



Enhancing Inhibitory Control in Early Childhood through Children's Songs and Body Percussion Activities

Lulu Nailufar¹, Taufik Hidayatulloh²

¹Kaizen Music School, Malang, Indonesia

²Pendidikan Guru Pendidikan Anak Usia Dini, STKIP Kusuma Negara, Indonesia

Abstract

Inhibitory control is a fundamental component of executive functions that enables children to regulate impulses, control behaviors, sustain attention, and respond appropriately to environmental demands. The development of inhibitory control during early childhood has received increasing attention because of its contribution to later academic achievement, self-regulation, and socioemotional competence. Although movement-based and music-based interventions have demonstrated potential for supporting executive function development, limited evidence has investigated the integration of body percussion activities and children's songs as a developmentally appropriate strategy for strengthening inhibitory control among preschool children. Therefore, this study aimed to examine the effects of body percussion activities integrated with children's songs on inhibitory control development in early childhood. This study employed a mixed-methods pretest–posttest one-group design with an embedded qualitative component involving 40 parents and 8 preschool teachers from South Jakarta and Malang, Indonesia. Quantitative data were collected using pretest–posttest questionnaires developed from inhibitory control domains adapted from the *Behavior Rating Inventory of Executive Function–Preschool Version (BRIEF-P)*. At the same time, qualitative data were obtained through focus group discussions and semi-structured interviews. Quantitative data were analyzed using descriptive statistics and paired-samples *t*-tests, whereas qualitative data were analyzed through thematic analysis. The findings revealed significant improvements in inhibitory control scores with a large practical effect size, while qualitative results indicated observable changes in stopping behavior, attention regulation, patience, emotional control, and participation. These findings suggest that body percussion activities integrated with children's songs may provide a meaningful and developmentally appropriate approach for supporting inhibitory control development and strengthening self-regulatory capacities among young children.

Keywords: *inhibitory control, body percussion activities, children's songs, early childhood education, self-regulation.*

To cite this article:

Nailufar, L., & Hidayatulloh, T. (2026). Enhancing inhibitory control in early childhood through children's songs and body percussion activities. *The International Journal of Emerging Issues in Early Childhood Education (IJEECE)*, 8(1), 77-89.

To link to this article: <https://jurnal.ut.ac.id/index.php/ijeiece>

Published by: Universitas Terbuka

Jl. Pd. Cabe Raya, Pd. Cabe Udik, Kec. Pamulang, Kota Tangerang Selatan, Banten 15437



INTRODUCTION

Early childhood represents a critical developmental period characterized by substantial growth in cognitive, social, emotional, and behavioral domains that collectively shape later developmental trajectories (Shonkoff & Phillips, 2000). During this developmental period, executive functions (EFs) have gained increasing scholarly attention because these higher-order cognitive processes support children's ability to regulate thoughts, behaviors, and emotions in goal-directed contexts (Diamond, 2013). Executive functions are generally conceptualized as consisting of three core components: inhibitory control, working memory, and cognitive flexibility (Diamond, 2013). Among these components, inhibitory control is particularly important because it enables children to suppress impulsive responses, resist distractions, and selectively focus attention on relevant information (Diamond, 2013). Strong inhibitory control during preschool years has been associated with better academic achievement, self-regulation, language competence, and social adjustment across childhood development (Filipe et al., 2023). Furthermore, emerging evidence indicates that inhibitory control in children aged three to five years significantly predicts later performance in language and mathematics, highlighting its foundational role in learning trajectories (Beisly et al., 2024).

Inhibitory control develops rapidly during early childhood as neural systems associated with executive functioning undergo significant maturation, particularly within the prefrontal cortex and interconnected neural networks (Diamond, 2020). However, inhibitory control does not emerge automatically and requires continuous stimulation through interactions with environmental and educational experiences (Diamond, 2013). Previous studies have demonstrated that active engagement and socially mediated learning experiences contribute significantly to executive function development because children acquire self-regulatory capacities through repeated participation in meaningful activities (Diamond & Ling, 2020). Research also indicates that interventions involving physical movement and social interaction produce stronger executive function outcomes than passive instructional approaches because such interventions simultaneously engage cognitive, behavioral, and emotional regulation processes (Diamond & Ling, 2020).

Recent educational research has increasingly recognized the role of movement-based and music-based activities as promising approaches for supporting executive function development in young children (Degé et al., 2020). Music and rhythmic experiences simultaneously engage multiple cognitive systems, including auditory processing, motor coordination, attentional regulation, and working memory processes (Degé et al., 2020). Rhythm-based activities also require children to synchronize body movements, follow sequential patterns, and inhibit automatic reactions, all of which are closely associated with inhibitory control mechanisms (Williams & Berthelsen, 2019). Body percussion activities, which involve generating rhythmic sounds through movements such as clapping, tapping, and stomping, may be particularly relevant because they combine physical activity with structured cognitive engagement (Patel, 2021). Such activities require children to coordinate movements according to auditory cues while continuously regulating impulses and adapting behavioral responses (Patel, 2021).

Children's songs may further strengthen the cognitive value of body percussion activities because they provide meaningful auditory structures that increase engagement and facilitate participation (Degé et al., 2020). Songs naturally contain rhythmic repetition, sequencing, and predictive structures that support self-regulation and cognitive processing (Patel, 2021). Within play-based early childhood settings, integrating children's songs with body percussion activities aligns with developmentally appropriate pedagogical principles because young children learn most effectively through enjoyable, socially interactive, and physically active experiences (Copple & Bredekamp, 2021). From an embodied learning perspective, cognitive development is closely

connected to bodily movement and sensory experiences, suggesting that movement-based musical activities may facilitate higher-order cognitive functioning through integrated sensorimotor processes (Leshem & Yefet, 2020).

Despite increasing attention toward executive function interventions in early childhood education, several research gaps remain. Existing intervention studies have predominantly focused on computerized cognitive training, structured physical exercise programs, or general music interventions (Diamond & Ling, 2020). Comparatively limited evidence has investigated how children's songs integrated with body percussion activities specifically contribute to inhibitory control development among preschool children. Furthermore, many existing interventions rely on isolated cognitive tasks rather than classroom activities embedded within children's authentic learning environments (Diamond & Ling, 2020). Therefore, further investigation is necessary to determine whether integrating children's songs with body percussion activities may serve as an effective and engaging strategy for strengthening inhibitory control in early childhood settings. Accordingly, this study aims to examine the effectiveness of children's songs integrated with body percussion activities in improving inhibitory control among young children. The findings are expected to contribute to the growing literature on executive function interventions and provide practical implications for educators seeking developmentally appropriate approaches to strengthening children's self-regulatory abilities in playful learning contexts.

