciplinary differences in neural interaction patterns.
Li et al. (2024)[26]	fNIRS hyperscanning in flipped classroom	Structured interaction increased learning outcomes and teacher–student synchrony in the left DLPFC.	Indicates that instructional design influences neural synchrony.
Zhang et al. (2024)[27]	fNIRS hyperscanning in early STEM education	Storytelling and storyboarding increased teacher–student synchrony and STEM learning outcomes.	Shows how pedagogical approaches may shape neural interaction patterns.

3.4. Comparative Synthesis

Taken together, the differences between Western and East Asian literature appear to lie less in whether educational neuroscience should be adopted in education and more in the central questions that organize research within the field. Western scholarship has tended to place greater emphasis on establishing the disciplinary identity of educational neuroscience, justifying the logic of translation between neuroscience and education, critiquing neuromyths, and ensuring methodological rigor. In contrast, East Asian literature has focused more strongly on developing teachers' neuroscience literacy, examining the effectiveness of teacher professional development, adapting neuroscience-informed approaches to specific school contexts, exploring the practical applicability of these approaches in classroom instruction, and measuring interaction processes within real classroom environments.

These differences may reflect broader institutional and epistemic contexts shaping the development of educational neuroscience across regions. In many Western contexts, educational neuroscience has often developed within highly specialized disciplinary and publication systems, where scientific legitimacy and methodological rigor are strongly emphasized. By contrast, East Asian research appears more closely connected to teacher education systems and school implementation contexts, where the practical applicability of neuroscience-informed approaches is more directly linked to educational practice and professional training. Such differences should not be interpreted as fixed cultural characteristics, but rather as outcomes shaped by distinct institutional structures, educational priorities, and knowledge translation processes.

Bibliometric evidence also provides insight into the broader publication landscape. Xu et al.[32], in a bibliometric analysis of the field of neuroscience in education between 1995 and 2022, reported that the United States produced the largest number of publications, followed by the United Kingdom and Australia, whereas China accounted for a relatively smaller number of English-language publications indexed in international databases. These patterns suggest that Western countries continue to occupy dominant positions within global publication networks. At the same time, they indicate that educational neuroscience research conducted in Korean,

Chinese, and Japanese may remain underrepresented in international bibliographic databases due to language barriers and English-dominant indexing systems.

The dominance of English-language publication systems may therefore contribute to asymmetrical visibility between Western and East Asian educational neuroscience research traditions. In this sense, differences between regional research traditions may reflect not only variations in research focus, but also broader inequalities in the circulation, recognition, and institutional legitimization of scientific knowledge. Perspectives from the sociology of knowledge and Science and Technology Studies (STS) suggest that educational neuroscience knowledge is shaped not only by empirical evidence itself, but also by publication systems, academic networks, institutional structures, and the conditions under which particular forms of knowledge become internationally visible and influential [33].

Consequently, future comparative reviews should consider publication ecosystems themselves as important objects of analysis. Examining how language, indexing practices, teacher education systems, and regional academic networks shape the visibility and translation of educational neuroscience research may provide a more balanced understanding of how the field has developed across different global contexts. A comparative summary of these patterns across Western and East Asian literature is presented in **Table 4**.

Table 4. Comparative synthesis of Western and East Asian literature.

Analytical Dimension	Western Literature	East Asian Literature	Interpretation
Core research question	"How can neuroscience contribute to education in a scientifically valid way?"	"How can teachers and schools learn and apply neuroscience knowledge?"	The difference lies in problem framing rather than acceptance of neuroscience.
Dominant themes	Field identity, bridge/translation models, neuromyth critique, methodological rigor	Teacher neuroscience literacy, neuromyth, professional development, contextual adaptation, classroom application	Western research emphasizes disciplinary legitimacy and theoretical justification, whereas East Asian research more strongly emphasizes teacher education and practical implementation within school contexts.
Main level of analysis	Conceptual discussions, reviews, translation frameworks	Teacher populations, school contexts, training programs, classroom interaction	Differences in level of analysis may reflect variation in teacher education systems and institutional priorities across regions.
Types of evidence	Conceptual reviews, theoretical models, and policy discussions	Surveys, teacher training studies, and increasingly classroom neuroscience experiments	East Asia shows growing engagement with ecologically valid classroom neuroscience research.
Role of neuromyth research	Focus on scientific rigor and epistemic clarification	Linked to teacher training systems, information channels, and professional contexts	Neuromyths may reflect not only misconceptions, but also institutional, discursive, and professional contexts of knowledge circulation.
Student outcome evidence	Often indirect and limited	Some intervention studies exist, but robust causal evidence remains scarce	Both regions still lack strong student-level causal evidence.
Recent research direction	Translation models and responsible use of neuroscience evidence	Classroom neuroscience and context-sensitive interventions	Future integration may combine translation frameworks with classroom-level evidence.
Knowledge and publication systems	Strong integration into English-language publication networks and disciplinary journals	Greater presence of regional-language scholarship and locally oriented educational research	Publication asymmetry and English-dominant indexing systems may shape the international visibility and circulation of regional research traditions.

