Volume : 2 | Issue : 6 | Received-07-11-2026 | Accepted-11-11-2026 | Published-14-11-2026

UAI JOURNAL OF EDUCATION, HUMANITIES AND LITERATURE (UAIJEHL)

Abbreviated Key Title: UAI J Eud Huma Lit.
ISSN: 3049-3196 (Online)
Journal Homepage: https://uaipublisher.com/uaijehl-2/
Volume- 2 Issue- 6 (November-December) 2026
Frequency: Bimonthly

Music-Integrated Instruction, Teacher Competence, and Preschool Executive-Function Behaviors

VO MINH VINH[1] and TRINH KHANH CHI[2]

[1] Faculty of Management and Economics, Tomas Bata University, Czech Republic

[2] Nguyen Sieu School, Hanoi, Vietnam

Corresponding Author: VO MINH VINH

ABSTRACT

This study examines the relationships among music-integrated instructional design, teacher musical pedagogical competence, and educators' perceptions of preschool children's executive-function behaviors in Vietnam, while considering the moderating role of perceived baseline self-regulation. Drawing on Sociocultural Theory and Pedagogical Content Knowledge, the study employed a quantitative cross-sectional design and collected self-report data from 385 early childhood education professionals using a five-point Likert-scale questionnaire. The reported child behaviors covered sustained attention, inhibitory control, working memory, and cognitive flexibility and therefore did not constitute direct assessments of children's cognitive development. Reliability analysis, exploratory factor analysis, multiple regression, and moderation analysis were conducted using SPSS. Music-integrated instructional design ($\beta = .632$, $p < .001$) and teacher musical pedagogical competence ($\beta = .537$, $p < .001$) were positively associated with educator-reported executive-function behaviors. Perceived baseline self-regulation also positively moderated the association between teacher competence and these reported behaviors ($B = .523$, $p < .001$). These findings indicate that professionals reporting more intentional music integration and stronger musical pedagogical competence also tended to report stronger executive-function behaviors among preschool children. Nevertheless, direct child assessments and longitudinal or experimental research are required to determine whether these associations reflect actual developmental changes.

KEY WORDS: executive-function behaviors; music-integrated instructional design; teacher musical pedagogical competence; perceived baseline self-regulation; preschool education; Vietnam.

1. Introduction

Early childhood cognitive development represents a critical challenge, as the swift advancement of executive functions such as working memory, inhibitory control, and cognitive flexibility, forms the foundation for school readiness, while early disparities in these skills can widen gaps and perpetuate long-term disadvantages. Longitudinal studies reveal that preschool deficits in executive functions are associated with reduced resilience, lower self-regulatory confidence, and increased behavioral issues by age nine, highlighting persistent vulnerabilities rather than fleeting developmental delays (Rungsattatharm et al., 2025). In educational settings, both affective ("hot") and cognitive ("cool") aspects of executive control forecast future learning patterns, largely by fostering sustained attention and engagement, which underscores how these abilities manifest in daily classroom interactions beyond

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

formal assessments (Wyatt et al., 2025). Compounding the issue, early educators often lack consistent knowledge of executive functions and effective scaffolding techniques, with professional preparation frequently depending on practical experience over structured guidance (Madanipour et al., 2025). Music interventions show considerable potential yet inconsistent outcomes; a comprehensive meta-analysis indicates modest to moderate benefits for preschoolers' inhibitory control, working memory, and flexibility, with gains influenced heavily by program intensity and duration (Lu et al., 2025). Thus, the central research challenge lies in pinpointing feasible, classroom-embedded strategies that enhance cognitive growth while considering children's initial self-regulation levels.

Existing evidence broadly affirms the value of music-based programs for boosting preschool executive functions, as a recent review of comparative trials reported small-to-medium improvements across key domains, moderated by implementation factors like session frequency and length, emphasizing that delivery quality rivals mere presence of music activities (Lu et al., 2025). Applied research further demonstrates that rhythm-focused movement initiatives, led by classroom teachers rather than experts, can produce lasting gains in self-regulation and readiness for school, enhancing real-world applicability (Bentley et al., 2023). Gaps persist, however, due to brief interventions, limited sample sizes, varied measurement tools, and sparse fidelity data, which obscure underlying processes (Lu et al., 2025). Notably, educators' musical teaching proficiency is seldom assessed using established tools (Zarza-Alzugaray et al., 2021), and children's starting self-regulation is infrequently examined as a moderator, even though such programs appear particularly beneficial for those with early regulatory challenges (Brown et al., 2022).

This investigation addresses the following research questions: (1) How strongly does a music-integrated approach to instructional design support cognitive growth in young children? (2) In what ways does teachers' musical pedagogical competence shape cognitive outcomes within music-enriched learning settings? and (3) To what degree does children's initial level of self-regulation moderate the link between teachers' musical pedagogical competence and cognitive development? Accordingly, the study aims to examine the association between music-integrated instructional design and educator-reported preschool executive-function behaviors; assess the association between teacher musical pedagogical competence and these reported behaviors; and determine whether perceived children's baseline self-regulation moderates the relationship between teacher musical pedagogical competence and educator-reported executive-function behaviors. The scholarly significance of this work stems from its holistic viewpoint, which shifts the focus from isolated intervention trials toward a broader framework centered on pedagogical expertise. Through rigorous testing of moderation pathways, it deepens theoretical insight into how child-specific traits interact with instructional quality to influence early learning. Ultimately, the research offers a more refined and context-aware understanding of music-based pedagogy, filling critical voids in existing literature that has frequently neglected both educator skill levels and individual differences among learners when accounting for cognitive benefits.

In this study, early cognitive development is treated as the broader developmental domain, executive functioning constitutes the specific cognitive outcome examined, and baseline self-regulation represents a related but distinct capacity that conditions children's responsiveness to teachers' musical pedagogical competence. The study was conducted within the Vietnamese preschool education context. Vietnam's early childhood education system includes nursery provision for children below three years of age and kindergarten education generally serving children from three to six years old (Vu, 2021). The present study focused specifically on preschool settings serving children aged 3–6, including classes for children aged 3–4, 4–5, and 5–6 years, as well as mixed-age classrooms. Within Vietnam's national preschool education program, music-related experiences including singing, listening, rhythmic movement, and musical games, form part of children's aesthetic and holistic development (Xuan & Dung, 2024). These activities are commonly delivered by generalist preschool teachers and integrated into play, classroom routines, movement, and other learning activities rather than being provided exclusively by specialist music teachers (Vu, 2021). This context is important because the study examines teachers' ability to use music pedagogically in ordinary preschool practice rather than specialist musical performance competence.

2. LITERATURE REVIEW

2.1 Early Childhood Cognitive Development

The cognitive development of young children, typically aged 3 to 6, involves the gradual building and sharpening of fundamental thinking skills that support learning and everyday adjustment. At the heart of this growth are executive functions including inhibitory control, working memory, and cognitive flexibility, which advance quickly during these years and are broadly acknowledged as essential building blocks for readiness to start school and future academic achievement (Blair, 2016). Current perspectives in early childhood research thus frame cognitive development as both a personal trait and a responsive outcome influenced by deliberate curriculum design and sensitive pedagogical support (Madanipour et al., 2025). In typical preschool settings, cognitive difficulties most often surface through challenges in self-regulation rather than gaps in factual knowledge that children may find it hard to maintain focus, curb immediate reactions, take turns patiently, or finish tasks on their own. Long-term studies indicate that early weaknesses in executive functions correspond to reduced resilience, diminished self-regulatory skills, and elevated behavioral concerns in middle childhood, underscoring that these early hurdles represent enduring risks rather than passing stages (Rungsattatharm et al., 2025). Even when children seem broadly prepared for school entry, subtle deficits in foundational cognitive processes can persist, reinforcing the view that development in this domain forms an interconnected system rooted in routine classroom experiences rather than an isolated mental faculty (Coelho et al., 2023). Robust evidence further confirms that strong preschool executive functions reliably forecast emerging literacy and numeracy abilities, affirming that bolstering cognitive growth during early childhood offers a potent means to promote lasting educational progress (Cook & Phillips, 2023).