LITERATURE REVIEW

Inhibitory Control in Early Childhood Development

Inhibitory control constitutes one of the core components of executive functions and refers to an individual's ability to deliberately suppress impulsive responses, ignore irrelevant stimuli, and regulate behavior toward achieving goal-directed actions (Diamond, 2013). Within early childhood contexts, inhibitory control is considered a fundamental cognitive mechanism because it supports self-regulation, attentional processes, emotional control, and adaptive behavior during learning activities (Filipe et al., 2023). Preschool years represent a particularly sensitive period for inhibitory control development due to substantial maturation occurring in brain regions associated with executive processing, particularly within the prefrontal cortex (Diamond, 2020).

Previous empirical studies have consistently demonstrated positive associations between inhibitory control and later developmental outcomes. Children with stronger inhibitory control skills tend to demonstrate better academic readiness, language performance, mathematical competence, and social adaptation compared to peers with weaker inhibitory abilities (Beisly et al., 2024). Moreover, inhibitory control enables children to delay immediate responses, follow classroom instructions, and sustain attention during learning tasks, which are critical competencies in early educational environments (Diamond & Ling, 2020). Consequently, strengthening inhibitory control during early childhood has become an important educational objective because it contributes not only to cognitive outcomes but also to broader developmental functioning.

However, inhibitory control development is not solely determined by biological maturation. Environmental experiences, social interaction, and pedagogical practices substantially influence its growth (Diamond & Ling, 2020). Therefore, researchers increasingly emphasize the importance of designing developmentally appropriate learning interventions that provide opportunities for active participation, behavioral regulation, and repeated cognitive engagement.

Body Percussion Activities and Cognitive Development

Body percussion refers to rhythmic activities that use body movements to create sound patterns through actions such as clapping, stomping, tapping, or snapping (Patel, 2021). Unlike traditional music instruction relying on external instruments, body percussion directly integrates

bodily movement with auditory and cognitive experiences, making it particularly suitable for young children. The theoretical basis for body percussion activities can be understood through embodied cognition perspectives, which propose that cognitive processes are deeply interconnected with sensory and motor experiences (Leshem & Yefet, 2020). According to this perspective, learning emerges not only through abstract mental processing but also through bodily interaction with the environment. During body percussion activities, children continuously coordinate movement sequences, process rhythmic patterns, and regulate behavioral responses according to external cues. Such integrated processes simultaneously activate attentional systems, motor planning, working memory, and inhibitory mechanisms.

Recent evidence suggests that rhythm-based and movement-oriented activities may positively influence executive functions because they require children to synchronize actions and inhibit automatic responses (Degé et al., 2020). In addition, movement-based interventions appear to facilitate stronger executive function outcomes than passive instructional approaches because they integrate cognitive and behavioral demands in meaningful contexts (Diamond & Ling, 2020). Therefore, body percussion activities may provide a promising strategy for promoting inhibitory control development in early childhood settings.

Children's Songs as Meaningful Learning Stimuli

Children's songs constitute an important pedagogical medium in early childhood education because they naturally integrate language, rhythm, emotion, and social interaction within enjoyable learning experiences (Copple & Bredekamp, 2021). Songs frequently involve repetitive structures, predictable sequences, and rhythmic patterns that support children's attention and participation during learning activities. Research suggests that music experiences influence cognitive functioning by engaging multiple neural systems associated with attention, memory, and motor coordination (Patel, 2021). Furthermore, rhythmic structures embedded in songs may support self-regulatory processes because children are required to anticipate sequences, monitor responses, and coordinate actions with auditory information (Degé et al., 2020).

Within play-based educational environments, children's songs may provide an effective mechanism for increasing children's engagement and motivation because learning experiences become enjoyable and emotionally meaningful (Copple & Bredekamp, 2021). Integrating children's songs into body percussion activities may therefore strengthen both cognitive and emotional dimensions of learning while simultaneously encouraging active participation.

Integration of Children's Songs and Body Percussion Activities for Inhibitory Control Development

The integration of children's songs and body percussion activities may offer unique opportunities for enhancing inhibitory control because it combines rhythmic auditory stimulation with structured physical engagement. During such activities, children are expected to synchronize body movements with song patterns while regulating impulses and following specific movement rules. From an embodied learning perspective, coordinated movement and musical interaction may strengthen cognitive processing through direct sensorimotor experiences (Leshem & Yefet, 2020). Additionally, play-based learning principles suggest that children acquire self-regulatory skills more effectively when learning activities are meaningful, enjoyable, and socially interactive (Copple & Bredekamp, 2021).

Although previous studies have examined music interventions and movement-based activities separately, empirical evidence specifically investigating children's songs integrated with body percussion activities for improving inhibitory control remains limited. Existing interventions predominantly focus on computerized cognitive training or generalized physical activities rather than classroom-based experiences embedded within children's everyday learning contexts (Diamond & Ling, 2020). This limitation indicates an important research gap and highlights the

need for further investigation regarding the effectiveness of integrated body percussion and children's song activities for enhancing inhibitory control in preschool children.

RESEARCH METHOD

This study employed a **mixed-methods pretest–posttest one-group design with an embedded qualitative component** (Creswell & Plano Clark, 2018). The quantitative component was used to examine changes in children’s inhibitory control before and after the implementation of body percussion activities integrated with children’s songs, whereas the qualitative component consisting of focus group discussions and semi-structured interviews was used to provide deeper explanations regarding behavioral changes across home and school contexts (Creswell & Creswell, 2023).

This design was considered appropriate because the study aimed not only to determine whether changes occurred following the intervention but also to understand how parents and teachers perceived those changes within children's everyday experiences (Creswell & Plano Clark, 2018). The pretest–posttest structure enables researchers to compare changes across measurement points, while qualitative findings provide contextual understanding of observed phenomena and behavioral processes (Tashakkori & Teddlie, 2021).

Participants and Research Setting

The participants consisted of **40 parents and 8 early childhood teachers** from early childhood education institutions located in South Jakarta and Malang, Indonesia. Parents were included because inhibitory control behaviors are observable across multiple contexts, including home routines, social interaction, emotional regulation, and rule-following behavior (Diamond, 2013). Teachers were included because they directly observe children’s behavioral responses and learning engagement during classroom activities and structured educational experiences (Gioia et al., 2003).

The inclusion criteria for parents included having children enrolled in participating institutions, actively engaging in children’s daily care routines, and willingness to participate in pretest and posttest procedures. Teacher participants were selected based on their direct involvement in learning implementation and their experience observing children’s behavioral regulation within educational contexts (Creswell & Creswell, 2023).

Participant demographic characteristics are presented in Table 1. A total of 48 participants were involved in this study, consisting of 40 parents and 8 preschool teachers from South Jakarta and Malang, Indonesia. Parents were included to provide observations of children’s inhibitory control behaviors within home environments, whereas teachers contributed classroom-based perspectives related to children’s behavioral regulation during learning activities. The inclusion of participants from different educational settings and social contexts was intended to provide a more comprehensive understanding of inhibitory control development across children’s everyday experiences. Demographic information such as age, educational background, relationship to the child, teaching experience, and child characteristics was collected to describe participant diversity and contextualize the study findings.

