Music to Learn: Investigating the Effects of Instrumental Music Training on Children's Cognitive Development

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Abstract

This study investigated the influence of playing a musical instrument on children's cognitive ability, focusing on memory, attention, reasoning, and academic performance. Although music education is often viewed primarily as an artistic activity, empirical evidence suggests that instrumental training contributes significantly to cognitive development. The study adopted a quantitative design in which data were collected from 43 pupils exposed to instrumental music instruction, with perceptions obtained from parents and teachers using a structured questionnaire. Descriptive statistical techniques, including frequency counts, percentages, and charts, were applied to analyze the data. Findings revealed that children engaged in instrumental music training demonstrated improvement in memory retention, sustained attention, and enhanced reasoning ability. Positive effects were also observed on academic performance, particularly in reading and mathematics. The results confirm that music training supports executive functioning and broader intellectual development. The study provides empirical evidence from a Nigerian educational context, highlighting the cognitive value of music education in primary and secondary schools. It concludes that instrumental music training is not merely extracurricular, but an effective educational intervention that promotes intellectual growth. The paper recommends that schools integrate structured instrumental music programs into the curriculum and that educational stakeholders invest in qualified music instructors and instructional resources. Further studies are encouraged to explore longitudinal effects and instrument-specific outcomes on cognitive development.

Keywords: Musical instrument, music education, cognitive ability, child development, academic performance, executive functioning.

Introduction

Cognitive development in children remains a central concern in education, as it determines how effectively children acquire knowledge, solve problems, and adapt to increasingly complex learning environments (Cai *et al*., 2025; Shonkoff & Phillips, 2000). Educators and psychologists worldwide continue to explore activities that support intellectual growth beyond conventional classroom instruction. Traditional teaching methods alone often fail to meet the diverse learning needs of children, particularly in contexts where access to educational resources is limited (Adebayo, 2019; UNESCO, 2020). Consequently, attention has shifted toward enrichment activities that stimulate learning through experience, creativity, and multisensory engagement. One of such activity is musical instrument training, which is increasingly recognized not only as an artistic pursuit but also as a tool for cognitive, academic, and socio-emotional development (Sala & Gobet, 2020; James *et al*., 2024).

Despite growing evidence of its educational value, music remains undervalued in many school systems, including Nigeria (Okafor, 2005; Nzewi, 2003; UNESCO, 2020). In many Nigerian schools, music is treated as an elective or extracurricular subject rather than as a core component of child development. This limits children's access to structured music education that could enhance intellectual and personal growth. Recent research challenges this approach, suggesting that creative engagement—particularly musical training—strengthens fundamental cognitive processes such as memory, attention, reasoning, and executive functioning (Cai *et al*., 2025; Ekwueme, 2016).

Cognitive ability refers to a child's mental capacity to acquire knowledge, retain information, and apply learned skills to solve problems (Neisser *et al*., 1996). It encompasses processes such as perception, memory, attention, language development, processing speed, and logical reasoning, all of which are essential for academic achievement and lifelong learning. Playing a musical instrument involves complex coordination: reading notation, listening, controlling motor movements, recalling sequences, and making real-time adjustments during performance (Lehmann *et al*., 2007). These tasks engage multiple brain regions simultaneously, representing a form of mental exercise that promotes neuroplasticity and strengthens cognitive pathways (Herholz & Zatorre, 2012; James *et al*., 2024).

Musical training is inherently multisensory. Instrumental learning integrates visual processing (reading notation), auditory processing (listening to pitch and rhythm), and fine motor coordination (hand and finger movements), which supports enhanced attention, learning efficiency, and brain development (Herholz & Zatorre, 2012). Childhood represents a sensitive period for such cognitive stimulation, during which environmental inputs can significantly shape memory, attention control, and emotional regulation (Shonkoff & Phillips, 2000).