2.2 Critical Analysis of Theoretical Frameworks Sociocultural Theory of Learning.

Sociocultural Theory of Learning, first developed by Lev Vygotsky, argues that young children's cognitive growth arises primarily through interactions with others and the cultural tools they encounter, with guided support serving as a key driver in building advanced mental abilities (Vygotsky, 1978; Blair, 2016). In preschool classrooms, structured musical activities involving rhythm, movement, sequencing, and turn-taking function as cultural tools that engage attention, inhibitory control, working memory, and

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

cognitive flexibility. When teachers model musical patterns, provide prompts, regulate task difficulty, and gradually transfer responsibility to children, music-integrated instruction may create meaningful opportunities to practise executive-function behaviors (Madanipour et al., 2025). This theoretical mechanism proposes a positive association between music-integrated instructional design and educator-reported executive-function behaviors.

The theory also explains why teacher musical pedagogical competence is central to these learning processes. Competent teachers can adapt musical complexity, pacing, feedback, and scaffolding to children's developmental needs, thereby maintaining engagement and appropriate cognitive challenge. Evidence from teacher-led rhythm-and-movement programs supports the developmental relevance of intentionally structured musical experiences (Bentley et al., 2023; Williams et al., 2020). Sociocultural theory further positions children's baseline self-regulation as a condition affecting their participation in guided musical activities. Children differ in their initial attention and impulse control, which may influence their responsiveness to teachers' support and their capacity to internalize structured routines (Brown et al., 2022). Because the benefits of music training also vary with instructional intensity and opportunities for repeated participation (Lu et al., 2025), baseline self-regulation moderates the relationship between teacher musical pedagogical competence and educator-reported executive-function behaviors.

Pedagogical Content Knowledge.

Pedagogical Content Knowledge (PCK), as originally proposed by Shulman, highlights that successful teaching hinges on educators' capacity to blend deep subject expertise with pedagogical insight and a nuanced grasp of learners, thereby converting complex material into accessible and impactful learning opportunities (Shulman, 1986; Zarza-Alzugaray et al., 2021). In preschool music education, this competence combines knowledge of rhythm, pitch, and musical structure with the ability to select age-appropriate activities, sequence tasks, provide feedback, and adapt instruction to children's attention and executive-function capacities. This distinction is important because many early childhood educators recognize music's developmental value but remain insufficiently prepared to deliver intentional and developmentally responsive music instruction (Bautista et al., 2024). PCK therefore explains how music-integrated instructional design translates musical content into structured activities requiring children to remember sequences, inhibit impulsive responses, and adapt to changing patterns (Blair, 2016).

PCK provides the primary theoretical basis because teacher musical pedagogical competence determines how effectively musical knowledge is transformed into cognitively engaging classroom practices. This competence can be measured through developmentally appropriate instruments (Zarza-Alzugaray et al., 2021) and strengthened through professional learning, although teachers' training needs may vary according to their experience (Wong et al., 2024). Focused music preparation can also promote more intentional, play-oriented teaching practices and strengthen educators' pedagogical confidence (Excell & Van As, 2018). Finally, PCK suggests that instructional adaptation depends on children's initial self-regulation. Teachers may need to adjust rhythmic complexity, pacing, task progression, and scaffolding according to children's attention and behavioral regulation. Thus, PCK connects music-integrated design and teacher competence with educator-reported executive-function behaviors while explaining why the relationship may vary according to perceived baseline self-regulation.

In this study, although music-integrated instructional design (MIID) and teacher musical pedagogical competence (TMPC) are closely related, they represent conceptually distinct components of music-based pedagogy. TMPC is a teacher-level capability encompassing musical knowledge, developmental understanding, pedagogical confidence, and the ability to select, adapt, sequence, and guide musical activities. In contrast, MIID is an instructional-practice construct reflecting the extent to which music is intentionally and systematically embedded in lesson objectives, classroom routines, cognitively challenging tasks, and core learning areas. In capability–enactment terms, TMPC represents what an educator is able to do, whereas MIID represents how music-based pedagogy is designed and enacted in classroom practice. Higher TMPC may theoretically facilitate stronger MIID, but instructional enactment may also depend on contextual conditions such as curriculum requirements, available resources, time, class size, and institutional support. Therefore, this study does not define MIID as an outcome or mediator of TMPC. Instead, the two constructs are specified as correlated but distinct predictors whose unique associations with educator-reported executive-function behaviors are estimated simultaneously.

2.3 The Impact of Music-Integrated Instructional Design

Music-integrated instructional design (MIID) refers to a deliberate educational approach that weaves musical components like rhythm, melody, singing, dance-like movement, and organized musical games directly into the core of lesson goals, teaching sequences, and evaluation methods to foster cognitive, behavioral, and social-emotional growth, instead of treating music as a separate artistic add-on (Gee, 2023; Bautista et al., 2024). In this study, the term "music-based program" does not refer to a single researcher-designed intervention with a fixed curriculum, duration, or number of sessions. Instead, it refers to educators' existing music-integrated instructional practices, defined as the intentional and structured incorporation of rhythm, melody, singing, movement, listening, and musical games into preschool lesson objectives, learning sequences, classroom routines, and core learning activities. These practices may involve rhythmic imitation, call-and-response, turn-taking, sequence recall, start–stop activities, movement in response to changing auditory cues, and integration of music into language, numeracy, and classroom transitions. Consistent with research distinguishing structured music training from incidental musical exposure, the construct emphasizes pedagogical intentionality, active participation, cognitive demands, progressive task structure, and educator scaffolding (Degé & Frischen, 2022; Rodriguez-Gomez & Talero-Gutiérrez, 2022; Bentley et al., 2023). From developmental research, music-rich tasks offer natural opportunities for young children to practice executive skills, requiring them to hold back impulses, keep patterns in mind, and adapt smoothly to shifting musical signals (Degé & Frischen, 2022). In practice, teachers in early childhood settings commonly incorporate music during group circles, transitions, literacy, and math routines, yet studies reveal wide differences in how thoughtfully this is done: many use songs mainly for classroom management or engagement, while fewer intentionally craft them to challenge higher-level thinking (Gee, 2023; Bautista et al., 2024). Broader classroom observations also highlight how shared musical experiences build group norms, mutual regulation, and interpersonal synchrony, which are essential foundations for learning, though they need to be paired with cognitively rich tasks to reach their full potential (Degé & Frischen, 2022).

When MIID is deliberately encouraged and carried out with well-

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

defined learning objectives, its role in supporting early childhood cognitive growth gains stronger theoretical grounding. Activities that blend music into instruction place clear demands on children's ability to manage attention, process sequences, and follow rules, skills that lie at the heart of emerging executive functions. Comprehensive reviews and meta-analyses reliably show that structured music-based interventions link to gains in executive-function skills for 3- to 6-year-olds, with the clearest benefits appearing in inhibitory control and more modest but still positive effects on working memory and cognitive flexibility (Rodriguez-Gomez & Talero-Gutiérrez, 2022; Lu et al., 2025). Brain-based studies add weight to these findings by suggesting that rhythmic and synchronized musical experiences can bolster timing mechanisms and attention networks in the brain, providing a believable pathway for the observed improvements (Patel, 2011). However, researchers continue to debate how large and dependable these cognitive benefits truly are. Some recent meta-analyses report small-to-moderate gains, especially in rigorous randomized or long-term studies where music activities remain focused and progressively challenging (Jamey et al., 2024; Lu et al., 2025), while others detect little or inconsistent impact when music appears as unstructured play, brief add-ons, or when comparison groups enjoy equally engaging non-musical experiences (Degé & Frischen, 2022; Kosokabe et al., 2025). Such patterns make clear that music alone does not guarantee cognitive boosts; instead, the quality of instructional planning, the level of task demand, and the amount of exposure play critical roles. Viewed through a combined psychological and sociological lens, MIID reaches its fullest potential when it functions as a thoughtfully built learning framework that weaves together clear musical guidelines, increasing difficulty, repeated practice across settings, and group coordination. Under these conditions, it offers children ongoing, meaningful chances to exercise self-control within rich social contexts, thereby nurturing wider cognitive progress.

Drawing together this conceptual and evidence-based overview, it is reasonable and well-supported to argue that carefully crafted and consistently applied music-integrated teaching makes a valuable positive contribution to cognitive development in early childhood:

H1: Music-integrated instructional design has a positive impact on early childhood cognitive development.

