Music-Based Intervention as a Strategy to Improve Attention and Information Processing in Children with Special Needs : Literature Review

Anne Effane[1] , Rizki Umar Ali[2]

[1]Universitas Djuanda, anne.effane@unida.ac.id

[2]Universitas Djuanda, rizki.umar2019@unida.ac.id

Abstract

Children with Special Needs (ABK) often experience challenges in core cognitive functions, particularly attention regulation and stimulus processing, which impact learning engagement and adaptability. Multisensory and adaptive interventions are needed to address these needs. This article aims to synthesize scientific evidence regarding the role of music-based interventions as a strategy for strengthening cognitive functions through a *Systematic Literature Review* (SLR) approach. The method used is a systematic review of national and international journal articles, including empirical studies, *systematic reviews* , and *meta-analyses* , with descriptive-qualitative analysis and narrative synthesis. The results of the study indicate that structured music interventions that require children's active participation consistently contribute to improvements in attention control, attention flexibility, and focus stability. In addition, music interventions also show potential in supporting aspects of cognitive processing such as stimulus organization, sequencing ability , working memory, and response speed, although findings in these domains still show variation between studies. The implications of this study emphasize the importance of music as a neurocognitive stimulus that can be integrated into special education practices and evidence-based therapy services. The limitations of this study lie in the heterogeneity of research designs and measurement instruments used in the reviewed literature. The novelty of this article lies in its targeted synthesis linking the neurocognitive mechanisms of music with the mapping of specific cognitive outcomes within a single integrative framework, thus strengthening the theoretical and practical basis for the use of music interventions in special populations.

Keywords: cognitive regulation, multisensory stimulation, musical rhythm, executive function, narrative synthesis

INTRODUCTION

Children with Special Needs (ABK) are a group of children who experience developmental challenges in one or more aspects of cognitive, behavioral, sensory, and social functioning, such as children with Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), Down Syndrome, and specific learning disabilities. One of the main problems that often arise in this group is limited attention and information processing abilities. These challenges directly impact their ability to follow instructions, maintain focus, and organize and respond effectively to stimuli in the learning process and social interactions. (Kasuya-Ueba et al., 2020) . Thus, the need for intervention strategies that can increase focus, cognitive engagement, and information processing efficiency becomes crucial in both special education and therapy contexts.

Attention is fundamental to the development of advanced cognitive functions, including working memory, executive function, and problem-solving abilities. Attention deficits that persist from an early age are correlated with lower academic achievement and increased maladaptive behavior in school-aged children. In children with ASD and ADHD, attentional limitations are often accompanied by difficulties in processing information sequentially and integratedly, thus hindering the success of conventional educational interventions (Ke et al., 2022 ; Gao et al., 2025) . This condition shows that increasing attention and information processing cannot be seen as separate abilities, but rather as a series of interrelated cognitive processes that determine the quality of children's learning.

Various intervention approaches have been developed to improve the cognitive function of children with special needs, including behavioral therapy, cognitive training, sensory integration, and pharmacological interventions. However, a multisensory, adaptive, and minimally side-effect approach is considered more appropriate for the characteristics of children with special needs. Music, as a structured auditory stimulus rich in rhythm, tempo, and melody, can simultaneously activate various brain areas, including the prefrontal cortex, temporal lobe, cerebellum, and limbic system, which play a role in attention, working memory, and emotional regulation (Mina et al., 2021 ; Kanzari et al., 2025) . This multisystem activation is the theoretical basis for why music is considered potential to strengthen cognitive engagement and support the learning process of children with special needs.

Music-Based Intervention (MBI) is a therapeutic approach that systematically utilizes music through active activities such as rhythm games, singing, *call-and-response* , and the integration of music and movement. Unlike using music as a passive stimulus, MBI positions children as active participants in structured musical experiences. Experimental research shows that active musical activities are more effective in improving attentional control than non-musical activities with the same level of engagement (Kasuya-Ueba et al., 2020) . In other words, the power of MBI lies not only in the "music" aspect itself, but also in the structure of the activities, which require attention, pattern prediction, and sequential responses.

Several *systematic reviews* and *meta-analyses* have strengthened the empirical evidence regarding the effectiveness of music interventions in children with ASD. Ke et al. (2022) reported that *music therapy* had a positive impact on adaptive behavior, attention, and social engagement, although the level of effectiveness varied across domains. More recent findings by Gao et al. (2025) showed that music interventions produced moderate to significant effects in improving behavioral symptoms in children with ASD (SMD = −0.66), which was indirectly related to improved attention regulation and information processing. This variation in effectiveness indicates the importance of reviewing the literature linking the form of music intervention to specific cognitive outcomes, so that implementation recommendations can be more targeted.