Table 1. Demographic Characteristics of Participants

Variable	Category	n	%
Parent Participants (N = 40)			
Gender	Male	12	30.0
	Female	28	70.0
Age	20–29 years	9	22.5
	30–39 years	23	57.5

	≥40 years	8	20.0
Relationship with child	Mother	28	70.0
	Father	10	25.0
	Other guardian	2	5.0
Educational background	High school	10	25.0
	Diploma/Bachelor degree	24	60.0
	Postgraduate degree	6	15.0
Location	South Jakarta	20	50.0
	Malang	20	50.0
Child age	4 years	11	27.5
	5 years	18	45.0
	6 years	11	27.5
Child gender	Boys	21	52.5
	Girls	19	47.5
Teacher Participants (N = 8)			
Gender	Female	8	100
Age	20–29 years	2	25.0
	30–39 years	4	50.0
	≥40 years	2	25.0
Educational background	Diploma	1	12.5
	Bachelor degree	6	75.0
	Master degree	1	12.5
Teaching experience	1–5 years	2	25.0
	6–10 years	4	50.0
	>10 years	2	25.0
Location	South Jakarta	4	50.0
	Malang	4	50.0

Note. Percentages were calculated separately for parent participants and teacher participants. Parent participants completed pretest–posttest questionnaires regarding children’s inhibitory control behaviors in home contexts, whereas teacher participants provided classroom-based observations and participated in interviews related to the implementation of body percussion activities integrated with children’s songs.

A total of 48 participants were involved in the study, consisting of 40 parents and 8 preschool teachers from South Jakarta and Malang. Parent participants represented children aged 4–6 years, while teacher participants were directly involved in implementing body percussion activities integrated with children’s songs in classroom settings. The inclusion of parents and teachers enabled the study to capture inhibitory control behaviors across both home and school environments.

Intervention: Body Percussion Activities and Children’s Songs

The intervention consisted of structured learning activities integrating children’s songs with body percussion movements such as clapping, tapping, stomping, snapping, and coordinated rhythmic movements. Rhythm-based movement activities have been identified as potentially beneficial for executive function development because they simultaneously engage attentional, motor, and self-regulatory processes (Lu et al., 2025). The intervention activities were designed to stimulate inhibitory control by requiring children to respond to rhythmic cues, regulate impulsive responses, follow movement rules, and adapt behavior according to changing instructions (Khanjankhani et al., 2024).

Examples of intervention activities included “start–stop songs,” clapping only on specific words, movement inhibition games, rhythm imitation, call-and-response singing, and group synchronization tasks. These activities were implemented in developmentally appropriate and playful contexts because children learn more effectively through active, enjoyable, and socially interactive experiences (Coppie & Bredekamp, 2021).

Research Procedure

The research procedure consisted of five main stages. First, the researchers conducted preparation and instrument adaptation. The questionnaire, interview guide, and FGD guide were developed based on the conceptual dimensions of inhibitory control adapted from the Behavior Rating Inventory of Executive Function–Preschool Version (BRIEF-P). The BRIEF-P is a standardized rating scale completed by parents and teachers to assess preschool children's executive function in everyday contexts, including the scales of Inhibit, Shift, Emotional Control, Working Memory, and Plan/Organize. The Inhibitory Self-Control Index in BRIEF-P is composed of the Inhibit and Emotional Control scales, which are directly relevant to this study's focus on children's inhibitory control.

Second, a pretest questionnaire was administered to parents and teachers before the intervention. The pretest aimed to identify baseline conditions of children's inhibitory control, including impulsive behavior, ability to wait, ability to follow rules, emotional regulation, response inhibition, attention to instructions, and behavioral adjustment during play and learning activities. Third, the intervention was implemented through body percussion activities integrated with children's songs. Teachers facilitated the activities in classroom learning sessions, while parents were informed about the learning focus so they could observe related behaviors at home. During this stage, the researchers documented classroom implementation and noted children's behavioral responses.

Fourth, after the intervention, parents and teachers completed the posttest questionnaire using the same indicators as the pretest. The posttest aimed to identify perceived changes in children's inhibitory control after participating in the learning activities. Fifth, qualitative data were collected through FGD and semi-structured interviews. FGD with parents was used to explore shared perceptions of children's behavioral changes at home, while interviews with teachers were used to examine classroom-based observations related to children's ability to inhibit impulses, follow rhythm-based rules, wait for turns, regulate emotions, and respond to movement cues

Research Instruments

The study employed three instruments consisting of a pretest–posttest questionnaire, an interview guide, and an FGD guide. The questionnaire was developed using inhibitory control indicators derived from BRIEF-P dimensions, specifically the *Inhibit* and *Emotional Control* domains. Inhibitory control represents children's ability to suppress impulsive responses, regulate emotional reactions, and adjust behavior according to environmental demands (Diamond, 2013).

Because BRIEF-P is a proprietary psychological assessment instrument, the original items should not be reproduced without formal authorization (Psychological Assessment Resources, 2020). Therefore, contextual items based on theoretical dimensions were developed to reflect children's behavioral characteristics while maintaining conceptual consistency with inhibitory control constructs. The BRIEF-P instrument contains 63 items completed by parents and teachers and has been widely used to evaluate executive function behaviors in preschool-aged children across natural settings.

The questionnaire used in this study was developed based on theoretical dimensions of inhibitory control adapted from the *Behavior Rating Inventory of Executive Function–Preschool Version (BRIEF-P)*, particularly the domains related to inhibition and emotional regulation (Gioia et al., 2003). The indicators were designed to capture observable behaviors that could be identified by both parents and teachers within children's everyday contexts, including home routines, classroom activities, and social interactions. Because inhibitory control is manifested through behavioral responses rather than isolated cognitive performance, the selected indicators focused on practical expressions of self-regulation such as response inhibition, impulse control, attentional

behavior, emotional regulation, and behavioral adjustment. The questionnaire indicators used in this study are presented in Table 2.

Table 2. Questionnaire Indicators for Assessing Children's Inhibitory Control

Dimension	Indicator
Response inhibition	Child can stop an action when asked
Impulse control	Child can wait before responding
Rule-following	Child follows simple movement or classroom rules
Attention control	Child listens to instructions before acting
Emotional control	Child manages frustration when asked to stop or wait
Behavioral adjustment	Child changes behavior according to cues
Turn-taking	Child waits for their turn during group activities
Sustained engagement	Child remains involved in rhythmic activities without excessive disruption

Note. The questionnaire may use a 4-point Likert scale, for example: 1 = never, 2 = rarely, 3 = often, 4 = consistently. A higher score indicates stronger inhibitory control. If negative items are used, reverse scoring should be applied.

To obtain a deeper understanding of children's inhibitory control behaviors within home environments, focus group discussions (FGDs) were conducted with parents. Parents play an important role in observing children's everyday behavioral patterns because inhibitory control is reflected not only in classroom activities but also in home routines, emotional responses, waiting behavior, and social interactions (Diamond, 2013). The FGD guide was designed to explore parents' perceptions of behavioral changes before and after the implementation of body percussion activities integrated with children's songs. The questions focused on observable dimensions of inhibitory control, including response inhibition, emotional regulation, behavioral adjustment, and impulse control. The FGD guide for parents is presented in Table 3.