Beyond cognitive benefits, musical training fosters social and emotional growth. Learning an instrument requires discipline, perseverance, and delayed gratification, which strengthen self-regulation and self-confidence (McPherson & Renwick, 2001). Participation in ensembles encourages teamwork, communication, and interpersonal competence, which indirectly supports cognitive development by enhancing motivation and focus (Nzewi, 2003; Hallam, 2010; Cai *et al*., 2025).

Empirical evidence consistently supports these claims. Schellenberg (2004) reported measurable IQ gains in children receiving music lessons, while Schlaug *et al*. (2005) observed structural brain changes in musically trained children, particularly in motor and auditory regions. Forgeard *et al*. (2008) found improved verbal memory, literacy, and mathematical ability in children exposed to music instruction. Executive functioning, including working memory, attention control, and self-regulation, also improves through instrumental training, supporting both academic achievement and social behavior (Diamond, 2013; Miendlarzewska *et al*., 2014).

Although most literature originates from Western contexts, Nigerian and African studies provide complementary evidence. Research in Nigeria indicates that music education improves memory retention, classroom engagement, and academic performance (Ojukwu, 2016; Adeyemi & Ogunyemi, 2019). More recent studies emphasize that culturally relevant music instruction strengthens cognitive skills and fosters motivation to learn (Okafor, 2020; Nwokeoma, 2022; Akinwale, 2021). While socioeconomic factors and school resources may influence access to music training, the cognitive benefits of instrumental learning remain significant (Sirin, 2005; Bradley & Corwyn, 2017).

Given this background, the present study examines the influence of playing musical instruments on children's cognitive abilities in selected schools and homes in Lagos State, Nigeria. By including both parents and teachers as respondents, the study captures a comprehensive perspective on how musical training influences memory, attention, problem-solving, academic performance, and socio-emotional development. The findings are expected to provide evidence-based recommendations for educators, parents, and policymakers on integrating music education into child development programs.

Literature Review

Research in education, psychology, and neuroscience increasingly demonstrates that learning to play a musical instrument significantly influences children's cognitive development. Cognitive ability encompasses mental processes such as reasoning, problem-solving, memory, and information processing, which are essential for academic success and everyday functioning (Sternberg, 2012; Alloway & Alloway, 2019). Music training is a complex cognitive task that simultaneously engages auditory, visual, motor, and emotional systems. This multisensory engagement strengthens neural connections and promotes brain plasticity, particularly during childhood when the brain is highly adaptable (Habibi *et al*., 2018; Schlaug, 2015). Consequently, music instruction is increasingly recognized as a tool for enhancing intellectual development in young learners.

Gardner's theory of multiple intelligences highlights musical intelligence as a foundational domain that interacts with linguistic and logical-mathematical abilities (Gardner, 2011). Engagement in music can therefore serve as a bridge for developing broader cognitive competencies (Armstrong, 2018). Vygotsky's sociocultural theory emphasizes social interaction and cultural tools in learning, positioning music as a medium through which cognitive skills are constructed (Vygotsky, 1978; Kozulin, 2020). Instrumental learning often occurs in guided, collaborative environments, allowing children to develop higher-order thinking within their zone of proximal development. Piaget's theory further supports this view by linking engagement with musical patterns and notation to the development of symbolic thinking and abstract reasoning (Piaget, 1972; Lourenço, 2016).

Schellenberg (2004) found that children who received music lessons exhibited measurable gains in IQ compared to peers engaged in other activities. Longitudinal studies have reinforced these findings, showing that sustained musical training contributes to improvements in both verbal and non-verbal intelligence (Schellenberg, 2019; Jaschke *et al*., 2018). Neuroimaging research indicates that musically trained children show structural brain changes, including increased gray matter volume in areas associated with auditory processing, memory, and executive control (Hyde *et al*., 2009; Habibi *et al*., 2018). These findings demonstrate that cognitive benefits of music are rooted in measurable neurological development rather than being purely behavioral.