Furthermore, a recent systematic review confirmed that the benefits of MBIs are not limited to behavioral aspects, but also encompass the neurocognitive mechanisms underlying attention and information processing. Music with a consistent rhythmic structure serves as an *external temporal scaffold* that helps children organize stimuli, maintain focus, and increase response speed to auditory information (Ke et al., 2022 ; Gao et al., 2025) . Synchronizing musical rhythm with cognitive

activity also contributes to strengthening neural networks involved in attentional control. (Kasuya-Ueba et al., 2020) . Theoretically, this strengthens the argument that music is not merely a supporting medium, but a stimulus that can facilitate attention regulation through predictable temporal structures. In the context of information processing, the sequential and repetitive structure of music facilitates *sequencing skills* , working memory, and sensory integration. Music combines auditory, visual, and motor stimuli simultaneously, thus helping children process multiple pieces of information in parallel without excessively increasing cognitive load. (Mina et al., 2021 ; Kanzari et al., 2025) . This approach is particularly relevant for children with special needs who tend to have difficulty managing complex sensory input, as music can simplify stimuli into meaningful, consistent, and easy-to-follow patterns.

To provide an empirical overview of the contribution of Music-Based Intervention to improving attention and information processing in children with special needs, Table 1 presents a summary of relevant previous research.

Table 1. Summary of Research on Music-Based Intervention for Children with Special Needs

Researchers	Year	Subject Characteristics	Music-Based Intervention Form	Key Findings
Kasuya-Ueba et al.	2020	Children aged 6–9 years	Musical Attention Control Training (MACT)	Improved attentional control and attention switching
Suyanto & Wimbarti	2019	ADHD children	Structured music intervention program	Decreased hyperactivity and increased focus
Mina et al.	2021	Children with learning disabilities	Active and multisensory music therapy	Improved working memory and auditory processing
Divanovena	2025	Children with Down Syndrome	Preference-based music	Extended focus span and emotional stability
Kanzari et al.	2025	ASD children	Integration of music and motor activities	Improved cognitive function and behavioral regulation

Table 1 shows that Music-Based Intervention has been applied to various groups of children with special needs with different characteristics and needs. Despite variations in intervention forms and research designs, all summarized studies reported positive impacts of MBIs on attention and/or information processing. These findings indicate that music functions as an effective cognitive stimulus, both in improving selective focus, prolonging attention span, and supporting the organization and integration of sensory information. Overall, the empirical evidence summarized in the table strengthens the argument that Music-Based Intervention is a relevant, flexible, and adaptable approach in special education and clinical therapy contexts. However, differences in intervention types, durations, and measured outcomes suggest the need for a comprehensive

literature review to synthesize these findings. Therefore, this *literature review* aims to integrate scientific evidence regarding the effectiveness of Music-Based Intervention in improving attention and information processing in children with special needs.

Based on this explanation, this research is guided by the main questions: (1) To what extent is Music-Based Intervention effective in improving attention (selective focus, attention span, and distraction control) in children with special needs? and (2) To what extent is Music-Based Intervention effective in improving information processing (stimulus organization, *sequencing* , working memory, and response speed) in children with special needs? These questions are elaborated to ensure that the literature synthesis is not only general, but targets specific cognitive outcomes that align with the needs of educational and therapeutic practice.

Specifically, this *literature review* aims to: (1) identify the forms of Music-Based Intervention most frequently used in children with special needs; (2) summarize empirical findings related to the impact of MBI on the attention component; (3) summarize empirical findings related to the impact of MBI on the information processing component; and (4) identify factors that influence variations in the effectiveness of MBI, such as the type of special needs, intervention characteristics, and implementation context (Kasuya-Ueba et al., 2020) ; Ke et al., 2022 ; Mina et al., 2021 ; Kanzari et al., 2025) . Thus, this article positions MBI as an evidence-based intervention strategy oriented towards strengthening core cognitive functions.

The author's main position or argument in this article is that Music-Based Intervention is a strategy that is not only practically relevant, but also has a strong neurocognitive theoretical basis for improving attention and information processing in children with special needs, especially when the intervention is designed in a structured, consistent manner, and involves the child's active participation (Mina et al., 2021 ; Kanzari et al., 2025) . The focus of the problem in this study is narrowed down to two main cognitive domains, namely attention and information processing, because both are prerequisites for successful learning and social adaptation of children with special needs (Kasuya-Ueba et al., 2020 ; Ke et al., 2022) .

The *scope and limitations* of this *literature review* include: populations with special needs (ASD, ADHD, Down Syndrome, and learning disabilities), interventions that explicitly use music as a primary component (not just background music), and outcomes directly related to indicators of attention and information processing. This review did not focus on purely non-cognitive outcomes (e.g., only social behavior without cognitive links) unless they were reported to be related to attention regulation or information processing (Gao et al., 2025 ; Ke et al., 2022) . Furthermore, because the literature has a variety of designs and measurement instruments, the results of the synthesis may show heterogeneity in findings.

The novelty of this article lies in presenting a targeted synthesis that connects: (a) empirical evidence of the effectiveness of MBIs, (b) theoretical mechanisms of music as a rhythmic and multisensory stimulus, and (c) mapping specific cognitive outcomes (attention and information processing) across categories of children with special needs within a single integrative framework. Thus, this study is expected to not only conclude that "music is beneficial," but also explain *why* , *in what*

aspects , and *under what conditions* MBIs are most effective (Mina et al., 2021 ; Kanzari et al., 2025 ; Kasuya-Ueba et al., 2020) .