Table 3. Focus Group Discussion (FGD) Guide for Parents

No.	Focus Area	Guiding Questions
1	Initial behavioral condition	What behaviors did you observe in your child before the body percussion and children's songs activities were introduced?
2	Behavioral changes after intervention	Did you notice any changes in your child's ability to wait, stop, listen, or follow instructions after the activities?
3	Home-context observation	In what home situations did these changes appear most clearly?
4	Response inhibition	How did your child respond when asked to stop an activity or wait for a turn?
5	Emotional regulation	Did your child show changes in emotional regulation, such as reduced frustration or better patience?
6	Perceived effectiveness	What aspects of the song or movement activities seemed most enjoyable or helpful for your child?

The FGD questions presented in Table 3 were intended to capture parents' perspectives regarding changes in children's inhibitory control across everyday situations. Parents' observations provided valuable contextual information regarding children's behavioral regulation outside formal educational settings. Such perspectives were expected to contribute to a broader understanding of how intervention effects may extend into children's daily routines and family interactions.

To complement parental perspectives and examine inhibitory control behaviors within educational settings, semi-structured interviews were conducted with preschool teachers. Teachers were selected as key informants because they directly observed children's behavioral responses during classroom activities and learning interactions. Previous research suggests that teacher observations provide important information regarding children's executive functioning because teachers frequently assess children's ability to follow instructions, regulate behavior, sustain attention, and adapt to structured learning environments (Gioia et al., 2003). The interview guide

focused on behavioral changes observed during body percussion and children’s song activities, particularly in relation to response inhibition, movement regulation, and classroom participation. The interview guide for teachers is presented in Table 4.

Table 4. Semi-Structured Interview Guide for Teachers

No.	Focus Area	Guiding Questions
1	Initial classroom response	How did children respond during the initial sessions of body percussion and children’s songs?
2	Rule-following and attention	What changes did you observe in children’s ability to follow rhythmic cues and movement rules?
3	Inhibitory control development	Did children become more able to stop, wait, or regulate movement during activities?
4	Effective activity patterns	Which activity patterns appeared most effective for stimulating inhibitory control?
5	Implementation challenges	What challenges emerged during implementation?
6	Practical feasibility	How feasible is this activity for regular classroom practice?

The interview questions presented in Table 4 were developed to facilitate systematic exploration of teachers’ observations regarding inhibitory control development during classroom implementation. Teacher perspectives were expected to provide detailed insights into children’s behavioral responses during structured learning experiences and contribute to understanding the practical feasibility of integrating body percussion activities and children’s songs into everyday classroom practices.

Data Analysis

Quantitative data obtained from pretest and posttest questionnaires were analyzed using both descriptive and inferential statistical procedures (Creswell & Creswell, 2023). Descriptive analysis included the calculation of means, standard deviations, minimum and maximum values, and percentage changes across inhibitory control indicators to provide an overview of score distributions and changes before and after the intervention (Field, 2024). Prior to inferential testing, assumptions of normality for pretest–posttest difference scores were examined because the selection of statistical procedures depends on distributional characteristics of the data (Hair et al., 2022).

When the difference scores met assumptions of normality, a paired-samples *t*-test was employed to examine statistically significant differences between pretest and posttest scores (Field, 2024). In contrast, when normality assumptions were violated, the Wilcoxon signed-rank test was used as a nonparametric alternative appropriate for repeated-measure comparisons (Pallant, 2020). In addition to statistical significance testing, effect sizes were calculated using Cohen’s *d* for paired comparisons and *r* effect size for nonparametric analyses to determine the practical magnitude of intervention effects beyond significance values alone (Cohen, 1988; Lakens, 2013).

Qualitative data collected through focus group discussions and semi-structured interviews were analyzed using thematic analysis procedures (Braun & Clarke, 2022). The analysis involved transcription of audio recordings, repeated reading of textual data, initial coding, category development, theme generation, and interpretive synthesis of the emerging findings (Braun & Clarke, 2022). The coding framework combined deductive coding derived from theoretical domains of inhibitory control based on BRIEF-P constructs with inductive coding that emerged directly from participant narratives and experiences (Nowell et al., 2017). Deductive categories included response inhibition, waiting behavior, emotional control, attention regulation, behavioral flexibility, and rule-following behaviors.

Quantitative and qualitative findings were integrated during the interpretation stage to generate a comprehensive understanding of intervention outcomes (Creswell & Plano Clark, 2018). Integrating findings across methods allows researchers to examine whether statistical patterns correspond with participants' experiences and contextual observations (Fetters et al., 2013). For example, if posttest findings indicated improvements in children's ability to stop actions upon instruction, qualitative interview data could be used to explain how these changes manifested during start-stop songs and rhythm-based movement activities.

Validity and Trustworthiness

For the quantitative component, content validity of the questionnaire was established through expert judgment involving specialists in early childhood education, child development, and educational measurement (Zamanzadeh et al., 2015). Expert review procedures are important because they assess the degree to which instrument items adequately represent the theoretical domains intended to be measured (Zamanzadeh et al., 2015). Reliability analysis was performed using Cronbach's alpha and composite reliability indices to determine internal consistency among questionnaire items (Hair et al., 2022). Furthermore, a pilot study involving a small sample of parents and teachers was conducted prior to the main data collection to assess item clarity, readability, and response interpretation (Taherdoost, 2022).

For the qualitative component, trustworthiness was ensured using several established criteria, including credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). Credibility was strengthened through triangulation of data sources involving parents and teachers to compare behavioral observations across home and school environments (Carter et al., 2014). Methodological triangulation was also applied through the integration of questionnaires, focus group discussions, and interviews because combining multiple methods can enhance confidence in research findings (Carter et al., 2014). Member checking procedures were implemented by sharing preliminary interpretations with selected participants to verify whether the interpretations accurately reflected their experiences (Candela, 2019). In addition, an audit trail documenting coding decisions and analytical processes was maintained to enhance transparency and dependability of the findings (Nowell et al., 2017).

Ethical Considerations

Because this study involved young children, ethical safeguards were carefully integrated throughout the research process (Alderson & Morrow, 2020). Written informed consent was obtained from parents, teachers, and institutional authorities prior to data collection to ensure voluntary participation and adequate understanding of the study objectives and procedures (Graham et al., 2015). Children's participation was guided by age-appropriate assent procedures, whereby children's verbal expressions and behavioral indications of discomfort or unwillingness were respected during research activities (Powell et al., 2020).

Participant confidentiality and privacy were maintained by anonymizing all identifying information and reporting data using codes rather than personal names (Alderson & Morrow, 2020). All intervention activities were designed to remain developmentally appropriate, non-invasive, and enjoyable for children (Copple & Bredekamp, 2021). Researchers ensured that body percussion activities did not create physical discomfort, excessive competition, embarrassment, or emotional pressure that could negatively affect children's well-being (Copple & Bredekamp, 2021). Participants were also informed that their involvement was voluntary and that withdrawal from the study could occur at any stage without negative consequences.