Language development is strongly influenced by music training. Music and language share overlapping neural mechanisms, particularly in the processing of sound, rhythm, and pitch (Patel, 2008; Kraus & Chandrasekaran, 2010). Consequently, children involved in instrumental learning often display enhanced phonological awareness, verbal memory, and speech perception (Forgeard *et al*., 2008; Tierney & Kraus, 2013). Rhythm-based musical training has been shown to improve reading fluency and comprehension among children (Gordon *et al*., 2015; Flaugnacco *et al*., 2018). In African contexts, indigenous musical practices, which emphasize rhythm and oral patterns, further reinforce language acquisition and literacy development (Ekwueme, 2020).

Mathematical reasoning and spatial-temporal skills are also influenced by music training. Instrumental practice involves counting, sequencing, pattern recognition, and proportional reasoning—all foundational to mathematics (Rauscher *et al*., 1997; Vaughn, 2000; Miendlarzewska & Trost, 2014). Recent studies confirm a positive association between sustained music education and performance in mathematical tasks requiring abstract thinking and problem-solving (Sala & Gobet, 2020). Within Nigerian classrooms, integrating music into instruction has been shown to improve engagement with numeracy concepts, especially in resource-limited settings (Adeyemi, 2021).

Executive functioning—including attention control, working memory, cognitive flexibility, and self-regulation—is consistently enhanced through musical training (Diamond, 2013). Children who learn musical instruments demonstrate superior attention spans, inhibitory control, and goal-directed behavior compared to peers without music exposure (Habibi *et al*., 2014; Shen *et al*., 2019). Neurological evidence indicates increased activation in the prefrontal cortex, the brain

region responsible for planning, decision-making, and self-management (Zatorre *et al*., 2007; Moreno *et al*., 2017). These improvements underpin both academic performance and social-emotional regulation.

While much of the literature originates from Western contexts, Nigerian and African studies corroborate these findings. Research shows that music education is associated with improved memory, classroom engagement, and academic performance among Nigerian children (Ojukwu, 2016; Adeyemi & Ogunyemi, 2019). Recent contributions highlight that culturally relevant music instruction strengthens cognitive skills, motivation, and student identity (Okafor, 2020; Nwokeoma, 2022; Akinwale, 2021). Although factors such as socioeconomic status, school resources, and parental involvement can affect access to music education, experimental and longitudinal studies indicate that music training independently enhances cognitive development (Sirin, 2005; Bradley & Corwyn, 2017; Winner, Goldstein & Vincent-Lancrin, 2013).

Both theoretical and empirical literature provide compelling evidence that learning to play a musical instrument enhances children's cognitive abilities, including intelligence, language, mathematics, and executive functioning. While international research is extensive, context-specific studies within Nigeria remain limited. This gap underscores the need for research, such as the present study, to examine how instrumental music training can be effectively employed to support cognitive development in Nigerian educational settings.

Methodology

This study adopted a descriptive survey research design to examine the influence of playing a musical instrument on children's cognitive ability. The study was conducted in selected primary schools within Ajegunle and Apapa areas of Lagos State, Nigeria. These locations were chosen due to their accessibility and the presence of schools with varying levels of exposure to musical instruction among pupils. The population of the study comprised teachers from four selected private primary schools within the study area, as well as parents whose children are engaged in musical instrument training. These participants were considered appropriate because teachers and parents interact closely with children and are well-positioned to observe cognitive attributes such as memory, attention span, reasoning ability, and problem-solving skills. A sample of between 30

and 60 respondents was drawn from this population, consisting of classroom teachers, music instructors, and parents.

A stratified random sampling technique was employed to ensure adequate representation across relevant categories such as school, class level, and teacher roles, as well as parents of children involved in musical training. Following stratification, simple random sampling was used within each group to select participants for the study. This approach ensured fairness and minimized selection bias.