2.4 The Impact of Teacher Musical Pedagogical Competence

Teacher musical pedagogical competence (TMPC) refers to the integrated professional expertise that allows early childhood teachers to thoughtfully plan, guide, and adjust musical experiences—including singing, moving to rhythms, playful rhythmic exercises, and games involving music—so that they suit young children's developmental stages, pursue clear educational aims, and carry genuine cognitive value. Current studies in early childhood teacher preparation, especially in programs training generalist rather than specialist music teachers, reveal that many trainees appreciate music's importance yet often feel unprepared and uncertain when it comes to delivering challenging or inventive musical lessons, an issue that points to a practical shortfall in TMPC within daily classroom settings (Kong & Xiong, 2025). Emerging findings on how this competence develops stress the value of dedicated guidance during teacher training: focused mentoring boosts future teachers' confidence in using music and their active involvement in learning, both of which strongly forecast improvements in the practical musical capabilities needed for effective teaching (You et al., 2025).

In this light, TMPC serves as a key professional bridge connecting the quality of teacher education to the richness of musical instruction children actually experience in preschool. Drawing from interdisciplinary perspectives in sociology and developmental psychology, TMPC highlights teachers' crucial influence on the structure and depth of everyday learning interactions. Comprehensive reviews of music-and-movement approaches confirm that rhythmic, synchronized activities deliver meaningful educational gains only when grounded in sound pedagogical design, marked by well-defined goals, carefully sequenced steps, appropriately scaled challenges, and ongoing supportive feedback rather than left as unstructured or solely expressive moments (del Barrio & Arús, 2024). Supporting insights from studies on executive functions highlight that young children in preschool thrive most in settings marked by consistent, rich interactions between teachers and children, especially when these interactions persist over meaningful periods of time. In particular, extended involvement in such high-quality exchanges correlates with notable improvements in inhibitory control and working memory, key markers of early cognitive progress (Gavrilova et al., 2024). Long-term research tracking toddlers similarly affirms the vital role teachers play: warm, responsive, and instructionally attuned behaviors from educators reliably predict advances in focused attention and memory skills, emphasizing how pedagogical expertise shapes cognitive paths from the earliest years (Koşkulu-Sancar et al., 2023). In today's preschool classrooms, music is commonplace, but its educational depth depends heavily on TMPC. When teachers have lower levels of this competence, music often serves mainly as a way to manage behavior, calm emotions, or smooth transitions, the roles that support regulation yet offer limited cognitive challenge. On the other hand, educators strong in TMPC tend to craft musical tasks into subtle yet powerful cognitive workouts, prompting children to await signals, adhere to rhythmic patterns, recall sequences of movements or words, shift flexibly between rules, and synchronize actions with peers. Recent work on professional development reveals that training programs in music and movement that complete with coaching, ready-to-use plans, and video examples can markedly boost teachers' assurance and steadiness, resulting in more deliberate, cognitively focused musical practices (Savage et al., 2024). Still, researchers note that greater skill in implementation does not guarantee cognitive benefits unless teachers also grasp the concepts of executive functions and proven ways to cultivate them in everyday activities; indeed, considerable differences exist in early educators' understanding of these functions and their classroom applications, indicating that TMPC needs solid grounding in developmental knowledge to drive strong cognitive results (Madanipour et al., 2025). Altogether, TMPC can be understood as a valuable teaching asset that helps transform music from a tool for social harmony and emotional connection into a challenging arena for cognitive growth. When well cultivated, it ensures musical experiences become ongoing, meaningful occasions for practicing attention, memory, and self-regulation, thereby promoting early childhood cognitive development in a reliable and lasting way. On this combined theoretical and evidence-based foundation, the following hypothesis is both logically sound and empirically supported:

H2: Teacher musical pedagogical competence has a positive impact on early childhood cognitive development.

2.5 The moderating role of Children's Baseline Self-Regulation

Children's Baseline Self-Regulation (CBSR) describes a young

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

child's starting ability to handle their attention, feelings, and actions in ways that help them meet classroom expectations, such as waiting patiently, following several instructions at once, holding back impulses, or switching tasks smoothly. In preschool studies, researchers typically measure CBSR through direct activities like the Head-Toes-Knees-Shoulders task or teachers' observations, both of which strongly predict early academic progress (Kenny et al., 2023; Philpott-Robinson et al., 2023).

At its core, CBSR acts as a foundational readiness skill that influences how fully children engage with teaching and make use of guided support. In real preschool settings, self-regulation often varies widely among kids, showing up most clearly during transitions, group activities, or rule-following moments; studies and practical programs highlight that while this skill can improve, outcomes depend heavily on each child's initial level and the quality of classroom guidance they receive (Vasseleu et al., 2024; Williams et al., 2022). From a social viewpoint, CBSR is deeply interpersonal, shaping how well children fit into group norms, join collective routines, and connect with peers (Salminen et al., 2021). With this in mind, CBSR is ideally suited to moderate the link between teacher musical pedagogical competence (TMPC) and young children's cognitive growth, as it governs how effectively kids turn strong music teaching into lasting learning gains. Effective music lessons naturally include demanding elements—like taking turns, pausing on rhythm, remembering patterns, or adapting to new rules—but children need solid baseline regulation to stay focused and absorb these opportunities. In this way, CBSR serves as a gateway: those with stronger starting self-regulation tend to gain more from skilled TMPC, staying engaged and building on guidance, which creates a pattern where early advantages grow over time. This idea aligns with findings that the quality of teacher-child interactions boosts both self-regulation and learning, showing how classroom dynamics often reward children who can already participate well in guided activities (Salminen et al., 2021). Yet there is another compelling perspective, commonly seen in intervention research as a compensatory or differential-susceptibility model, which suggests that children starting with lower self-regulation might actually gain the most from highly skilled teachers; these educators offer clear structure, shared regulation, and reliable routines that effectively step in where a child's own internal controls are still developing. Research on preschool program intensity, for instance, reveals patterns where the link between children's exposure to activities and gains in self-regulation grows stronger in classrooms with higher overall quality, underscoring how outcomes hinge on both a child's starting point and the level of guidance provided by adults (Melo et al., 2022). Studies of teacher training and classroom management initiatives likewise indicate that children's initial traits often shape how much they benefit from such efforts, particularly for skills tied to regulation, making moderation a realistic factor in everyday early education (Sankalaitė et al., 2021). Practical programs aimed at building young children's self-regulation further stress that differences in baseline abilities significantly influence how kids respond to teaching strategies and organized activities (Vasseleu et al., 2024). Within music and movement settings specifically, initial assessments frequently uncover notable self-regulation difficulties among preschoolers, which highlights why CBSR serves as an important marker for distinguishing who thrives most, and to what degree, in teacher-led classroom experiences (Williams et al., 2022).

However, the idea of moderation isn't backed by every study. Certain randomized trials focused on interventions have found minimal or no evidence that children's starting self-regulation alters the benefits of structured teaching activities, which suggests that, in some cases, excellent instruction delivers fairly consistent gains across the board, irrespective of initial differences, or that limitations in study design and measurement might mask any real interactions (Lonigan et al., 2022). From a methods perspective, spotting moderation can prove tricky when assessments show floor effects among children with poorer regulation, when teachers apply programs unevenly, or when comparison groups still offer solid cognitive challenges; broader reviews of the field note that ways of assessing preschool self-regulation differ considerably, which complicates conclusions about differential benefits (Philpott-Robinson et al., 2023). On a social level, such moderation likely varies by context: group norms, interactions among peers, and the extent of shared classroom regulation can either shield children with lower CBSR from falling behind or heighten their disconnection from enriching activities, leading to varied patterns of interaction across different environments (Salminen et al., 2021).

In short, the body of research lends strong theoretical weight to CBSR as a plausible moderator, given its role in reflecting children's early ability to connect with demanding, structured music-based teaching, while the mixed empirical results support pursuing a moderated hypothesis yet call for precise measurement and thorough statistical checks for interactions. For these reasons, it makes clear conceptual sense to put forward this moderated perspective:

H3: Children's baseline self-regulation moderates the influence of teacher musical pedagogical competence on early childhood cognitive development.