Because BRIEF-P is a proprietary standardized assessment instrument, ethical and legal considerations associated with instrument use were carefully addressed (Gioia et al., 2003). Researchers were required either to obtain formal authorization for use of the original instrument

or to develop contextualized measures based on theoretical domains without reproducing copyrighted items directly. Compliance with intellectual property requirements is essential for maintaining research integrity, ethical transparency, and publication credibility.

FINDINGS

Quantitative Results

To explore changes in children’s inhibitory control after participation in body percussion activities integrated with children’s songs, descriptive statistical analyses were conducted on pretest and posttest scores reported by parents. The analysis aimed to examine patterns of change in score distributions and provide an initial understanding of differences in inhibitory control before and after the intervention. The descriptive results, including mean scores, standard deviations, and score ranges, are presented in Table 5.

Table 5. Descriptive Statistics of Pretest and Posttest Inhibitory Control Scores (N = 40)

Measure	Mean	SD	Minimum	Maximum
Pretest	26.75	4.82	18	36
Posttest	33.48	4.11	24	40

The descriptive findings presented in Table 5 indicate an increase in children’s inhibitory control scores following participation in body percussion activities integrated with children’s songs. The mean score increased from 26.75 during the pretest to 33.48 during the posttest, representing an average increase of 6.73 points. This increase suggests an overall improvement in children’s ability to regulate behavior, control impulsive responses, follow instructions, and adapt actions according to environmental demands after the intervention. In addition to the increase in mean scores, a decrease in score variability was observed, as reflected by the reduction in standard deviation from 4.82 in the pretest to 4.11 in the posttest. This finding indicates that children’s inhibitory control behaviors became relatively more consistent following the intervention. Lower variability after the intervention may suggest that improvements were experienced not only by a small number of participants but also more broadly across children in the study sample.

Changes were also observed in the score range between pretest and posttest measurements. The minimum score increased from 18 to 24, indicating that children with initially lower inhibitory control performance demonstrated improvement after participating in the activities. Likewise, the maximum score increased from 36 to 40, suggesting that some children reached higher levels of behavioral regulation following the intervention. The increase in both lower and upper score boundaries may indicate that the intervention supported improvements across different levels of initial inhibitory control ability. Overall, these descriptive findings suggest a positive trend toward enhanced inhibitory control among preschool children following exposure to body percussion and children’s song activities. However, while descriptive statistics provide initial evidence of improvement, inferential statistical analysis is necessary to determine whether the observed differences are statistically significant and reflect meaningful intervention effects rather than random variation.

Before conducting inferential statistical analysis, the assumptions underlying parametric procedures were examined to determine the appropriateness of the selected statistical method. The normality of pretest–posttest difference scores was assessed using the Shapiro–Wilk test. The results indicated that the difference scores met the assumptions of normal distribution ($p > .05$), suggesting that the distribution of the data did not significantly deviate from normality. Since the normality assumption was satisfied, parametric analysis was considered appropriate for examining changes in inhibitory control scores across measurement periods.

Following confirmation of data normality, a paired-samples *t*-test was conducted to

determine whether the observed differences between pretest and posttest inhibitory control scores were statistically significant. The paired-samples *t*-test was selected because it is suitable for comparing repeated measurements obtained from the same participants before and after an intervention. This analysis allowed examination of whether participation in body percussion activities integrated with children’s songs contributed to measurable changes in children’s inhibitory control. The results of the paired-samples *t*-test analysis are presented in Table 6.

Table 6. Paired-Samples *t*-test for Pretest and Posttest Scores

Variable	Mean Difference	t	df	p	Cohen's d
Inhibitory Control	6.73	8.65	39	<.001	1.12

The paired-samples *t*-test results revealed a statistically significant difference between pretest and posttest inhibitory control scores, $t(39) = 8.65$, $p < .001$, indicating that children’s inhibitory control behaviors improved following participation in body percussion activities integrated with children’s songs. The statistical significance suggests that the observed changes were unlikely to occur by chance and may reflect meaningful differences between children’s behavioral conditions before and after the intervention.

In addition to statistical significance, effect size analysis demonstrated a large practical effect ($d = 1.12$). According to conventional interpretations of effect size magnitude, values above 0.80 indicate substantial practical influence, suggesting that the intervention may have produced not only statistically detectable changes but also meaningful behavioral improvements in real-world contexts. The large effect size further indicates that the observed changes extended beyond minor fluctuations and represented notable shifts in children’s inhibitory control abilities.

From a developmental perspective, these findings imply that body percussion activities integrated with children’s songs may support children’s ability to regulate impulsive responses and behavioral actions during daily interactions. Since inhibitory control encompasses the ability to stop actions, delay responses, regulate emotions, and follow rules, improvements in overall scores may indicate enhanced self-regulatory functioning across different situations. Furthermore, because the intervention combined movement coordination with rhythmic and auditory cues, repeated engagement in such activities may have strengthened children’s behavioral monitoring and response control processes. However, overall score improvements do not necessarily indicate that all dimensions of inhibitory control developed equally. Some aspects of inhibitory control may be more sensitive to movement-based and rhythm-based interventions than others. Therefore, further analysis at the indicator level was conducted to identify which specific inhibitory control behaviors showed greater changes following the intervention.

To obtain a more detailed understanding of behavioral changes following the intervention, an indicator-level analysis was conducted across the dimensions of inhibitory control measured in the questionnaire. Examining individual indicators allows identification of specific behavioral domains that may have contributed to the overall improvement in inhibitory control scores. Such analysis also provides insight into whether body percussion activities integrated with children’s songs influenced aspects of self-regulatory behavior more strongly than others. The changes observed across inhibitory control indicators are presented in Table 7.

Table 7. Changes Across Inhibitory Control Indicators

Indicator	Pretest Mean	Posttest Mean	Mean Increase
Response inhibition	2.41	3.29	0.88
Impulse control	2.58	3.31	0.73
Rule-following	2.72	3.45	0.73
Attention control	2.61	3.37	0.76
Emotional regulation	2.47	3.18	0.71

Turn-taking behavior	2.54	3.39	0.85
----------------------	------	------	------

The findings presented in Table 7 indicate that improvements occurred across all inhibitory control indicators following participation in body percussion activities integrated with children's songs. Although all dimensions showed positive changes, the magnitude of improvement varied across behavioral domains, suggesting that some aspects of inhibitory control may be more responsive to rhythmic movement-based interventions than others. The largest increases were observed in response inhibition and turn-taking behavior, indicating that children became more capable of stopping actions when instructed and waiting appropriately during social interactions. These findings suggest that repeated exposure to activities requiring children to start and stop movements according to musical cues may have strengthened their ability to suppress impulsive reactions and regulate behavioral responses.