Data were collected using a structured questionnaire designed by the researcher. The instrument consisted of two sections: Section A captured demographic information such as age, gender, educational background, years of teaching or parenting experience, type of musical instrument played by the child, and duration of training; while Section B assessed cognitive ability indicators, including memory, attention, reasoning, problem-solving skills, and academic behaviour using Likert-scale items. The instrument was validated through expert review in the fields of music education and educational psychology to ensure content relevance and clarity.

The questionnaire was administered electronically using Google Forms. Teachers completed the instrument during their free periods, while parents accessed it via WhatsApp platforms. Respondents were guided with clear instructions to ensure accurate completion based on their observations of the children. Participation was voluntary, and respondents were encouraged to provide honest responses.

Data were analysed using both descriptive and inferential statistics. Frequency counts, percentages, and different charts, such as a pie chart and a bar chart. Ethical considerations were strictly observed throughout the study. Informed consent was obtained from all participants, including teachers and parents, after clearly explaining the purpose of the research. Respondents were assured of anonymity and confidentiality, and no personal identifiers were collected. All information gathered was used strictly for academic purposes, and participants were informed.

Results and Findings

This section presents findings based on data collected from parents and teachers using a structured questionnaire. The responses reflect their observations of children who engage in musical instrument training. The analysis covers key cognitive domains, including memory retention, attention and concentration, problem-solving and reasoning, academic skills, and social-emotional development. Findings are presented using frequency tables, percentages, and concise interpretation.