To strengthen the theoretical grounding of the proposed hypotheses, this study systematically aligns each theoretical framework with the relevant constructs and hypothesized relationships tested in the empirical model, as presented in Table 1:

Table 1

Mapping Theories to the Proposed Research Hypotheses

Theoretical framework	**Principal theoretical proposition**	**Construct informed**	**Instrument development**	**Role in data analysis**
Sociocultural Theory of Learning	Cognitive development occurs through social interaction, cultural tools, scaffolding, and internalization.	Music-integrated instructional design; executive function development; baseline self-regulation	Items on modelling, guided participation, rhythmic routines, collaborative engagement, instructional prompts, working memory, inhibitory control, attention, and cognitive	Supports testing the effect of prompts, working memory, inhibitory control, attention, and cognitive flexibility

This work is licensed under *a Creative Commons Attribution-NonCommercial 4.0 International License.*
DOI: 10.5281/zenodo.24213801

			flexibility	
Pedagogical Content Knowledge	Effective instruction requires the integration of content knowledge, learner knowledge, and pedagogical strategies.	Teacher musical pedagogical competence; music-integrated instructional design	Items on musical knowledge, developmental appropriateness, activity selection, task sequencing, pacing, feedback, differentiation, and instructional adaptation	Supports testing whether teachers' musical pedagogical competence and instructional design predict children's executive function development
Integrated theoretical perspective	Cognitive benefits depend on both the quality of the musical learning environment and teachers' capacity to adapt instruction to children's regulatory needs.	Overall conceptual model	Establishes theoretical alignment across teacher-level, instructional, and child-level measures	Guides interpretation of direct effects, interaction effects, and unsupported relationships

Building on robust theoretical foundations, this study extends existing scholarship by proposing the following conceptual framework:

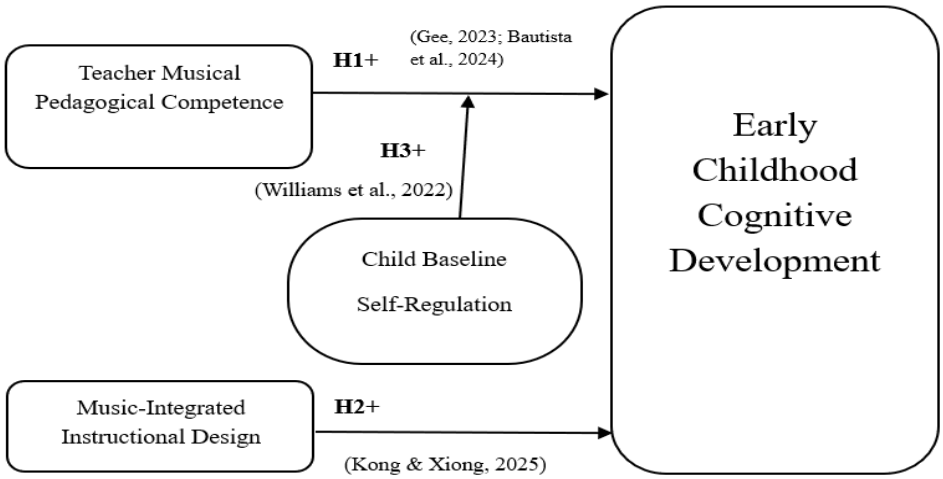


Figure 1. *The Paper's Conceptual Framework*

3. Methods

3.1. Sampling Strategy

This research utilized a quantitative, cross-sectional approach to carefully investigate the connections among music-integrated instructional design, teacher musical pedagogical competence, and cognitive development in early childhood, while also exploring how children's baseline self-regulation moderates these links. A quantitative method was chosen as it best suited the goal of examining theory-based hypotheses and measuring the magnitude of direct and moderating influences on underlying constructs through survey data. By adopting a cross-sectional framework, the study efficiently gathered insights into perceptions and practices in actual preschool environments, in line with established studies on early education and executive function growth. To promote representativeness across essential roles in early childhood education, the authors applied stratified sampling, which helped achieve balanced representation of key subgroups and bolstered the findings' applicability, as suggested in prior methodological guidance (Bryman, 2016). The unit of analysis was the individual early childhood education professional whose responsibilities involved delivering, observing, supervising, designing, or supporting children's learning experiences. The sample included preschool teachers and classroom educators, school leaders and pedagogical coordinators, early childhood specialists such as psychologists and special educators, teacher trainers and professional-development staff, and other relevant professionals, including curriculum designers and independent consultants. Although participants held different professional titles, all retained respondents met the direct-experience requirement. School leaders and pedagogical coordinators were included only when they maintained regular classroom observation or instructional responsibilities, while specialists were included only when their work involved direct and sustained assessment or support of preschool children. Academics, teacher trainers, consultants, and curriculum designers without recent direct classroom contact were excluded from the child-behavior analysis.

More specifically, the participants possessed varying levels of professional experience. Respondents with more than 10 years of experience represented 34% of the sample, followed by those with 6–10 years (28%), 3–5 years (24%), and fewer than 3 years (14%). Regarding their primary teaching or professional context, 32% worked mainly with children aged 5–6 years, 29% with children aged 4–5 years, 21% with children aged 3–4 years, and 18% in mixed-age preschool settings. These characteristics indicate that a substantial proportion of the sample had extensive professional experience and direct familiarity with the developmental stages examined in the study. Participants also differed in the frequency with which they incorporated or engaged with music-based activities in their professional practice. Specifically, 35% reported using or supporting such activities very frequently, 31% frequently, 22%

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

occasionally, and 12% rarely. Consequently, 66% of respondents had frequent or very frequent exposure to music-based pedagogy, providing an appropriate experiential basis for evaluating music-integrated instructional design and musical pedagogical competence. Nevertheless, the frequency of music use should not be interpreted as evidence that all participants possessed specialist qualifications in music education.

In Vietnam, music is embedded within the national preschool education program as part of children's aesthetic and holistic development rather than generally being organized as a separate specialist subject. The national program applies to preschool institutions throughout the country and includes age-appropriate musical experiences such as singing, listening to music, rhythmic movement, musical games, and responding creatively to musical patterns. Consequently, generalist preschool teachers are normally expected to organize music-related activities as part of daily classroom practice and to integrate them with play, movement, routines, and other developmental learning areas. However, this curricular responsibility does not necessarily mean that every preschool teacher is trained as a specialist music educator. The depth of music-specific preparation may differ according to teachers' preservice programs, professional development participation, institutional resources, and prior teaching experience. Accordingly, the present study conceptualized teacher musical pedagogical competence as a variable that may differ across participants rather than assuming a uniform level of specialist musical expertise. This context is important for interpreting the self-reported competence scores: they reflect respondents' perceived ability to select, structure, deliver, and adapt developmentally appropriate music-based activities within regular preschool practice, rather than professional-level competence in music performance or specialist music instruction.

Data were collected through a structured self-report questionnaire comprising 16 substantive items across four constructs, with four items per construct. The instrument was developed and contextually adapted from established definitions, indicators, and validated scales in early childhood education, music pedagogy, executive function, and developmental psychology. Item wording was adjusted to reflect music-integrated practices in Vietnamese preschools. Complete items and their sources are presented in Table 2 below:

Table 2

Survey Items

No.	Variables	Items	Content
1.	Early Childhood Cognitive Development	ECCD1	Children in my classroom are able to sustain attention during structured learning activities for age-appropriate periods. (Blair, 2016; Madanipour et al., 2025)
		ECCD2	Children can inhibit impulsive responses and follow classroom rules during group-based learning tasks. (Cook & Phillips, 2023)
		ECCD3	Children demonstrate the ability to hold and manipulate information in mind when completing multi-step classroom activities. (Blair, 2016; Coelho et al., 2023)
		ECCD4	Children can flexibly adapt their behavior when classroom instructions or task rules change. (Cook & Phillips, 2023; Madanipour et al., 2025)
2.	Music-Integrated Instructional Design	MIID1	Musical activities in my classroom are intentionally designed to support children's attention, memory, and self-regulation rather than used only for enjoyment. (Gee, 2023; Bautista et al., 2024)
		MIID2	Music-based activities are systematically embedded into daily lesson objectives and learning sequences. (Gee, 2023; Lu et al., 2025)
		MIID3	Musical tasks in my classroom involve structured rules (e.g., rhythm patterns, turn-taking, sequencing) that cognitively challenge children. (Degé & Frischen, 2022; Rodriguez-Gomez & Talero-Gutiérrez, 2022)
		MIID4	Music is integrated into core learning areas (e.g., language, numeracy, transitions) to enhance cognitive engagement. (Bautista et al., 2024; Lu et al., 2025)
3.	Teacher Musical Pedagogical Competence	TMPC1	I am confident in using music-based strategies to support children's cognitive and self-regulatory development. (Zarza-Alzugaray et al., 2021; Bautista et al., 2024)
		TMPC2	I can adjust musical activities to match children's developmental levels and attention capacities. (Shulman, 1986; Kong & Xiong, 2025)
		TMPC3	I intentionally structure musical tasks to include clear rules, progression, and feedback for children. (del Barrio & Arús, 2024; Madanipour et al., 2025)
		TMPC4	My musical teaching practices help children practice memory, impulse control, and flexible thinking. (Zarza-Alzugaray et al., 2021; Gavrilova et al., 2024)
4.	Children's Baseline Self-	CBSR1	At the beginning of the school year, most children in my classroom could