Substantial improvements were also identified in attention control and rule-following behavior, suggesting that children became more responsive to instructions and more capable of sustaining attention during structured activities. The rhythmic and predictable nature of children's songs may have facilitated attentional engagement by providing clear auditory signals and movement expectations. Improvements in emotional control and behavioral adjustment further indicate that children demonstrated greater ability to regulate frustration and modify behaviors according to environmental demands. This pattern may reflect the role of collaborative musical activities in promoting not only cognitive regulation but also socioemotional adaptation. Since body percussion activities required children to continuously monitor movements, coordinate actions with peers, and adjust responses to changing cues, these activities may have created repeated opportunities for practicing self-regulatory behaviors within meaningful social contexts. Overall, the indicator-level findings suggest that the intervention did not influence inhibitory control as a single isolated construct but rather supported multiple interconnected dimensions of self-regulatory functioning. These findings provide stronger evidence that body percussion activities integrated with children's songs may contribute to broader developmental gains in children's behavioral regulation and everyday functioning.

Qualitative Results

Qualitative findings were obtained through focus group discussions with parents and semi-structured interviews with teachers. Thematic analysis generated four major themes describing perceived changes in children's inhibitory control after participation in body percussion activities integrated with children's songs.

Theme 1: Increased Ability to Stop and Control Impulsive Responses

Parents and teachers consistently reported improvements in children's ability to stop ongoing actions when receiving instructions. Children who previously reacted immediately without considering instructions appeared more capable of pausing and waiting.

A parent explained:

"Before the activities, my child usually acted immediately without listening completely. After several sessions, I noticed that my child began waiting and listening until instructions were finished."

Similarly, a teacher noted:

"Children became more responsive to stop signals during movement games. Initially they continued moving even when the music stopped, but later they learned to control themselves."

These findings suggest that repeated exposure to movement inhibition activities embedded in songs may strengthen behavioral self-regulation.

Theme 2: Improved Attention and Listening Behavior

Participants reported that children demonstrated increased attention during activities and became

more responsive to verbal instructions.

One teacher stated:

"Children became more focused on listening because they wanted to follow the rhythm correctly."

Parents similarly described improved attentional behaviors at home:

"I noticed my child paying attention more carefully when I explained something."

These findings indicate that rhythm and auditory cues may facilitate attentional engagement and behavioral monitoring.

Theme 3: Enhanced Emotional Regulation and Patience

Parents and teachers also observed changes in emotional responses, particularly in situations involving waiting and turn-taking.

A parent reported:

"Previously, my child became frustrated quickly when waiting. Now I see more patience."

A teacher explained:

"Children seemed calmer when they had to wait for their turn during group activities."

The findings suggest that structured rhythmic activities may indirectly support emotional regulation and tolerance for delayed responses.

Theme 4: Increased Social Participation During Group Activities

Participants indicated that body percussion activities encouraged children to become more cooperative and socially engaged.

A teacher described:

"Children learned to coordinate with friends because movements had to match the rhythm together."

A parent similarly stated:

"My child started practicing the songs at home and wanted family members to join."

These findings suggest that body percussion activities integrated with children's songs may create socially meaningful learning environments that strengthen behavioral regulation and interaction.

Integrated Findings

The integration of quantitative and qualitative findings indicated convergent patterns. Quantitative analysis demonstrated statistically significant improvements in inhibitory control scores, while qualitative findings explained how these improvements manifested in children's daily behaviors. Improvements in stopping behavior, attention regulation, patience, and participation consistently emerged across both data sources. These results suggest that body percussion activities integrated with children's songs may serve as a developmentally appropriate approach for supporting inhibitory control development among preschool children.

To facilitate the integration and interpretation of findings obtained from both quantitative and qualitative analyses, an integrated mixed-methods model was developed to illustrate the relationships among the intervention process, observed behavioral outcomes, and educational implications. The model presents how body percussion activities integrated with children's songs may contribute to inhibitory control development through multimodal learning experiences involving rhythm, movement, and social interaction. Furthermore, the figure illustrates the convergence of statistical evidence and contextual behavioral observations obtained from parents and teachers. The integrated findings model is presented in Figure 1.

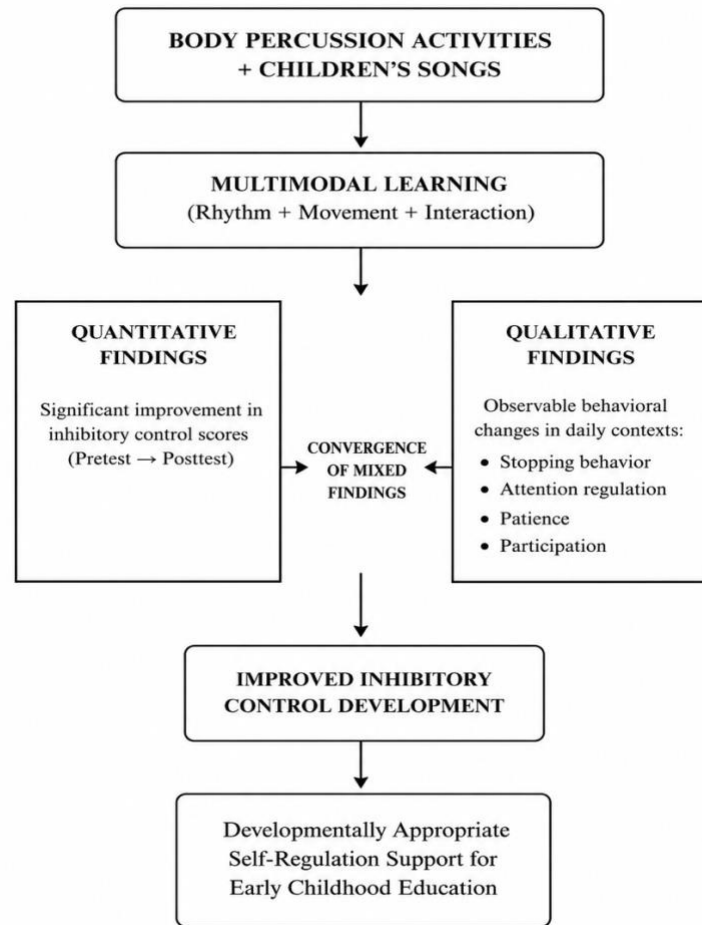


Figure 1. Integrated Mixed-Methods Model of Body Percussion Activities and Children’s Songs for Supporting Inhibitory Control Development

As illustrated in Figure 1, the integration of quantitative and qualitative findings demonstrated convergent patterns regarding the influence of body percussion activities integrated with children’s songs on children's inhibitory control development. Quantitative findings indicated significant improvements in inhibitory control scores, while qualitative findings provided contextual explanations of how these changes manifested in children’s daily behaviors, including improvements in stopping behavior, attention regulation, patience, and participation. The integrated model suggests that rhythmic movement experiences combined with meaningful social interaction may create developmentally appropriate learning environments that support children's self-regulatory capacities. These findings further emphasize the potential of body percussion activities and children’s songs as practical and engaging pedagogical approaches for promoting inhibitory control development in early childhood education settings.