As a content map, this article is structured as follows: The first section explains the introduction and urgency of the study; The second section explains the theoretical basis of music as a neurocognitive stimulus, rhythm for attention, and music in information processing; The third section explains the *Systematic Literature Review method* used for the selection and synthesis of studies; The fourth section presents the results and discussion in the form of a summary of findings and interpretations based on theory; and The final section presents conclusions, educational/therapeutic implications, and recommendations for further research.

THEORETICAL BASIS

1.1 Music And Activation Brain

Music is a complex auditory stimulus that combines rhythm, melody, harmony, and timbre, and is therefore processed through a broad and integrated neural network. The distinct temporal structure of music means that its processing involves not only the auditory cortex but also cross-network integration connecting the auditory system with motor and cognitive control systems. This integration explains the emergence of directional responses, such as following the beat or adjusting responses to changes in patterns, suggesting the involvement of predictive and timing mechanisms *in* music processing. (McAdams & Giordano, 2009 ; (Zatorre et al., 2007) .

Neurocognitively, music functions as a multisystem stimulus that activates brain areas related to executive function and attention (prefrontal cortex), sound and language processing (temporal lobe), cognitive-motor rhythm synchronization (cerebellum), and emotional and motivational regulation (limbic system) (Habibi et al., 2014 ; Koelsch, 2014) . Structured music interventions have been reported to correlate with improved *attention control* and *attention switching* , reflecting the involvement of prefrontal-based attention control mechanisms (Kasuya-Ueba et al., 2020). Flexibility of musical parameters such as tempo, rhythm, and pattern complexity making music easily adaptable to the needs of children with special needs, although the literature still shows limitations in mapping specific musical parameters to certain cognitive domains (Kasuya-Ueba et al., 2020 ; Kanzari et al., 2025) .

1.2 Music as a Rhythmic Stimulus For Attention

Rhythm is a fundamental element of music that provides a stable and predictable temporal structure, thus functioning as an *external auditory cue* in regulating attention. Theoretically, rhythm helps focus attention on relevant stimuli and reduces distractions by aligning neural activity to regular temporal patterns. Attention includes several components, such as selective attention, sustained attention, and attentional control; rhythm is seen as being able to facilitate all three because it provides an "external anchor" that helps individuals direct and maintain focus for a certain duration (Thaut et al., 2008) .

Empirically, rhythmic activity-based music interventions have been reported to improve *attention control* and *attention switching* in school-aged children, indicating enhanced flexibility

and attention regulation (Kasuya-Ueba et al., 2020) . These findings are supported by reports in educational and therapeutic contexts showing that music with moderate tempo and simple rhythms improves the concentration of children with autism during learning activities (Aulia, 2020) . The primary mechanism explaining this effect is *rhythmic entrainment* , the tendency of the neural system to align itself with external time patterns, thereby assisting in the regulation of response timing and focus transitions (Thaut et al., 2008 ; Ke et al., 2022) . However, some literature still reports general improvements in "concentration" without distinguishing specific attentional components. Therefore, rhythm in this study is positioned as a key theoretical pathway bridging Music-Based Intervention with improvements in more targeted attentional components.

1.3 Music And Processing Information

Information processing encompasses a series of cognitive processes ranging from stimulus reception, encoding, temporary storage in working memory, to generating a response. Music provides a clear internal structure through temporal patterns and repetition, thus functioning as *a scaffold* that helps children organize sensory input and reduce processing complexity, especially in multisensory contexts (Sousa, 2016) . Within a conceptual framework, music supports input organization, strengthening working memory through repetitive patterns, sequential processing (*sequencing*), and increasing response speed through predictable time structures.

Research synthesis indicates that structured musical experiences are correlated with strengthening basic cognitive abilities, particularly in managing auditory and visual stimuli simultaneously, as well as in remembering sequences and anticipating subsequent information (Prasetyo, 2020) . Music interventions involving active activities, such as following rhythmic patterns or playing simple instruments, have been reported to improve working memory and auditory attention, which are directly related to information processing (Mina et al., 2021) . However, the literature still shows heterogeneity in definitions and measurement instruments for information processing, as well as a tendency to focus on behavioral outcomes without explicitly mapping cognitive domains. Therefore, this study positions information processing as a specific cognitive outcome synthesized through four main components: sensory input organization, working memory strengthening, sequencing, and response speed (Kasuya-Ueba et al., 2020) .

3.3 Theoretical Framework of the Study

The theoretical framework of this study was developed based on a synthesis of theory and research findings, which confirm that attentional and information processing impairments in children with special needs (ABK) require an intervention approach capable of reaching the underlying neurocognitive mechanisms. Music-Based Intervention (MBI) is positioned as a primary intervention strategy due to its multisensory, temporally structured, and adaptive characteristics to the child's needs. To clarify the relationship between the ABK's initial condition, the intervention implemented, the mechanism of action, and the expected cognitive impact, the theoretical framework of this study is visualized in the form of a conceptual diagram as shown in Figure 1.