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

	Regulation		regulate their behavior during structured group activities. (Kenny et al., 2023; Philpott-Robinson et al., 2023)
		CBSR2	Children initially showed the ability to wait their turn and follow multi-step instructions. (Williams et al., 2022; Vasseleu et al., 2024)
		CBSR3	At baseline, children were able to remain focused despite distractions during classroom tasks. (Salminen et al., 2021; Kenny et al., 2023)
		CBSR4	Children entered the classroom with differing levels of self-regulation that influenced their participation in learning activities. (Brown et al., 2022; Philpott-Robinson et al., 2023)

Early childhood cognitive development (ECCD), the dependent variable, was measured through four items addressing sustained attention, inhibitory control, working memory, and cognitive flexibility. The items were informed by Blair (2016), Cook & Phillips (2023), Coelho et al. (2023), and Madanipour et al. (2025). ECCD served as the outcome construct across all three research questions. Music-integrated instructional design (MIID), the first independent variable, was measured using four items assessing the intentional incorporation of music into cognitive and self-regulatory objectives, instructional sequences, cognitively challenging activities, and core classroom practices. Item development drew on Gee (2023), Bautista et al. (2024), Degé & Frischen (2022), Rodriguez-Gomez & Talero-Gutiérrez (2022), and Lu et al. (2025). MIID addressed the first research question. Teacher musical pedagogical competence (TMPC) was operationalized through four items assessing teachers' confidence in using music, adapting activities to children's needs, structuring musical tasks, and supporting cognitive abilities through music. The items were principally informed by Zarza-Alzugaray et al. (2021) and contextualized through relevant pedagogical research (Shulman, 1986; Bautista et al., 2024; del Barrio & Arús, 2024; Gavrilova et al., 2024; Kong & Xiong, 2025). TMPC corresponded to the second research question. Children's baseline self-regulation (CBSR), the moderator, was measured through four items capturing children's initial capacity to regulate behavior, follow instructions, sustain attention, and participate in structured activities. Respondents evaluated these behaviors at the beginning of the school year or before sustained exposure to music-integrated practices. The items drew on Salminen et al. (2021), Brown et al. (2022), Williams et al. (2022), Kenny et al. (2023), Philpott-Robinson et al. (2023), and Vasseleu et al. (2024). CBSR addressed the third research question by testing its moderating role in the TMPC–ECCD relationship.

The questionnaire was shared digitally through Google Forms and circulated via established professional channels, such as early childhood education networks, teaching associations, preschool alliances, and partnerships between universities and schools in Vietnam, including dedicated online communities, specialist forums, and teacher development groups. Of the 612 questionnaires initially submitted, 107 were excluded during the eligibility and data-quality screening process. Specifically, 24 responses were removed because of missing informed consent or failure to meet the eligibility criteria, 31 because they exceeded the predetermined missing-data threshold, 12 because they were identified as duplicate submissions, 18 because they contained objectively contradictory eligibility or professional-background information, and 22 because they displayed multiple indicators of low-quality responding, such as implausibly short completion times, failed attention checks, and uniform response patterns across substantive items. Each excluded case was assigned to only one primary exclusion category to prevent double counting. This screening process resulted in 505 eligible and usable responses.

The remaining responses were then classified into four predefined professional strata: (1) preschool teachers and classroom educators responsible for routine teaching and the implementation of music-integrated learning activities; (2) school administrators and curriculum coordinators responsible for supervising instructional practices and curriculum implementation; (3) early childhood specialists, including psychologists and special educators involved in children's cognitive, behavioral, and self-regulatory development; and (4) academics, teacher educators, and professional-development trainers involved in early childhood pedagogy, teacher preparation, and instructional standards. A random-number procedure was subsequently applied within each stratum to select the final analytical sample. Because 385 could not be divided exactly into four equal groups, the final sample comprised 97 preschool teachers and classroom educators (25.2%), 96 school administrators and curriculum coordinators (24.9%), 96 psychologists and special educators (24.9%), and 96 academics, teacher educators, and professional-development trainers (24.9%). This stratified random-selection procedure ensured approximately equal representation across the four professional groups and prevented any single subgroup from disproportionately influencing the results.

3.2. Instrument Review, Refinement, and Validation

The preliminary instrument was subsequently reviewed by a panel of 15 early childhood education specialists. The panel consisted of university lecturers in early childhood education, preschool practitioners, developmental psychologists, music-education specialists. Panel members were selected because their combined expertise covered early childhood development, preschool pedagogy, music-integrated instruction, executive functioning, and questionnaire design. The specialists independently assessed each item according to five criteria: (1) relevance to its intended construct; (2) clarity and comprehensibility; (3) developmental appropriateness for Vietnamese preschool settings; (4) consistency with the construct's theoretical definition; and (5) potential ambiguity, redundancy, or overlap with other items. They were also asked to examine whether the questionnaire adequately represented all four constructs and whether respondents could answer the items on the basis of their professional experience. Written comments were collected to identify items requiring revision.

On the basis of this review, the authors revised the wording of several items to improve clarity, reduce technical terminology, eliminate conceptual duplication, and align the statements more closely with everyday preschool practices. Items that did not adequately represent their intended constructs were revised, whereas items considered relevant but insufficiently clear were reworded. The revised questionnaire contained 16 substantive items, comprising four items for each construct, and used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

Following the expert-review stage, the authors compared all recommendations, resolved differences through discussion, and checked the revised items against the theoretical definitions and research questions. The final questionnaire was approved only after agreement was reached that each item was conceptually relevant, clearly worded, nonredundant, and appropriate for the Vietnamese early childhood education context. The complete wording of the final items and their supporting sources is provided in Table 2. The authors were directly involved in all stages of instrument development and finalization. The research team first reviewed the relevant theoretical and empirical literature, defined the constructs, selected the dimensions to be represented, and prepared the initial item pool. The authors then mapped each item to the corresponding construct and research question before submitting the preliminary questionnaire to the expert panel. During the review stage, the authors coordinated the evaluation process, compiled and compared the specialists' comments, and identified items requiring clarification, contextual adaptation, or removal. Following the expert review, the authors revised the questionnaire, examined the consistency of the revised items with the theoretical framework, and finalized the instrument for digital administration. After data collection, the authors conducted data screening, item-level reliability assessment, Cronbach's alpha analysis, and exploratory factor analysis to evaluate the empirical performance of the finalized scales.

3.3. Data Analysis

Analysis was carried out with SPSS version 20. The process began with descriptive statistics, reliability checks, calculating Cronbach's alpha values that all surpassed the accepted 0.70 benchmark, confirming strong internal consistency (Hair et al., 2009). Next, exploratory factor analysis helped confirm the underlying structure of the scales, keeping only items with loadings greater than 0.50. Direct relationships were then examined through multiple linear regression, focusing on how music-integrated teaching strategies and teachers' musical pedagogical abilities influenced young children's cognitive growth (Shrestha, 2020) with all effects at the $p < 0.05$ significance level. Lastly, the moderating effect of children's baseline self-regulation on the link between teacher competence and cognitive outcomes was tested, adhering to recommended protocols for detecting interactions (Hayes, 2022).

4. Results

4.1. Reliability analysis

Table 3

Reliability analysis of "Early Childhood Cognitive Development".

Reliability Statistics	
Cronbach's Alpha	N of Items
.835	4

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
ECCD1	7.023	4.112	.727	.786
ECCD2	7.566	5.914	.712	.735
ECCD3	6.008	7.391	.789	.794
ECCD4	6.012	7.089	.728	.780

Source: (The authors, 2026)

Where the survey items denoted as ECCD1 to ECCD4 aligned directly with questions 1 through 4 and were specifically constructed to capture the underlying construct of early childhood cognitive development.

As shown in Table 3, all items exhibited corrected item–total correlations exceeding the recommended minimum threshold of 0.3. The scale achieved a Cronbach's alpha of 0.835, which is well above the conventional benchmark of 0.7, indicating strong internal reliability (Hair et al., 2009). Importantly, the removal of any individual item led to a marginal reduction in the overall alpha value, suggesting that no item weakened the scale. In addition, the alpha-if-item-deleted values for all four indicators were consistently higher than their corresponding corrected item–total correlations, further confirming that each item contributed positively to the internal consistency of the construct (Tavakol & Dennick, 2011). Consequently, all four items were retained for further analysis, while comparable reliability levels were also observed across the study's remaining measurement scales.