DISCUSSION

The present study demonstrated that body percussion activities integrated with children’s songs contributed to significant improvements in inhibitory control among preschool children (Lu et al., 2025). Quantitative findings indicated increases in inhibitory control scores from pretest to posttest measures, while qualitative findings from parents and teachers revealed observable behavioral changes in children’s ability to stop actions, wait for turns, regulate emotional reactions, and follow instructions (Khanjankhani et al., 2024). The convergence between statistical changes and everyday behavioral observations is noteworthy because executive functions are frequently criticized for being measured only through decontextualized cognitive tasks rather than authentic child behavior (Theroux et al., 2025). The present findings suggest that improvements in inhibitory control were not restricted to isolated task performance but extended to meaningful social and

learning contexts (Bortz et al., 2025). Such transferability is particularly important because executive function interventions are increasingly expected to demonstrate ecological validity beyond laboratory-based measures (Theroux et al., 2025).

One important interpretation of these findings is that rhythmic movement activities may strengthen inhibitory control by simultaneously engaging multiple neural and cognitive systems (Patel, 2021). In body percussion activities, children are required to listen, anticipate, synchronize movement, inhibit premature responses, and adjust actions according to changing cues (Khanjankhani et al., 2024). These demands create conditions in which inhibitory mechanisms are repeatedly activated within enjoyable learning experiences (Lu et al., 2025). Recent meta-analytic evidence suggests that music training significantly improves inhibitory control among preschool children and that rhythmic engagement may particularly strengthen self-regulatory processes through repeated executive demands (Lu et al., 2025). Rather than functioning as isolated motor behavior, rhythmic movement appears to serve as a cognitive coordination process involving attentional monitoring and behavioral control (Patel, 2021).

The findings also support emerging perspectives from embodied cognition theories suggesting that cognitive processes are grounded in bodily experiences and sensorimotor interactions (Leshem & Yefet, 2020). Traditional approaches to executive function development have often emphasized direct cognitive training involving computerized tasks and structured exercises (Diamond & Ling, 2020). However, the present findings suggest that inhibitory control may also develop through movement-based learning environments where cognitive regulation occurs naturally during participation (Liu et al., 2025). Children did not practice inhibition through explicit instruction; instead, they learned inhibition while engaging in songs, rhythm, and movement coordination (Lu et al., 2025). This distinction is theoretically important because it shifts the understanding of inhibitory control development from isolated mental processes toward integrated cognitive–motor experiences (Leshem & Yefet, 2020).

Another interesting finding concerns the role of children's songs as a meaningful structure that appears to support behavioral regulation (Patel, 2021). Parents and teachers repeatedly described improvements in children's listening behavior, waiting ability, and emotional responses during daily interactions. Songs inherently contain repetition, predictable sequences, and rhythmic patterns that may provide children with structured expectations regarding behavioral timing (Patel, 2021). Rhythm and musical predictability may reduce cognitive load because children can anticipate what will happen next, thereby allowing greater attentional resources to be allocated toward self-regulation processes (Ahokas et al., 2025). Recent evidence has highlighted music and rhythm-based activities as promising mechanisms for supporting executive function development because such activities simultaneously involve emotional engagement and cognitive regulation (Bortz et al., 2025).

The qualitative findings further suggest that improvements in inhibitory control may occur through social interaction processes rather than solely through individual cognitive change (Vygotskian perspectives supported by Diamond & Ling, 2020). Teachers frequently reported that children became more coordinated and attentive during group activities, while parents described increased cooperation and patience during interactions at home. This observation aligns with sociocultural perspectives indicating that self-regulation initially develops through social participation before becoming internalized as independent behavior (Diamond & Ling, 2020). Body percussion activities require children to observe peers, synchronize responses, and adjust actions according to collective rhythms, creating repeated opportunities for co-regulation and shared behavioral monitoring (Khanjankhani et al., 2024). Consequently, the intervention may influence inhibitory control not only through individual cognitive stimulation but also through socially mediated learning experiences (Liu et al., 2025).

An additional contribution of the present study concerns the ecological and pedagogical relevance of the intervention. Existing executive function interventions often rely on computerized cognitive training, specialized materials, or highly structured protocols that may limit classroom feasibility (Theroux et al., 2025). In contrast, body percussion and children's songs represent low-cost, accessible, and culturally adaptable activities that can be implemented within everyday educational settings (Khanjankhani et al., 2024). Recent evidence from movement-based interventions indicates that coordinated physical activities can positively affect executive functioning

while remaining highly engaging for children (Liu et al., 2025). Therefore, integrating rhythmic movement activities into regular classroom practices may offer educators a practical approach for strengthening self-regulatory development without introducing substantial resource demands (Bortz et al., 2025).

Despite these promising findings, several considerations should be noted. The present study relied on behavioral reports from parents and teachers rather than direct neurocognitive assessments, which may introduce subjective interpretation (Theroux et al., 2025). Additionally, the absence of a comparison group limits causal interpretation regarding the unique contribution of body percussion activities and children's songs (Creswell & Creswell, 2023). Future studies may benefit from randomized controlled designs, longitudinal approaches, and multimethod assessments combining observational measures, performance-based executive function tasks, and physiological indicators (Lu et al., 2025). Nevertheless, the current findings contribute to a growing body of evidence suggesting that inhibitory control development may emerge effectively through playful, embodied, and socially meaningful learning experiences rather than through isolated cognitive exercises alone (Bortz et al., 2025).

CONCLUSION

The findings of this study indicate that body percussion activities integrated with children's songs have the potential to contribute positively to the development of inhibitory control among preschool children. Quantitative findings demonstrated improvements in inhibitory control scores following the intervention, while qualitative findings from parents and teachers revealed observable changes in children's everyday behaviors, including increased ability to stop actions, wait for turns, regulate emotional responses, follow instructions, and sustain attention during activities. The convergence of these findings suggests that inhibitory control development extends beyond performance on isolated cognitive tasks and may emerge through meaningful behavioral experiences embedded within children's daily environments.

This study further highlights the importance of integrating movement, rhythm, and music within developmentally appropriate learning experiences. Body percussion activities combined with children's songs appear to create cognitively demanding yet enjoyable contexts in which children repeatedly engage in listening, movement coordination, response inhibition, and behavioral regulation. From a theoretical perspective, the findings support embodied and sociocultural views of learning, suggesting that executive function development may occur through active bodily engagement and social participation rather than through direct cognitive training alone. From a practical perspective, the intervention offers a low-cost, accessible, and classroom-friendly approach that can be implemented by teachers and families to strengthen young children's self-regulatory capacities. This study contributes to the growing literature on early childhood executive function interventions by providing evidence that playful and rhythm-based learning experiences may represent a promising pathway for supporting inhibitory control development in ecologically meaningful settings.

LIMITATION & FURTHER RESEARCH

Several limitations should be considered when interpreting the findings of this study. First, the study employed a pretest–posttest design without a comparison or control group, limiting the ability to establish strong causal relationships regarding the effectiveness of body percussion activities integrated with children's songs. Although improvements were observed after the intervention, other contextual factors such as maturation, home experiences, or classroom interactions may also have contributed to the observed changes.