Figure 1. Theoretical Framework of Music-Based Intervention on Attention and Information Processing in Children with Special Needs

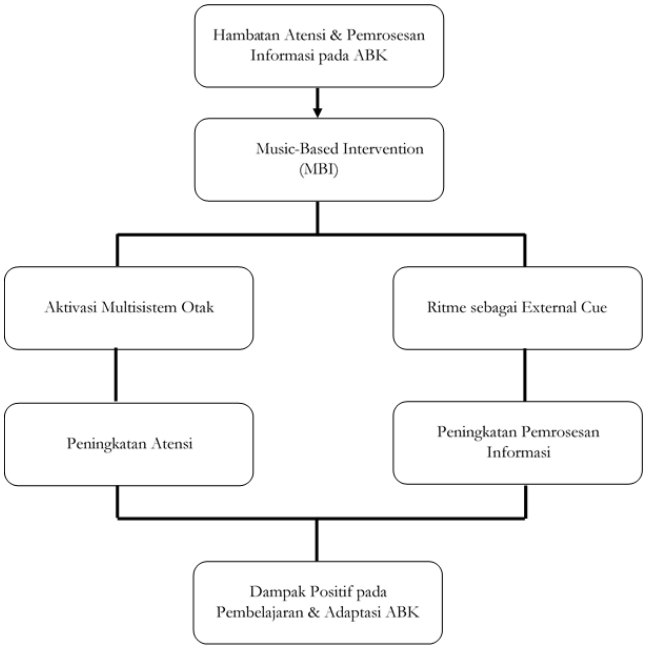

Figure 1 shows that Music-Based Intervention (MBI) acts as a bridge between attentional and information processing barriers in children with special needs and the expected positive impact. MBI works through two parallel mechanisms: multisystem brain activation and musical rhythm as an *external cue* . Multisystem brain activation contributes to increased attention through the involvement of prefrontal, temporal, cerebellar, and limbic networks, while musical rhythm supports increased information processing through *rhythmic entrainment mechanisms* that facilitate stimulus organization, *sequencing* , working memory, and response speed. Improvements in both cognitive aspects simultaneously lead to positive impacts on the learning and adaptation of children with special needs, so this framework provides a conceptual basis for interpreting the effectiveness of Music-Based Intervention in this literature review (Thaut et al., 2008 ; Kasuya-Ueba et al., 2020 ; Sousa, 2016 ; Mina et al., 2021) .

METHOD

Type of Research/Study Design

This study used a Systematic Literature Review (SLR) approach with a descriptive-qualitative design. The SLR approach was chosen because the study aims to systematically examine, review, and synthesize the results of previous studies that discuss the effectiveness *of Music-Based Intervention* on improving attention and information processing in children with special needs. The descriptive-qualitative design allows researchers to describe and interpret scientific findings in depth without manipulating variables, thus aligning with the characteristics of library research that uses documents as the primary data source (Herlina et al., 2025) . In the context of educational research, this design provides space to gain a comprehensive understanding of the phenomenon being studied through a systematic analysis of relevant literature. (Rukminingsih et al., 2020) .

The data sources for this study were national and international scientific journal articles discussing music-based interventions for children with special needs, including empirical research, *systematic reviews* , and *meta-analyses* that reported cognitive outcomes in the form of attention and/or information processing. The literature selection process was carried out systematically by applying inclusion and exclusion criteria to maintain the relevance and quality of the studies. Inclusion criteria included articles involving children with special needs, using *Music-Based Intervention* or *music therapy* as the main intervention, reporting attention and/or information processing outcomes, and being available in full text. Exclusion criteria included non-scientific articles, research with adult subjects, and studies that did not explicitly discuss aspects of attention or information processing (Herlina et al., 2025 ; Akmal et al., 2025) .

Data collection was conducted through documentation studies, namely collecting data from written documents in the form of journal articles, scientific books, and relevant research reports. Literature searches were conducted systematically through scientific databases using keywords related to *music-based intervention* , *music therapy* , attention, information processing, and children with special needs. The collected data were analyzed using a descriptive-qualitative analysis approach with a narrative synthesis method, through the stages of data reduction, grouping based on subject characteristics and forms of music intervention, and drawing interpretive conclusions. This approach allows the integration of cross-study findings into a coherent conceptual framework and is presented in the form of narrative descriptions and synthesis tables (Rukminingsih et al., 2020 ; Herlina et al., 2025) .

RESULTS AND DISCUSSION

Systematic Literature Review process , the reviewed studies show that *Music-Based Intervention* (MBI) has been applied to various groups of children with special needs, including children with ASD, ADHD, Down Syndrome, and learning disabilities. The forms of intervention used include active *music therapy* , rhythmic games, structured singing, *call-and-response* , and the integration of music and movement. The duration of interventions varies, from a single, short session to repeated intervention programs over several weeks. In general, most studies report a positive impact of MBI on aspects of attention and/or information processing, although with varying levels of effectiveness across domains and study designs (Ke et al., 2022; Gao et al., 2025).