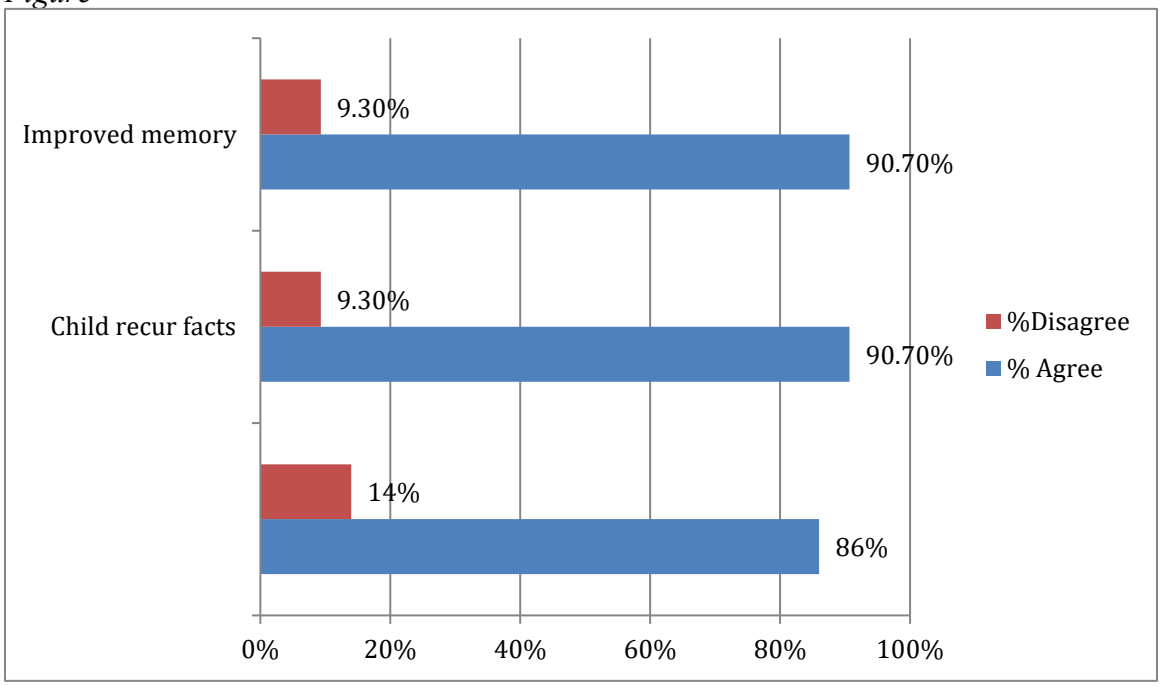
Memory Retention

Table 1

Respondents' opinions on the child's memory and retention

Item	Strongly Agree (SA)	Agree (A)	Disagree (D)	Strongly Disagree (SD)	Total	%Agree (SA+A)	% Disagree (D+SD)
The child remembers instructions easily	16	21	4	2	43	86%	14%
The child can recall facts learnt weeks earlier	14	25	3	1	43	90.7%	9.3%
Musical training has improved the child's memory	27	12	2	2	43	90.7%	9.3%

Figure 1



Findings indicate that, based on respondents' observations, playing of musical instrument is associated with improved memory retention in children. A large proportion of respondents (86%) agreed that children remember instructions more easily. Similarly, about 90.7% reported that children could recall facts learned weeks earlier, while the same proportion indicated that musical training had improved memory performance.

These responses suggest that, from the perspective of parents and teachers, musical engagement supports both short-term and long-term memory development in children.

Attention and Concentration

Table 2

Respondents' opinion on the child's attention and concentration

Item	**Never**	**Rarely**	**Often**	**Always**	**Total**	**% Never+Rarely**	**% Often+Always**
The child maintains focus on activities for extended periods	O	11	24	8	43	25.6%	74.4%
The child is less distracted compared to peers	1	13	21	8	43	32.6%	67.4%
Playing a musical instrument has enhanced the child's attention	0	1	23	19	43	2.3%	97.7%

Findings based on respondents' observations show improvement in children's attention and concentration. Approximately 74.4% reported that children maintained focus on tasks for extended periods, while 67.4% indicated reduced distractibility compared to peers. Notably, 97.7% of respondents reported that musical instrument playing enhanced children's attention.

These results suggest that musical training contributes to improved attentional control and sustained focus in children.

Problem-Solving and Reasoning

Table 3
Respondents' opinions on the child's problem-solving and reasoning

Item	SA	A	Neutral	D	SD	Total	% Agree (SA+ A)	%Neutral	%Disagree (D+ SD)
The child thinks of different solutions to a problem	10	16	15	1	1	43	60.5%	34..9%	4.6%
The child applies logical reasoning in tasks	12	20	10	1	0	43	74.4%	23.3%	2.3%
Musical training has improved the child's reasoning skills	13	19	11	0	0	43	74.4%	25.6%	0%

Responses indicate positive outcomes in problem-solving and reasoning abilities. About 60.5% of respondents reported that children could generate multiple solutions to problems, while 74.4% observed improved logical reasoning. Similarly, 74.4% agreed that musical training enhanced reasoning skills.

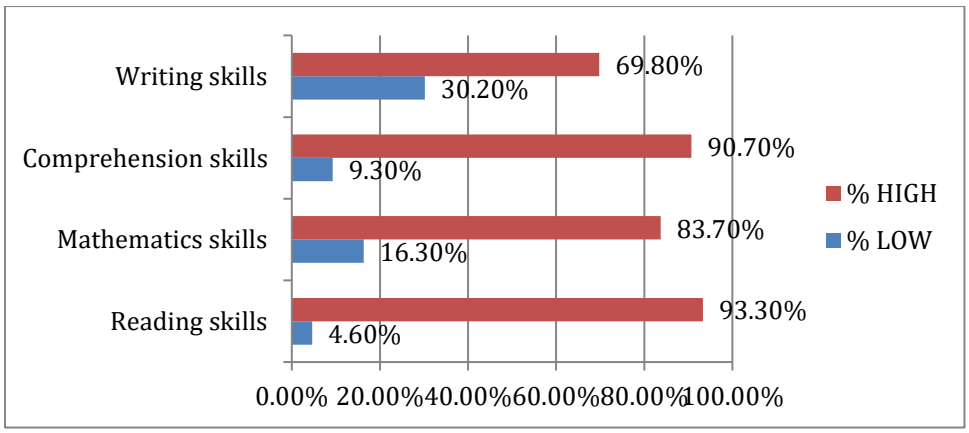
Although some respondents were neutral, the overall pattern suggests that musical engagement is perceived to support children's analytical thinking and problem-solving abilities.