4.2. Exploratory factor analysis (EFA)

Table 4

Factor Loading Matrix

Rotated Component Matrix[a]			
Component with loading factors			
1	2	3	4
ECCD1 .650 ECCD2 .695	MIID1 .640 MIID2 .640	TMPC1 .621 TMPC2 .674	CBSR1 .681 CBSR2 .626

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

ECCD3 .622 ECCD4 .615	MIID3 .667 MIID4 .690	TMPC3 .637 TMPC4 .711	CBSR3 .664 CBSR4 .630
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 7 iterations.			

Source: (The authors, 2026)

Where the items MIID1– MIID4, TMPC1– TMPC4, and CBSR1–CBSR4 were deliberately crafted to measure the two independent variables and the moderator one, with each construct captured through four specific questions.

Table 4 illustrates the results of an exploratory factor analysis, which successfully identified four distinct factors that corresponded exactly to the targeted dependent variable, the two predictor variables, and the moderator. All 16 items showed factor loadings above the established cutoff of 0.5 (Hair et al., 2009), indicating robust alignment with their assigned constructs. Consequently, the entire set of items was kept intact, offering firm support for the construct validity of each variable included in the study.

Discriminant validity was assessed to determine whether music-integrated instructional design and teacher musical pedagogical competence represented statistically distinct constructs. A confirmatory factor analysis was conducted for the four-factor measurement model (Hair et al., 2019). Composite reliability values were at least .70, and average variance extracted values were at least .50 (Fornell & Larcker, 1981; Hair et al., 2019). Discriminant validity was then evaluated using the Fornell–Larcker criterion. This criterion was satisfied when the square root of the AVE for each construct exceeded its correlations with all other constructs in the measurement model (Fornell & Larcker, 1981). Collectively, these assessments were used to determine whether the four constructs demonstrated adequate reliability, convergent validity, and discriminant validity.

4.3. Multiple linear regression model

Table 5

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.825	.777		4.218	.000
	MIID	.690	.744	.632	3.619	.000
	TMPC	.552	.859	.537	3.652	.000
a. Dependent Variable: ECCD						

Source: (The authors, 2026)

Where **ECCD**: Mean of ECCD1 - ECCD4; **MIID**: Mean of MIID1–MIID4; **TMPC**: Mean of TMPC1– TMPC4

As reported in Table 5:

The first research question examined whether music-integrated instructional design was associated with early childhood cognitive development. The regression results indicated that children exposed to classroom routines, and cognitively challenging tasks also reported higher levels of sustained attention, inhibitory control, working memory, and cognitive flexibility among children. The result therefore suggests that the cognitive relevance of classroom music lies not merely in its presence, but in whether musical activities are deliberately organized around rules, sequences, memory demands, and changes in patterns.

The second research question investigated the relationship between teacher mu functioning among children. This finding indicates that the educational value of music may depend partly on teachers' ability to transform musical content into developmentally appropriate cognitive tasks. The result concerns pedagogical competence rather than specialist musical performance ability.

4.4. Moderator analysis

Table 6

Results analysis of "Children's Baseline Self-Regulation".

Model: 1 Y: ECCD X: TMPC W: CBSR Sample Size: 385

****

OUTCOME VARIABLE: ECCD Model Summary

R	R-sq	MSE	F	dl1	dl2	p
.715	.511	.538	5.922	3.000	381.000	.000

Model

	coeff	se	t	p	LLCI	ULCI

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

Constant	7.366	.689	10.69	.000	6.015	8.717
TMPC	.675	.138	4.89	.000	.405	.945
CBSR	.662	.152	4.35	.000	.364	.960
Int_1	.523	.114	4.58	.000	.299	.747

Source: (The authors, 2025)

Where CBSR was calculated as the mean score of items CBSR1 to CBSR4.

As reported in Table 6, the third research question examined whether children's baseline self-regulation moderates the relationship between teacher musical pedagogical competence and early childhood cognitive development. The interaction between TMPC and CBSR was positive and statistically significant (Int_1=.523, se=.114, t=4.58, p<.001, 95%). Because the confidence interval excluded zero, H3 was supported. The positive interaction indicates that the association between teacher musical pedagogical competence and reported cognitive development became stronger as children's baseline self-regulation increased. In substantive terms, children who entered the learning environment with stronger attention and behavioral regulation appeared better positioned to engage with and benefit from teachers' structured musical guidance.

5. Discussion

5.1. Result Summary

Music-integrated instructional design and teacher musical pedagogical competence were both found to have strong and statistically significant influences on early childhood cognitive development, as reflected by standardized regression coefficients of 0.632 and 0.537, respectively. Furthermore, children's baseline self-regulation demonstrated a significant moderating role, strengthening the relationship between teacher musical pedagogical competence and early childhood cognitive development, with an interaction coefficient of 0.523. In conclusion, these findings provide robust empirical support for all three research hypotheses and offer strong validation for the proposed conceptual framework.

5.2. Theoretical Implications

The marked beneficial influence of MIID on cognitive development in young children provides solid theoretical grounding for sociocultural and constructivist perspectives, which view organized cultural practices as key drivers of executive function advancement (Vygotsky, 1978; Blair, 2016). These outcomes closely match evidence that carefully crafted musical tasks, involving patterns, guidelines, and rhythmic structure, offer ongoing chances to build skills in focused attention and short-term memory (Degé & Frischen, 2022; Lu et al., 2025). In contrast, the results counter cautious claims that music's advantages for cognition tend to fade or vary widely when paired with equally motivating non-musical controls (Kosokabe et al., 2025); instead, they show that MIID produces distinct and meaningful cognitive gains when music is deliberately tied to educational aims rather than tacked on as a side element. Still, the study partly agrees with syntheses that find generally small effect sizes, highlighting that mere access to music is not enough without clear teaching purpose (Rodriguez-Gomez & Talero-Gutiérrez, 2022). In theoretical terms, this casts MIID as a context-dependent tool for cognition, the one that succeeds through purposeful planning rather than passive contact, thus sharpening current scholarly conversations by stressing the importance of implementation over simple inclusion.

The clear and substantial connection between teachers' musical pedagogical competence (TMPC) and cognitive growth in young children lends firm support to Pedagogical Content Knowledge (PCK) theory, underscoring that it is the depth of teaching skill—rather than simply offering activities—that truly shapes developmental progress (Shulman, 1986; Zarza-Alzugaray et al., 2021). These results align well with research emphasizing that a teacher's capacity to carefully organize, support, and tailor musical experiences plays a decisive role in whether those experiences effectively build executive functions (del Barrio & Arús, 2024; Madanipour et al., 2025). On the other hand, the findings question approaches that place most weight on program features like length or regularity while giving less attention to teacher expertise (Lu et al., 2025), suggesting that even thoughtfully planned music initiatives can fall short if educators cannot skillfully turn musical components into challenging cognitive opportunities. Meanwhile, the study tempers overly positive views that greater teacher confidence by itself guarantees strong outcomes; echoing prior work, it highlights that real competence requires a solid grasp of executive function development, beyond mere enthusiasm for music (Bautista et al., 2024). From a theoretical standpoint, this elevates TMPC to a vital linking factor in music-centered teaching, broadening PCK theory by showing its value in explaining early cognitive gains, not only in traditional subject-area learning.

The notable moderating role of children's baseline self-regulation (CBSR) adds layered theoretical depth to ongoing discussions about whether early interventions tend to widen gaps (differential effects) or narrow them (compensatory effects). Evidence that stronger initial self-regulation boosts the benefits of high teacher musical pedagogical competence aligns with interactionist and pragmatist views, which hold that quality teaching yields the greatest gains when children already have enough regulatory skills to meet its challenges (Salminen et al., 2021; Wyatt et al., 2025). This pattern contrasts partly with compensatory theories claiming that lower-starting children gain the most from excellent instruction (Brown et al., 2022), revealing instead an amplification process in which early strengths enable larger cognitive advances. That said, the results do not outright dismiss compensatory ideas, since earlier studies finding no moderation might stem from measurement issues rather than flawed theory (Lonigan et al., 2022; Philpott-Robinson et al., 2023). Overall, this frames CBSR as a moderator sensitive to context, shaped by task design, teaching demands, and interaction dynamics, and strengthens sociocultural theory by showing how a child's readiness influences the uptake of guided musical experiences, thus deepening conversations around fairness, tailored support, and responsive practice in early childhood education.