4. Discussion

The comparative findings of this review suggest that the differences between Western and East Asian literature should not be simplified as a debate over whether neuroscience should be applied to education. Rather, the distinction lies in the central questions that organize research within the field. In Western contexts, the dominant question has been how neuroscience can contribute to education in a scientifically justified manner. This concern has been reflected in concepts such as disciplinary bridges, translational frameworks, methodological rigor, and the critique of neuromyths. By contrast, the central concern in East Asian contexts has been more practice-oriented, focusing on how teachers can learn

neuroscience-related knowledge and how such knowledge can be adapted to school contexts and classroom practice. From this perspective, the differences between the two regions are better understood not as differences in willingness to apply neuroscience to education, but as differences in the priorities that structure educational neuroscience research. The findings of this review suggest that educational neuroscience knowledge is shaped not only by scientific evidence itself, but also by institutional structures, publication systems, and regional traditions of teacher education. In this sense, the production and circulation of educational neuroscience knowledge cannot be regarded as culturally neutral processes, but are embedded within institutional definitions of legitimate evidence, academic publication systems, and broader educational priorities [34].

Despite these differences in emphasis, the literature across both regions also shares several common limitations. First, many studies remain at the level of surveys or teacher professional development programs, and therefore provide limited evidence of direct and long-term causal effects on students' academic achievement, engagement, emotional development, or well-being. Second, although improvements in teachers' knowledge or self-efficacy are frequently reported, the mechanisms through which these changes translate into actual instructional practices and student outcomes remain insufficiently understood. Third, while classroom neuroscience research offers promising approaches with higher ecological validity, careful interpretation is still required due to limitations related to sample size, the restricted range of classroom contexts studied, the interpretation of neural indicators, and the alignment between neural measures and behavioral data. Future progress in educational neuroscience will therefore depend less on generating increasingly sophisticated neural data alone and more on clarifying how such data can be meaningfully connected to educational theory, intervention design, and student-level outcomes.

These findings also provide several practical implications for teacher education. First, both preservice teacher education and in-service professional development programs should address foundational neuroscience literacy in ways that help educators distinguish between educational neuroscience research and commercially promoted "brain-based" claims. Second, efforts to correct neuromyths may require iterative and context-rich approaches rather than one-time lectures. Neuromyths may also function as socially circulated educational narratives shaped by teacher training systems, media discourse, and institutional pressures, rather than merely as isolated misconceptions held by individual teachers. Integrating classroom examples, research interpretation, reflective practice, and collegial discussion may provide more effective pathways for conceptual change among teachers. Third, evaluations of teacher training programs should adopt multi-level assessment frameworks that consider not only teachers' knowledge and attitudes but also instructional practices, student engagement, emotional development, and learning outcomes. As suggested by studies such as Hachem et al. [12] and Takizawa et al. [20], co-designed professional development programs may enhance teachers' acceptance and practical use of neuroscience-informed approaches, but demonstrating effects at the student level likely requires longer timeframes and more carefully designed research frameworks.

At least four directions appear particularly important for future research. First, cross-cultural comparative studies using shared instruments and research designs are needed to directly examine differences between Western and East Asian contexts. Much of the existing research is based on single-region samples, making it difficult to disentangle regional differences from variations in sampling, publication traditions, or educational systems. Second, relying exclusively on English-language databases risks overlooking regional research traditions developed in Korean, Chinese, and Japanese. Incorporating these local-language sources more systematically may provide a more comprehensive understanding of how educational neuroscience has evolved across regions. Future comparative work should also consider how global academic publishing systems influence which forms of educational neuroscience research become internationally visible and institutionally influential. Third, classroom neuroscience should not be treated as an isolated subfield separate from survey research or teacher professional development studies. Instead, it may serve as a translational platform connecting teacher education, classroom interaction research, and the study of student learning processes. Recent studies in classroom neuroscience and educational neuroimaging demonstrate that the field is increasingly moving from laboratory-based cognitive tasks toward the investigation of authentic learning processes, including self-regulation,

creativity, convergent thinking, and problem solving in real educational contexts[28–31].

Fourth, insights from cultural neuroscience—such as differences in self-construal, emotional preferences, and patterns of social interaction—may provide useful interpretive frameworks for understanding regional variation[35]. However, these insights should not be reduced to essentialist prescriptions for culturally specific teaching methods. Cultural differences may serve as contextual explanations, but educational practice must ultimately be understood within the institutional, organizational, and interactional contexts of schools and classrooms.

Finally, several limitations of this review should be acknowledged. Because the present study aimed at a comparative narrative synthesis rather than a formal meta-analysis, the quality of individual studies was not evaluated using a single standardized risk-of-bias framework. In addition, the review included diverse forms of scholarship—including empirical studies, review articles, theoretical discussions, and bibliometric analyses—resulting in heterogeneity in the types of evidence considered. Most importantly, the categories "Western" and "East Asian" are employed here as analytical constructs for comparing research traditions and publication ecosystems rather than as culturally homogeneous units. Accordingly, the conclusions of this review should not be interpreted as claims about essential regional differences, but rather as a comparative interpretation of how educational neuroscience has been organized around different research priorities across regions. Emerging studies using fMRI and fNIRS in authentic educational settings, including virtual reality-based science learning, self-regulation, and convergent thinking, further illustrate the potential of educational neuroscience to investigate complex learning processes beyond traditional laboratory paradigms[36]. As shown in **Figure 1**, these regional differences may be understood as outcomes of interactions among publication ecosystems, teacher education systems, and knowledge translation processes rather than as fixed cultural characteristics.