ACADEMIC SKILLS

Table 4
Respondents' opinions on the child's academic skills

Item	Very Low	Low	High	Very High	Total	%Low (VL+L)	% High (+VH)
The child's reading skills has improved since he or she started music training	0	2	26	15	43	4.6%	95.3%
The child's mathematics skills has improved since he or she started music training	0	7	24	12	43	16.3%	83.7%
The child's comprehension skills has improved since he or she started music training	0	4	24	15	43	9.3%	90.7%
The child's writing skills have improved since he or she started music training	0	13	19	11	43	30.2%	69.8%

Figure 2



Findings show that respondents observed improvements in children's academic skills following musical training. A high proportion reported improvements in reading (95.3%), comprehension (90.7%), and mathematics (83.7%), while writing showed relatively lower improvement (69.8%).

This pattern suggests that, from respondents' perspectives, musical training has a stronger influence on reading, comprehension, and numerical skills than on writing ability.

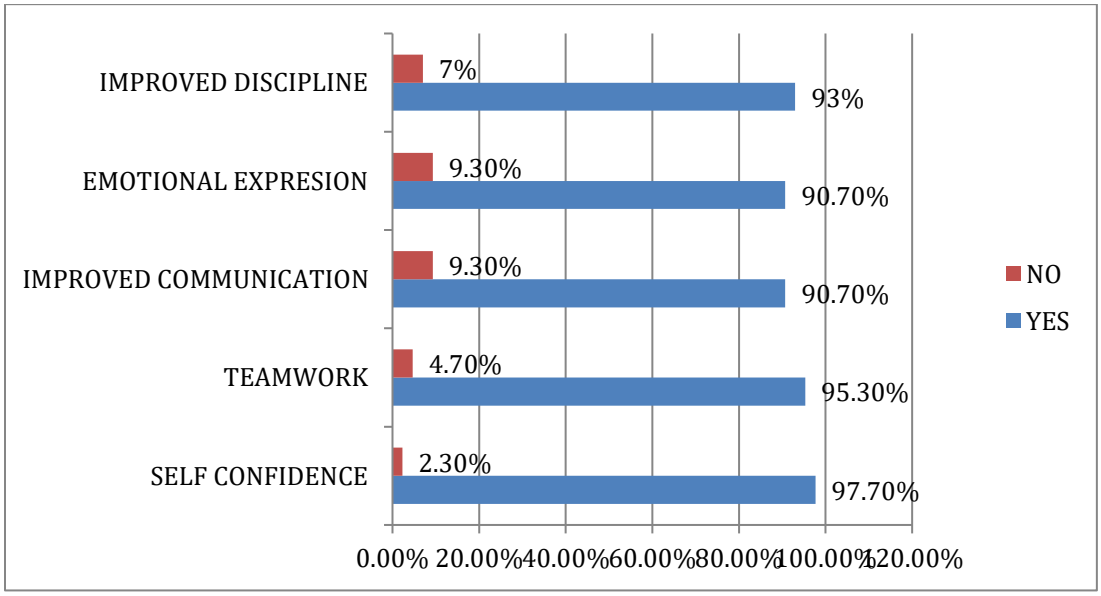
Social and Emotional Development

Table 5

Respondents' opinions on the child's social and emotional skills

Item	Yes	No	Total	%Yes	%No
Has the child's self-confidence improved since he or she started musical training	42	1	43	97.7%	2.3%
Has the child's teamwork improved since he or she started musical training	41	2	43	95.3%	4.7%
Has the child's communication improved since he or she started musical training	39	4	43	90.7%	9.3%
Has the child's emotional expression improved since he or she started musical training	39	4	43	90.7%	9.3%
Has the child's discipline improved since he or she started musical training	40	3	43	93%	7%

Figure 3



Findings indicate that musical training contributes significantly to children's social and emotional development. A large percentage of respondents reported improvements in self-confidence (97.7%), teamwork (95.3%), discipline (93%), communication (90.7%), and emotional expression (90.7%).