5.3. Practical Implications

The verified benefits of music-integrated instructional design (H1) hold clear practical value for shaping early childhood curricula. Instead of viewing music as a mere add-on or fun break, these results point to the need for intentional integration into main teaching plans to bolster key executive functions like sustained attention, working memory, and flexible thinking. In practice, this calls on teachers and curriculum planners to shift away from

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

occasional songs or filler activities and toward well-organized musical routines that build in rules, sequences, and shared turns—approaches that research shows deliver stronger cognitive gains than free-form musical exploration (Degé & Frischen, 2022; Lu et al., 2025). Policymakers and preschool directors can thus treat this design as an accessible, in-class tool to foster school readiness without depending on outside experts.

As for H2, the central influence of teachers' musical pedagogical competence underlines the importance of ongoing professional growth over simply supplying new resources; even strong music activities can fall flat without educators skilled in guiding, adjusting, and pushing children's thinking. Training programs should therefore weave together musical techniques and solid understanding of executive function development, in line with Pedagogical Content Knowledge frameworks (Shulman, 1986; Zarza-Alzugaray et al., 2021), and evidence suggests that sustained support through mentoring, demonstration, and practical lesson templates markedly raises teachers' effectiveness and assurance in music-enriched teaching (Savage et al., 2024). School leaders would do well, then, to favor in-depth, hands-on development over brief, one-off sessions.

The moderating influence of children's baseline self-regulation (H3) indicates that uniform teaching strategies are rarely the best fit in early education. In practice, educators should evaluate each child's starting level of self-regulation and tailor the difficulty, rhythm, and framework of musical tasks to match, offering more challenging activities to those with solid initial skills, while providing stepped support and co-regulation techniques for children who need it (Salminen et al., 2021; Vasseleu et al., 2024). This reinforces the value of differentiated teaching and stresses the role of routine observational assessment in preschool settings. Education leaders and teachers should therefore approach music-enriched instruction not as a fixed program, but as an adaptable resource that aligns with individual readiness to achieve the strongest cognitive benefits.

In practical terms, Vietnamese preschools can integrate structured musical activities into existing routines, language learning, numeracy, transitions, and group play without requiring separate specialist-led programs. School leaders should provide generalist teachers with practical training in rhythmic sequencing, start–stop activities, rule switching, scaffolding, and adapting task difficulty to children's self-regulation. Policymakers should embed these competencies in preservice and in-service teacher development while ensuring adequate instructional time and resources across differently resourced preschools. Nevertheless, these recommendations should be treated as preliminary because the findings reflect professionals' perceptions rather than directly observed child outcomes.

5.4. Limitations

Despite these insights, the study has notable limitations. Its cross-sectional nature limits claims about causation, capturing only snapshots of associations rather than changes over time; future longitudinal work could better track how music integration and teacher competence relate to children's development. A major limitation also concerns the measurement of the child-related constructs. The study did not directly assess individual children using standardized cognitive measures, executive-function tasks, independent classroom observations, or longitudinal developmental records. Instead, educators rated children's classroom behaviors related to sustained attention, inhibitory control, working memory, cognitive flexibility, and baseline self-regulation. The findings therefore represent adult perceptions of children's behaviors rather than objectively observed cognitive outcomes.

Reliance on educator self-reports risks bias and overstated relationships arising from common measurement sources. Because both the instructional predictors and child-related outcomes were reported by the same respondents, common method bias, consistency motives, and favorable evaluations of personal teaching practices may have inflated the observed relationships. Furthermore, the ratings summarize children's behaviors at the classroom level and cannot adequately capture individual differences among children. Additionally, self-regulation was measured indirectly rather than through direct observation, which may reduce measurement accuracy (Philpott-Robinson et al., 2023). Consequently, the findings should be interpreted as associations among educators' reported instructional practices, perceived competence, and perceptions of children's classroom behaviors rather than as evidence that music-based pedagogy caused cognitive development.

Although the sample supported robust statistical analysis, unexamined factors such as cultural context, institutional resources, and classroom dynamics could affect the applicability of the findings across different early learning environments. Furthermore, the study's exclusive focus on participants from Vietnam constrains its external validity, as educational practices, cultural norms, and institutional conditions may differ substantially across countries, thereby limiting the generalizability of the findings to broader international contexts.

5.5. Future Research Directions

Future investigations should employ longitudinal or experimental approaches to track the long-term effects of music-integrated instructional design and teachers' musical pedagogical competence on children's cognitive growth. Including direct behavioral or task-based assessments of executive functions and self-regulation would enhance the reliability of findings. Additional research could delve into differential susceptibility frameworks to determine if children starting with lower self-regulation gain extra advantages under certain teaching approaches. Cross-cultural comparisons would also prove valuable in revealing how varying institutional settings and societal norms affect the impact of music-centered teaching. Then, upcoming studies ought to investigate which elements of professional development—such as the depth of mentoring or specific curriculum emphases—serve as key links between teacher skill and improved child cognitive results. Lastly, future research should expand the geographical scope of sampling beyond Vietnam by incorporating cross-national or multi-regional datasets. Comparative studies across diverse cultural and educational contexts would enable researchers to examine whether the observed relationships between music integration, teacher competence, and cognitive development remain consistent or vary under different institutional conditions.

6. Conclusion

In conclusion, this research offers strong empirical support for the vital contributions of music-integrated instructional design and teacher musical pedagogical competence to early cognitive development, especially in building executive functions. By highlighting the moderating role of children's initial self-regulation, it deepens insight into the interplay between teaching quality and personal readiness in preschool contexts. The evidence moves beyond seeing music as simply an emotional boost, establishing it

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

instead as an effective cognitive support when applied with deliberate intent. On a practical level, the work emphasizes the need for skilled educators, tailored guidance, and thoughtful program planning to fully realize the benefits of music activities. Ultimately, the study delivers a refined, context-aware perspective that connects theory with classroom practice, providing useful direction for teachers, policymakers, and scholars aiming to strengthen young children's cognitive groundwork.