Table 2. Synthesis of Findings of Music-Based Intervention on Attention and Information Processing in Children with Special Needs

Researchers	Year	ABK Group	MBI Form	Measured Cognitive Outcomes	Key Findings
Kasuya-Ueba et al.	2020	School-age children	Musical Attention Control Training	Attention control, attention switching	Significant improvement in attentional control and flexibility
Suyanto & Wimbarti	2019	ADHD	Structured music program	Focus on learning, hyperactivity	Decreased hyperactivity and increased focus duration
Mina et al.	2021	Learning disorders	Active & multisensory music therapy	Working memory, auditory processing	Improved working memory and auditory processing
Divanovena	2025	Down Syndrome	Preference-based music	Attention span, emotional stability	Extended focus and more stable emotional regulation
Kanzari et al.	2025	ASD	Music + motor activities	Response speed, behavioral regulation	Improved cognitive-motor coordination and behavioral regulation

Table 2 shows that *music-based interventions* are consistently associated with improvements in attention and information processing across various groups of children with special needs, despite variations in intervention formats and outcome indicators. In the attention domain, improvements were most frequently reported in attentional control and the ability to shift focus, particularly in interventions that required active participation and responsiveness to changing stimuli (Kasuya-Ueba et al., 2020) . In children with ADHD, music functions as an *external regulator* , helping to reduce hyperactivity and maintain focus through a consistent time structure (Putri et al., 2024 ; Thaut et al., 2008) .

In the information processing domain, synthesized results indicate that music impacts working memory, sequencing, auditory processing, and response speed, although most studies report these outcomes indirectly. The repetitive and organized structure of music helps children manage sensory input, remember patterns, and process information incrementally, thus functioning as a *cognitive scaffold* that reduces cognitive load. (Prime, 2022; Mina et al., 2021) . The integration of music and motor activities in children with ASD also strengthens the stimulus timing and prediction mechanisms that underlie efficient information processing (Reagan et al., 2022) .

Findings related to Increasing Attention in Children with Special Needs

Based on the synthesis of research results summarized in Table 2, the most consistent improvement in attention through *Music-Based Intervention* (MBI) was seen in the components of attention control and attention switching . A study by Kasuya-Ueba et al. (2020) showed that *Musical Attention Control Training* significantly improved the speed and flexibility of attentional responses in school -age children , particularly in tasks requiring rapid adjustment to changing stimuli. Musical activities that require active responses to rhythmic patterns, tempo changes, and auditory cues have been shown to train executive control mechanisms that play a role in attention regulation. These findings reinforce the assumption that music serves not only as a background stimulus but also as a means of cognitive training that directly and repeatedly engages attentional processes.

Similar results were also found in children with ADHD, where a structured music intervention program was reported to be effective in reducing hyperactivity levels and increasing focus duration during learning activities (Suyanto & Wimbarti, 2019) . Music acts as *an external regulator* that provides a consistent and predictable time structure, thereby helping children maintain attention and reducing the tendency for distraction. From a neurocognitive perspective, these findings align with *external cueing* and *rhythmic entrainment theories* , which explain that musical rhythm can align neural activity with external time patterns, thereby increasing the stability and efficiency of the attentional system. (Thaut et al., 2008) . In other words, rhythm functions as a "temporal anchor" that helps children direct and maintain focus on the task at hand .

Furthermore, several studies in this review also showed that attentional improvements through MBIs were more pronounced in learning or therapy situations that involved active child participation, such as *call-and-response* , rhythmic games, or music-motor activities. These activities require children to continuously monitor stimuli, anticipate changes, and adjust responses quickly, thus strengthening aspects of attentional control and flexibility. These findings indicate that intervention designs that position children as active participants have greater potential to improve attentional quality than passive use of music.

However, a literature synthesis also shows that not all components of attention experience the same improvement. Several studies report that sustained attention *and* divided attention *do* not always show significant changes after music intervention, especially in short-duration interventions or those with low activity complexity (Kasuya-Ueba et al., 2020) . This indicates that the effectiveness of MBIs on attention is strongly influenced by the duration of the intervention, the intensity of the training, and the cognitive demands of the musical activity used. Thus, music tends to be more effective in improving attentional control and flexibility than maintaining attention over long durations, unless the intervention is designed progressively and continuously.

Overall, these findings suggest that music-based intervention has strong potential as a strategy to improve attention in children with special needs, particularly in the areas of control and distraction. However, optimizing these benefits depends heavily on intervention design that takes into account the child's characteristics, duration of implementation, and level of active engagement in musical activities.