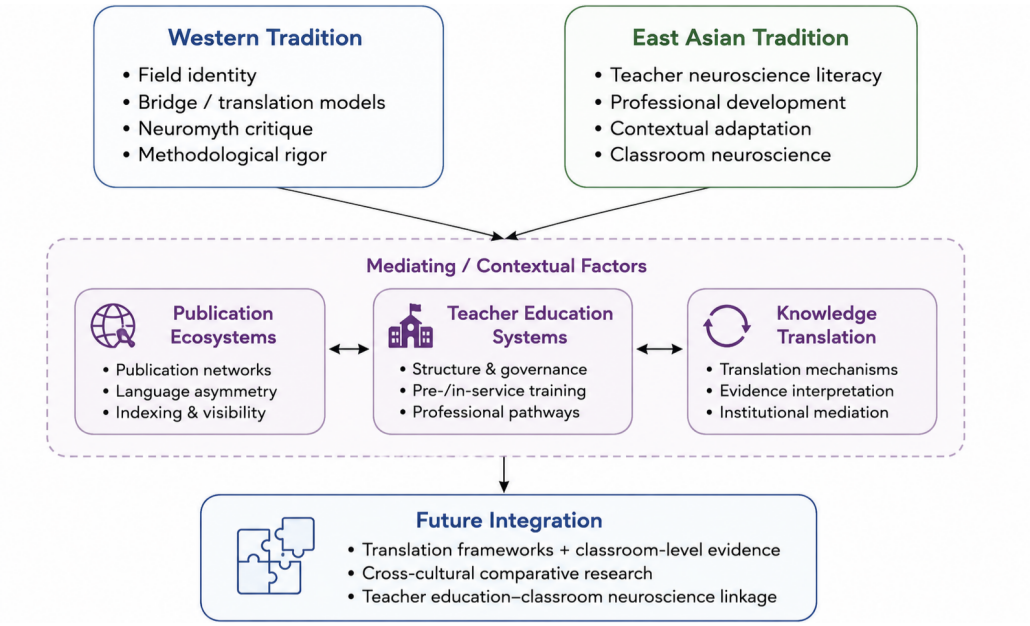

Figure 1. Conceptual comparison of Western and East Asian traditions in educational neuroscience, highlighting the roles of publication ecosystems, teacher education systems, and knowledge translation processes.

5. Conclusions

This study comparatively examined the literature on educational neuroscience in Western and East Asian contexts and argued that the differences between the two regions lie not in whether neuroscience should be applied to education, but in the problem framings that organize such applications. Western scholarship has largely developed around issues of disciplinary bridges, neuromyth critique, and methodological rigor, whereas East Asian research has emphasized teacher neuroscience literacy, contextual adaptation, and classroom-level application. Recent developments

in classroom neuroscience and hyperscanning research have opened new possibilities for examining the neural dynamics of classroom interaction under conditions of high ecological validity. However, such findings should not be immediately interpreted as strong causal evidence linking neural indicators to student outcomes. The findings of this review further suggest that the development and international visibility of educational neuroscience are shaped not only by empirical evidence, but also by publication systems, institutional contexts, and regional traditions of teacher education.

Future development of educational neuroscience will likely require integrating teacher neuroscience literacy, context-sensitive professional development, classroom-level measurement, and student outcome evaluation into a coherent translational chain. Only through such integration can educational neuroscience move beyond simplified "brain-based" discourse and develop into a genuinely interdisciplinary field capable of making meaningful contributions to educational practice.

From the perspective of teacher education, the findings of this review highlight the importance of strengthening foundational neuroscience literacy among teachers. Both preservice teacher education and in-service professional development programs should provide opportunities for educators to critically engage with neuroscientific evidence, distinguish empirically supported findings from neuromyths, and interpret neuroscience-related claims in relation to classroom practice. Rather than presenting neuroscience as a set of simplified prescriptions for teaching, teacher education programs should emphasize the interpretation of research evidence and its connections to existing educational theories and pedagogical knowledge.

In addition, the emerging field of classroom neuroscience suggests the potential value of integrating neuroscientific methods with research on classroom interaction and instructional design. Teacher professional development initiatives may benefit from incorporating collaborative inquiry models in which teachers, researchers, and schools jointly examine how neuroscience-informed perspectives can be meaningfully adapted to specific classroom contexts. Such approaches may help bridge the gap between neuroscience research and educational practice while ensuring that claims about brain-based teaching remain grounded in pedagogical evidence and student learning outcomes.

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Conflicts of Interest

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During the preparation of this work, the author used ChatGPT (OpenAI) to assist with language editing and improving the clarity of English expressions. After using this tool, the author carefully reviewed and revised the content and takes full responsibility for the content of the published article.

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