References

1. Bentley, L. A., Eager, R., Savage, S., Nielson, C., White, S. L., & Williams, K. E. (2023). A translational application of music for preschool cognitive development: RCT evidence for improved executive function, self-regulation, and school readiness. Developmental Science, 26(5), e13358. https://doi.org/10.1111/desc.13358
2. Blair, C. (2016). Executive function and early childhood education. Current Opinion in Behavioral Sciences, 10, 102–107. https://doi.org/10.1016/j.cobeha.2016.05.009
3. Brown, E. D., Blumenthal, M. A., & Allen, A. A. (2022). The sound of self-regulation: Music program relates to an advantage for children at risk. Early Childhood Research Quarterly, 60, 126–136. https://doi.org/10.1016/j.ecresq.2022.01.002
4. Bryman, A. (2016). Social research methods. Oxford University Press.
5. Bautista, A., Yeung, J., Mclaren, M. L., & Ilari, B. (2024). Music in early childhood teacher education: Raising awareness of a worrisome reality and proposing strategies to move forward. Arts Education Policy Review, 125(3), 139–149. https://doi.org/10.1080/10632913.2022.2043969
6. Coelho, R. M. D., Grisi, S. J. F. E., Brentani, A. V. M., & Ferrer, A. P. S. (2023). Assessment of school readiness and the importance of executive functions for learning. Revista Paulista de Pediatria, 42, e2022196. https://doi.org/10.1590/1984-0462/2024/42/2022196
7. Cook, C. J., Howard, S., Scerif, G., Twine, R., Kahn, K., Norris, S., & Draper, C. (2023). Executive function and pre-academic skills in preschoolers from South Africa. South African Journal of Childhood Education, 13(1), 1–11. https://doi.org/10.4102/sajce.v13i1.1369
8. Degé, F., & Frischen, U. (2022). The impact of music training on executive functions in childhood—a systematic review. Zeitschrift für Erziehungswissenschaft, 25, 579–602. https://doi.org/10.1007/s11618-022-01102-2
9. del Barrio, L., & Arús, M. E. (2024). Music and movement pedagogy in basic education: A systematic review. Frontiers in Education. https://doi.org/10.3389/feduc.2024.1403745
10. Excell, L., & Van As, A. J. (2018). Strengthening early childhood teacher education towards a play-based pedagogical approach through a music intervention programme. South African Journal of Childhood Education, 8(1), 1–10. https://hdl.handle.net/10520/EJC-15d5c62352
11. Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of marketing research, 18(1), 39-50. https://doi.org/10.1177/002224378101800104
12. Gavrilova, M. N., Karimova, A., Solopova, O., Veraksa, A. N., & Yakushina, A. A. (2024). Preschoolers' executive function: Effect of the duration of preschool attendance and quality of teacher-child interactions. Frontiers in Education. https://doi.org/10.3389/feduc.2024.1421037
13. Gee, J. L. (2023). Exploring music integration: Early childhood and elementary teacher practices. International Journal of Music Education, 43, 416–428. https://doi.org/10.1177/02557614231217793
14. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2009). Multivariate data analysis (7th ed.). Prentice Hall.
15. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis (8th ed.). Cengage.
16. Hayes, A. F. (2022). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach (3rd ed.). Guilford Press.
17. Jamey, K., Foster, N. E., Hyde, K., & Dalla Bella, S. (2024). Does music training improve inhibition control in children? A systematic review and meta-analysis. Cognition, 252. https://doi.org/10.1101/2023.02.08.527718
18. Kenny, S. A., Cameron, C. E., Karing, J. T., Ahmadi, A., Braithwaite, P. N., & McClelland, M. M. (2023). A meta-analysis of the validity of the Head-Toes-Knees-Shoulders task in predicting young children's academic performance. Frontiers in Psychology, 14. https://doi.org/10.3389/fpsyg.2023.1124235
19. Kong, S. H., & Xiong, X. (2025). Pre-Service Kindergarten Teachers' Confidence and Beliefs in Music Education: A Study in the Chinese Context. Education Sciences. https://doi.org/10.3390/educsci15060772
20. Koşkulu-Sancar, S., Blom, E., van de Weijer-Bergsma, E., Grandfield, E. M., Verhagen, J., & Mulder, H. (2023). Teachers matter in early childhood: The relation between teacher behaviours and executive function development in toddlerhood. Infant and Child Development. https://doi.org/10.1002/icd.2474
21. Kosokabe, T., Mizusaki, M., Nagaoka, W., Sato, Y., Tanaka, K., & Yamamoto, H. (2025). Self-directed music play to improve executive function in young children using NIRS. Scientific Reports, 15, Article 26608. https://doi.org/10.1038/s41598-025-10984-1
22. Lonigan, C. J., Hand, E. D., Spiegel, J. A., Morris, B. M., Jungersen, C. M., Alfonso, S. V., & Phillips, B. M. (2022). Does preschool children's self-regulation moderate the impacts of instructional activities? Evidence from a randomized intervention study. Journal of Experimental Child Psychology, 216, 105321. https://doi.org/10.1016/j.jecp.2021.105321
23. Lu, Y., Shi, L., & Musib, A. F. (2025). Effects of music training on executive functions in preschool children aged 3–6 years: Systematic review and meta-analysis. Frontiers in Psychology, 15, 1522962. https://doi.org/10.3389/fpsyg.2024.1522962
24. Madanipour, P., Garvis, S., Cohrssen, C., & Pendergast, D. (2025). Early childhood teachers' understanding of executive functions and strategies employed to facilitate them. Frontiers in Education, 9, 1488410. https://doi.org/10.3389/feduc.2024.1488410
25. Melo, C., Pianta, R. C., LoCasale-Crouch, J., Romo, F., & Ayala, M. C. (2022). The role of preschool dosage and quality in children's self-regulation development. Early Childhood Education Journal, 1–17. https://doi.org/10.1007/s10643-022-01399-y

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801

26. Patel, A. D. (2011). Why would musical training benefit the neural encoding of speech? The OPERA hypothesis. Frontiers in Psychology, 2. https://doi.org/10.3389/fpsyg.2011.00142
27. Philpott-Robinson, K., Johnson, T., Evans, L. H., Wales, K., Leonard, C., & Lane, A. E. (2023). Measurement of self-regulation in preschool and elementary children: A scoping review. Physical & Occupational Therapy in Pediatrics, 43, 403–429. https://doi.org/10.1080/01942638.2022.2158055
28. Rodriguez-Gomez, D. A., & Talero-Gutiérrez, C. (2022). Effects of music training in executive function performance in children: A systematic review. Frontiers in Psychology, 13. https://doi.org/10.3389/fpsyg.2022.968144
29. Rungsattatharm, L., Tasingha, P., Trairatvorakul, P., & Chonchaiya, W. (2025). Longitudinal associations between executive function and positive parenting during early childhood and resilience, self-regulation, and behavioral problems in school-age children. Child and Adolescent Psychiatry and Mental Health, 19(1), 19. https://doi.org/10.1186/s13034-025-00875-8
30. Salminen, J., Guedes, C., Lerkkanen, M., Pakarinen, E., & Cadima, J. (2021). Teacher–child interaction quality and children's self-regulation in toddler classrooms in Finland and Portugal. Infant and Child Development. https://doi.org/10.1002/icd.2222
31. Sankalaite, S., Huizinga, M., Dewandeleer, J., Xu, C., de Vries, N., Hens, E., & Baeyens, D. (2021). Strengthening executive function and self-regulation through teacher-student interaction in preschool and primary school children: A systematic review. Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.718262
32. Savage, S., Bentley, L., Williams, K. E., Nielson, C., & Eager, R. E. (2024). Developing early childhood teacher confidence to implement classroom music and movement activities: Key professional learning features. Early Childhood Education Journal, 53, 2275–2286. https://doi.org/10.1007/s10643-024-01737-2
33. Shrestha, N. (2020). Detecting multicollinearity in regression analysis. American Journal of Applied Mathematics and Statistics, 8(2), 39–42. https://doi.org/10.12691/ajams-8-2-1
34. Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, 15(2), 4–14. https://doi.org/10.3102/0013189X015002004
35. Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd
36. Vasseleu, E., Neilsen-Hewett, C., & Howard, S. J. (2024). An early start to self-regulation: Evaluating the effects of an early childhood self-regulation intervention on educator beliefs, knowledge, and practice. Journal of Research in Childhood Education, 39, 643–663. https://doi.org/10.1080/02568543.2024.2396907Vu, T. T. (2021). Early childhood education in Vietnam, history, and development. International Journal of Child Care and Education Policy, 15(1), 3. https://doi.org/10.1186/s40723-020-00080-4
37. Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.
38. Xuan, P. T., & Dung, T. A. (2024). Choosing Folk Song for Children 5-6 Years Old Through Teaching Organization Music Activities in Preschool. European Journal of Theoretical and Applied Sciences, 2(3), 74-81. https://doi.org/10.59324/ejtas.2024.2(3).08
39. Williams, K. E., Bentley, L., Savage, S., Eager, R. E., & Nielson, C. (2022). Rhythm and movement delivered by teachers supports self-regulation skills of preschool-aged children in disadvantaged communities: A clustered RCT. Early Childhood Research Quarterly. https://doi.org/10.35542/osf.io/px2qu
40. Williams, K. E., Savage, S., & Eager, R. (2020). Rhythm and Movement for Self-Regulation (RAMSR) intervention for preschool self-regulation development in disadvantaged communities: A clustered randomised controlled trial study protocol. BMJ Open, 10(9), e036392. https://doi.org/10.1136/bmjopen-2019-036392
41. Wong, J., Bautista, A., Ho, Y. L., & Kong, S. H. (2024). Preschool teachers' music-specific professional development preferences: Does teaching experience matter? Research Studies in Music Education, 46(1), 80–97. https://doi.org/10.1177/1321103X221139992
42. Wyatt, T. M., Denham, S. A., & Bassett, H. H. (2025). Self-regulation in preschool children: Hot and cool executive control as predictors of later classroom learning behaviors. Learning and Individual Differences, 121, 102701. https://doi.org/10.1016/j.lindif.2025.102701
43. You, T., He, H., & Yue, Y. (2025). Teacher support and pre-service preschool teachers' piano skill: The chain mediation effects of music self-efficacy and learning engagement. Behavioral Sciences, 15. https://doi.org/10.3390/bs15040484
44. Zarza-Alzugaray, F. J., Gil, D. G., Casanova, O., & Orejudo, S. (2021). A scale to measure educators' musical skills in early childhood education. Studies in Educational Evaluation, 71, 101085. https://doi.org/10.1016/j.stueduc.2021.101085

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.
DOI: 10.5281/zenodo.24213801