Findings related to Information Processing

In addition to improving attention, the results of *a Systematic Literature Review* indicate that Music-Based Intervention (MBI) also impacts various components of information processing, although these outcomes are often reported indirectly through derived cognitive indicators. Studies implementing active *music therapy* and a multisensory approach report improvements in working memory, auditory processing, and the ability to follow stimulus sequences (sequencing), particularly in children with learning disabilities and Down Syndrome (Mina et al., 2021 ; Divanovena, 2025) . These findings indicate that music not only functions as a trigger for attention, but also as a means to strengthen information processing processes that involve temporary storage, integration, and transformation of stimuli into meaningful responses.

Mechanistically, the repetitive, organized, and predictable structure of music helps children manage complex sensory input by simplifying information into meaningful patterns. Musical activities such as singing sequences, following rhythmic patterns, and responding to musical cues train children to retain information in working memory, recognize relationships between stimuli, and anticipate subsequent stimuli (Lwin et al., 2008; Yulianti, 2022). Within the framework of information processing, music acts as a *cognitive scaffold* that aids the encoding, organization, and retrieval of information, while simultaneously reducing cognitive load, which is often a major obstacle for children with special needs (Sousa, 2016 ; Mina et al., 2021) .

Furthermore, several studies confirm that integrating music with motor activities provides additional contributions to information processing, particularly in children with Autism Spectrum Disorder (ASD). Kanzari et al. (2025) reported that the combination of musical rhythm and coordinated movement is associated with increased response speed, behavioral regulation, and cognitive-motor coordination. Synchronization between rhythm and movement helps children predict stimulus *timing* , adjust responses, and strengthen the predictive and timing mechanisms *that* underpin efficient information processing. Thus, MBIs support not only static aspects of information processing (such as working memory), but also dynamic aspects related to the speed and accuracy of responses to the environment.

However, the synthesis also revealed variability in reporting information processing outcomes. Some studies focused more on behavioral changes or emotional regulation without explicitly measuring information processing components such as *sequencing* or *processing speed* . This suggests a methodological gap, as the impact of music on information processing has not always been measured directly and in a standardized manner. Therefore, while the existing evidence supports the positive role of MBIs on information processing, these findings require further research using specific cognitive indicators and more consistent measurement instruments.

Synthesis of Findings against Research Questions

Based on the results of *the Systematic Literature Review* , the answer to the first research question indicates that Music-Based Intervention (MBI) is consistently effective in improving certain components of attention in children with special needs, specifically attention control, attention switching *,* and attention duration within the context of structured activities. Findings across studies indicate that these effects are most pronounced in interventions that place children as active participants, for example through rhythmic games, *call-and-response* , and musical activities that

require rapid responses to changing stimuli (Kasuya-Ueba et al., 2020) . The steady rhythm of music serves as an *external cue* that helps children direct and maintain focus, while also training attentional flexibility when patterns or instructions change (Ke et al., 2022). Thus, MBI not only improves the ability to "pay attention," but also strengthens aspects of executive control that underlie attention regulation.

Furthermore, the synthesis of findings also indicates that the effectiveness of MBIs on attention is significantly influenced by intervention characteristics, such as the duration, intensity, and complexity of the musical activity. Interventions that are longer in duration and involve consistent rhythmic structures tend to have a more stable impact on sustained attention than brief or passive interventions (Kasuya-Ueba et al., 2020; Ke et al., 2022). This implies that music works optimally as an attentional regulation tool when used in a planned and repeated manner, rather than simply as a momentary supportive stimulus.

Answering the second research question, the study results indicate that Music-Based Intervention also has the potential to improve information processing in children with special needs, particularly in aspects of stimulus organization, *sequencing ability* , working memory, and response speed. However, compared to the attention domain, empirical evidence on information processing shows greater variation between studies. Some studies report improvements in auditory processing ability and working memory after active music intervention, while others highlight improvements in behavioral regulation and cognitive-motor coordination as indirect indicators of more efficient information processing (Idarianty et al., 2025 ; Gao et al., 2025) . This variation suggests that the impact of MBIs on information processing is often multidimensional and not always measured through the same cognitive indicators.

Overall, this synthesis confirms that MBIs have a more consistent direct impact on attention regulation, while their effects on information processing tend to emerge through supporting mechanisms, such as improved activity structure, reduced cognitive load, and enhanced stimulus predictability. This situation highlights the importance of using more specific and standardized measurement instruments to more accurately map changes in the information processing domain. Thus, the findings of this study not only answer the research questions but also identify methodological development directions for future research to enable a more comprehensive and precise understanding of the effectiveness of Music-Based Intervention.

Critical Discussion and Implications

Overall, the findings in this study strengthen the position of *Music-Based Intervention* (MBI) as a relevant and evidence-based intervention strategy for children with special needs, particularly in improving attention regulation and supporting information processing. The consistency of findings across studies suggests that the effectiveness of MBI lies not solely in the element of music as a pleasant stimulus, but rather in the temporal, rhythmic structure, and active response demands inherent in musical activities. This structure allows music to function as an *external cognitive scaffold* that helps children regulate focus, anticipate stimuli, and process information sequentially, especially in conditions where internal attention regulation is still limited.