Second, inhibitory control outcomes were primarily assessed through reports from parents and teachers, which may introduce subjective bias associated with perceptions and expectations of children's behavior. Although the use of multiple informants strengthened ecological perspectives,

future studies may benefit from incorporating direct behavioral assessments or performance-based executive function measures to provide more objective evaluations.

Third, the sample size was relatively limited and involved participants from only two geographical locations, namely South Jakarta and Malang. Consequently, the findings may not fully represent broader sociocultural and educational contexts across diverse populations. Variations in family background, school characteristics, and cultural learning practices may influence the effectiveness of rhythm-based interventions.

Future studies are encouraged to employ randomized controlled trials with larger and more diverse samples to strengthen causal interpretation and generalizability. Longitudinal research may also examine whether improvements in inhibitory control are sustained over time and whether these changes contribute to later academic and socioemotional outcomes. Additionally, future investigations may integrate multimethod approaches involving behavioral observations, neurocognitive assessments, physiological measures, and digital tracking tools to provide a more comprehensive understanding of how body percussion and children's songs influence executive function development. Further exploration of culturally responsive musical activities and technology-enhanced rhythm interventions may also expand the applicability of such approaches within contemporary early childhood education settings.

REFERENCES

- Ahokas, J. R., Saarikallio, S., & Eerola, T. (2025). The training of rhythm skills and executive function: A systematic review. *Music & Science*, 8. <https://doi.org/10.1177/20592043241305922>
- Alderson, P., & Morrow, V. (2020). *The ethics of research with children and young people* (2nd ed.). Sage.
- Beisly, A., Lonigan, C. J., & Phillips, B. M. (2024). Development of inhibitory control in Head Start children: Associations with academic outcomes. *Early Childhood Research Quarterly*, 67, 56–67. <https://doi.org/10.1016/j.ecresq.2024.01.003>
- Bortz, G., Ilari, B., Germano, N. D. G., Jackowski, A. P., Cogo-Moreira, H., & Lúcio, P. S. (2025). The impact of music education on children's cognitive and socioemotional development: A quasi-experimental study in the Guri Program in Brazil. *PLOS ONE*, 20(10), e0314355. <https://doi.org/10.1371/journal.pone.0314355>
- Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide*. Sage.
- Candela, A. G. (2019). Exploring the function of member checking. *The Qualitative Report*, 24(3), 619–628. <https://doi.org/10.46743/2160-3715/2019.3726>
- Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum*, 41(5), 545–547. <https://doi.org/10.1188/14.ONF.545-547>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Copple, C., & Bredekamp, S. (2021). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8* (4th ed.). National Association for the Education of Young Children.
- Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). Sage.
- Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). Sage.
- Degé, F., Patscheke, H., & Schwarzer, G. (2020). The influence of music training on motoric and executive function development in preschool children. *Developmental Science*, 23(1), e12977. <https://doi.org/10.1111/desc.12977>
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64(1), 135–168. <https://doi.org/10.1146/annurev-psych-113011-143750>

- Diamond, A. (2020). Executive functions. In J. H. Byrne (Ed.), *Learning and Memory: A Comprehensive Reference* (2nd ed., pp. 225–240). Elsevier. <https://doi.org/10.1016/B978-0-12-809324-5.23874-9>
- Diamond, A., & Ling, D. S. (2020). Review of the evidence on, and fundamental questions about, efforts to improve executive functions. *Frontiers in Psychology, 11*, 540. <https://doi.org/10.3389/fpsyg.2020.00540>
- Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs: Principles and practices. *Health Services Research, 48*(6), 2134–2156. <https://doi.org/10.1111/1475-6773.12117>
- Field, A. (2024). *Discovering statistics using IBM SPSS statistics* (6th ed.). Sage.
- Filipe, M. G., Correia, L., & Martins, I. P. (2023). Executive functions and language skills in preschool children. *Children, 10*(3), 548. <https://doi.org/10.3390/children10030548>
- Gioia, G. A., Espy, K. A., & Isquith, P. K. (2003). *Behavior Rating Inventory of Executive Function—Preschool Version (BRIEF-P)*. Psychological Assessment Resources.
- Graham, A., Powell, M., Taylor, N., Anderson, D., & Fitzgerald, R. (2015). *Ethical research involving children*. UNICEF Office of Research.
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage.
- Khanjankhani, E., Samadi, H., Ahar, S., & Romero-Naranjo, F. J. (2024). The effect of BAPNE body percussion exercises on the balance and executive functions of children with developmental coordination disorder: A preliminary study. *Per Musi, 44*, 1–13. <https://doi.org/10.35699/2317-6377.2024.49095>
- Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science. *Frontiers in Psychology, 4*, 863. <https://doi.org/10.3389/fpsyg.2013.00863>
- Leshem, R., & Yefet, M. (2020). The implications of motor and cognitive inhibition for executive functioning. *Frontiers in Psychology, 11*, 940. <https://doi.org/10.3389/fpsyg.2020.00940>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.
- 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, 16*, Article 1522962. <https://doi.org/10.3389/fpsyg.2024.1522962>
- Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods, 16*(1), 1–13. <https://doi.org/10.1177/1609406917733847>
- Pallant, J. (2020). *SPSS survival manual* (7th ed.). McGraw-Hill.
- Patel, A. D. (2021). Music, biological evolution, and the brain. *Annual Review of Psychology, 72*, 769–791. <https://doi.org/10.1146/annurev-psych-032720-095419>
- Powell, M. A., Graham, A., Taylor, N., Anderson, D., & Fitzgerald, R. (2020). Ethical research involving children: Encouraging reflexive engagement in research with children and young people. *Children & Society, 34*(6), 499–512.
- Psychological Assessment Resources. (2020). *BRIEF-P professional manual*. Psychological Assessment Resources.
- Shonkoff, J. P., & Phillips, D. A. (2000). *From neurons to neighborhoods: The science of early childhood development*. National Academies Press.
- Taherdoost, H. (2022). What are different research approaches? Comprehensive review of qualitative, quantitative, and mixed-methods research. *Journal of Management Science and Engineering Research, 5*(1), 53–68.
- Tashakkori, A., & Teddlie, C. (2021). *Handbook of mixed methods in social and behavioral research* (2nd ed.). Sage.
- Williams, K. E., & Berthelsen, D. (2019). Implementation of rhythm and movement intervention to support self-regulation skills of preschool-aged children. *Psychology of Music, 47*(6), 800–

820. <https://doi.org/10.1177/0305735619861433>

Zamanzadeh, V., Ghahramanian, A., Rassouli, M., Abbaszadeh, A., Alavi-Majd, H., & Nikanfar, A. R. (2015). Design and implementation content validity study: Development of an instrument for measuring patient-centered communication. *Journal of Caring Sciences, 4*(2), 165–178. <https://doi.org/10.15171/jcs.2015.017>