From a neurocognitive perspective, these findings strengthen the theoretical framework that positions music as a multisystem stimulus that activates the prefrontal (attentional control),

temporal (auditory processing), cerebellar (timing and coordination), and limbic (motivation and emotional engagement) systems. The simultaneous activation of these networks explains why MBIs tend to be effective on aspects of attentional control and cognitive flexibility, as well as having indirect effects on information processing such as working memory and sequencing. Thus, MBIs can be understood not as an adjunctive approach , but as an intervention that is inherently aligned with the brain's mechanisms of attention and information management.

The practical implications of these findings are significant for special education and therapy contexts. First, MBI has the potential to be an adaptive, flexible, and minimally invasive intervention strategy, particularly for children who are less responsive to conventional verbal or cognitive approaches. Musical parameters such as tempo, rhythm, pattern complexity, and activity format (active vs. passive) can be gradually modified according to the child's sensory needs and tolerance profile. Second, the study results indicate that active child involvement is a key factor in intervention success, so using music as a passive background tends to be less optimal than musical activities that require direct response and participation.

However, this review also identified several limitations in the reviewed literature. Heterogeneity in study designs, variations in intervention duration and form, and differences in measurement instruments make direct comparisons between studies difficult and limit the generalizability of findings. Furthermore, many studies report improvements in implicit information processing through behavioral indicators or auditory processing, without clear mapping to specific cognitive components such as working memory, sequencing, or response speed. This situation indicates a *methodological gap* in MBI research, particularly regarding the standardization of definitions and measurement of cognitive outcomes.

Based on these findings, further research is recommended to use more robust experimental designs, such as *randomized controlled trials* with clear comparison groups, adequate intervention duration, and the use of more specific and standardized measurement instruments for attention and information processing. Furthermore, future research should explore the relationship between specific musical parameters (e.g., tempo or rhythmic complexity) and specific cognitive domains, so that recommendations for MBI implementation can be more precise and mechanism-based. By strengthening these methodological aspects, Music-Based Intervention has the potential to be developed as an intervention approach that is not only empirically effective, but also theoretically sound and applicable in the practice of education and therapy for children with special needs.

CONCLUSION

Based on the results of *a Systematic Literature Review* of relevant studies, it can be concluded that *Music-Based Intervention* (MBI) is an effective and evidence-based intervention strategy in improving attention and supporting information processing in children with special needs, including children with ASD, ADHD, Down Syndrome, and learning disabilities. The effectiveness of MBI is most consistently seen in improving attention control, attention switching ability , and attention duration in the context of structured activities that require the child's active participation.

In addition to attention, MBIs also show positive potential in supporting information processing, particularly in stimulus organization, auditory processing, *sequencing* , working memory, and

response speed. The rhythmic, sequential, and repetitive structure of music acts as an *external cognitive scaffold* that helps children manage sensory input and process information more systematically. However, empirical evidence regarding information processing still shows variation, primarily due to differences in measurement indicators and outcome reporting, which are not always specific.

Theoretically, the findings of this study confirm that the effectiveness of MBI can be explained by the multisystem brain activation mechanism and the function of rhythm as *an external cue* that supports simultaneous attention regulation and information processing. Practically, MBI has the potential to be an adaptive, flexible, and easily integrated intervention approach in special education and therapy contexts. However, to strengthen the evidence base, further research is needed using a more robust experimental design, adequate intervention duration, and more standardized and specific cognitive outcome measures. Thus, Music-Based Intervention can be developed as an intervention strategy that is not only pedagogically appealing, but also neurocognitively robust and applicable for children with special needs.

BIBLIOGRAPHY

Akmal, AN, Maelasari, N. & Lusiana, L. (2025). Understanding Deep Learning in Education: Literature Analysis through the Systematic Literature Review (SLR) Method. *JIIP-Scientific Journal of Educational Sciences, 8(3)* , 3229–3236. https://doi.org/https://doi.org/10.54371/jiip.v8i3.7442

Aulia, SM (2020). Music education as a stimulant for the concentration of autistic children at the Ananda Padang partner autism school. *HANDAYANI JOURNAL OF PGSD FIP UNIMED* , *11(2)* , 55–67.

Divanovena, GP (2025). Preference-Based Music Intervention for Concentration Management in Children with Down Syndrome. In *Skripsi thesis, Indonesian Institute of the Arts Yogyakarta* .

Gao, X., Xu, G., Fu, N., Ben, Q., Wang, L. & Bu, X. (2025). The effectiveness of music therapy in improving behavioral symptoms among children with autism spectrum disorders: a systematic review and meta-analysis. *Frontiers in Psychiatry* , *15* (1511920). https://doi.org/https://www.frontiersin.org/journals/psychiatry/articles/10.3389/fpsyt.2024.1511920/full

Habibi, Assal & Damasio, A. (2014). Music, feelings, and the human brain. *Psychomusicology: Music, Mind, and Brain* , *24(1)* , 92. https://doi.org/https://psycnet.apa.org/buy/2014-13444-009

Herlina, L., Dachlian, D., Layyinnati, I., Sa'diyah, Z., Aurora, A., Darsimon, Hidayati, NN, Amri, S., Ariyati, E. & Arisona, RD (2025). *Educational Research Methodology* . HN Publishing.

Idarianty, Hartati, S. & Safitri, S. (2025). The Influence of Music on Cognitive Development and Focus Training in Early Childhood. *PrimEarly: Journal of Elementary Education and Early Childhood Studies* , *8(1)* , 59–69. https://doi.org/https://doi.org/10.37567/primearly.v8i1.3927

Kanzari, C., Hawani, A., Mkaouer, B., Mrayeh, M., Marsigliante, S. & Muscella, A. (2025). Cognitive, social, and behavioral effects of music and motor intervention in children with autism spectrum disorder: the role of time of day. *Frontiers in Pediatrics* , *13* (1683930). https://doi.org/https://www.frontiersin.org/journals/pediatrics/articles/10.3389/fped.20

25.1683930/full

Kasuya-Ueba, Y., Zhao, S. & Toichi, M. (2020). The effect of music intervention on attention in children: Experimental evidence. *Frontiers in Neuroscience* , *14* (757). https://doi.org/https://www.frontiersin.org/journals/neuroscience/articles/10.3389/fnins.2020.00757/full

Ke, X., Song, W., Yang, M., Li, J. & Liu, W. (2022). Effectiveness of music therapy in children with autism spectrum disorder: A systematic review and meta-analysis. *Frontiers in Psychiatry* , *13* . https://doi.org/https://doi.org/10.3389/fpsyt.2022.905113

Koelsch, S. (2014). Brain correlates of music-evoked emotions. *Nature Reviews Neuroscience* , *15(3)* , 170–180. https://doi.org/https://www.nature.com/articles/nrn3666

McAdams, S. & Giordano, B. L. (2009). The perception of musical timbre. *Oxford Handbooks Online* , 72–108. https://doi.org/https://doi.org/10.1093/oxfordhb/9780199298457.013.0007

Mina, F., Darweesh, MES, Khattab, A.N. & Serag, S.M. (2021). Role and efficacy of music therapy in learning disabilities: a systematic review. *The Egyptian Journal of Otolaryngology* , *37(1)* (31). https://doi.org/https://link.springer.com/article/10.1186/s43163-021-00091-z

Perdana, F. (2022). Traditional Music for Early Childhood Cognitive Development. *ASGHAR: Journal of Children Studies* , *2(1)* , 81–92. https://doi.org/https://doi.org/10.28918/asghar.v2i1.5772

Prasetyo, N. (2020). Children, Creativity and Their Arts (Music). In *Deepublish* .

Putri, NT, Asthiningsih, NWW & Milkhatun. (2024). The Effect of Music Therapy on Reducing Hyperactivity in Children with Attention Deficit Hyperactivity Disorder (ADHD): Literature Review. *JKM: Jurnal Keperawatan Merdeka* , *4(1)* , 7–17. https://doi.org/https://doi.org/10.36086/jkm.v4i1.2064

Reagan, J., Zoller, L. & Brown, M. (2022). Effectiveness of Physical Therapy and/or Music Therapy On Enhancing Motor Skills in Children With ASD: A Systematic Review. *Physical Therapy and Movement Sciences* . https://doi.org/https://scholarworks.utep.edu/dpt_cap/10

Rukminingsih, Adnan, G. & Latief, MA (2020). EDUCATIONAL RESEARCH METHODS QUANTITATIVE RESEARCH, QUALITATIVE RESEARCH, CLASSROOM ACTION RESEARCH. In *ERHAKA UTAMAA* . https://doi.org/https://www.researchgate.net/publication/343179796_METODE_PENELITIAN_PENDIDIKAN_Kuantitatif_Kualitatif_Penelitian_Taksikan_Kelas

Sousa, D. A. (2016). How the special needs brain learns. In *Corwin Press* .

Suyanto, BN & Wimbarti, S. (2019). Music intervention program for hyperactivity in children with attention deficit hyperactivity disorder (ADHD). *Gadjah Mada Journal of Professional Psychology (GamaJPP)* , *5(1)* , 15–25. https://doi.org/https://www.researchgate.net/publication/335043120_Musik_Intervention_Program_Terhadap_Hiperaktif_Anak_Attention_Deficit_Hyperactivity_Disorder_ADHD

Thaut, M.H., McIntosh, G.C. & Hoemberg, V. (2008). Neurobiological foundations of neurologic music therapy: rhythmic entrainment and the motor system. *Frontiers in Psychology* , *5* (1185). https://doi.org/https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2014.01185/full

Zatorre, R.J., Chen, J.L. & Penhune, V.B. (2007). When the brain plays music: auditory–motor interactions in music perception and production. *Nature Reviews Neuroscience* , *8(7)* , 547–558. https://doi.org/https://www.nature.com/articles/nrn2152