These responses highlight the role of musical engagement in supporting both social interaction and emotional development in children.

General Perception of Musical Instrument Training

Table 15

Respondents' opinion on the general perception of musical instrument training.

Item	**SA**	**A**	**D**	**SD**	**Total**	**%Agree (SA+A)**
Musical instrument training is essential for cognitive development	31	12	0	0	43	100%
Every child should be encouraged to learn an instrument	34	9	0	0	43	100%
Musical training benefits children beyond academic performance	35	8	0	0	43	100%
Children who play instrument are better at multitasking	24	19	0	0	43	100
Music lessons should be included in every school curriculum	36	7	0	0	43	100%
Music training can improve children's future career opportunities	36	7	0	0	43	100%

There was unanimous agreement among respondents on the value of musical instrument training. All respondents (100%) agreed that musical training is essential for cognitive development, should

be encouraged for all children, and offers benefits beyond academic performance. Respondents also supported its inclusion in school curricula and recognized its potential long-term benefits. This consensus reflects a strong positive perception of musical education among parents and teachers.

Discussion

The discussion of findings is organized according to the key cognitive domains examined in this study: memory retention, attention and concentration, problem-solving and reasoning, and academic skills.

Findings relating to memory retention indicate that children who engage in musical instrument training are perceived by parents and teachers to demonstrate improved ability to recall instructions and previously learned information. These observations suggest that musical engagement supports both short-term and long-term memory processes. This finding is consistent with Schellenberg (2004) and Hyde *et al*. (2009), who reported that music training enhances memory-related cognitive functions. Similarly, Habibi *et al*. (2014) found that structured music instruction strengthens working memory and cognitive processing capacity.

Concerning attention and concentration, the study found that children involved in musical training were observed to maintain focus for longer periods and exhibit reduced distractibility. These findings suggest that musical practice contributes to the development of attentional control and sustained concentration. This supports Diamond's (2013) assertion that activities requiring sustained mental effort enhance executive functioning. The repetitive and disciplined nature of musical practice may therefore explain the improvements in attention observed by respondents.

Findings on problem-solving and reasoning further indicate that musical training is associated with improved analytical thinking. Respondents reported that children engaged in music were better able to generate multiple solutions and apply logical reasoning in tasks. This aligns with Rauscher *et al*. (1997), who linked musical training with enhanced spatial-temporal reasoning, as well as Patel (2008), who emphasized the role of music in strengthening cognitive flexibility and reasoning processes.

In terms of academic skills, the findings show that musical training is perceived to positively influence children's performance in reading, comprehension, and mathematics. These observations support the work of Forgeard *et al*. (2008), who found that musically trained children perform better in language-related tasks due to improved auditory processing and phonological awareness. The relatively lower improvement observed in writing may be explained by the fact that writing involves additional motor and compositional skills not directly targeted by musical training.

Within the Nigerian context, the findings are consistent with studies by Ojukwu (2016) and Adeyemi and Ogunyemi (2019), which highlight the positive role of music education in enhancing learning outcomes. Given the cultural relevance of music in African societies, its integration into formal education may further reinforce cognitive development. However, challenges such as limited resources and insufficiently trained personnel remain barriers to effective implementation.

Overall, the findings of this study, based on parents' and teachers' observations, support existing theoretical and empirical evidence that musical instrument training contributes positively to children's cognitive development across multiple domains.

Conclusion

This study examined the influence of playing a musical instrument on children's cognitive development, based on observations reported by parents and teachers. Findings indicate that, engagement in musical instrument training is associated with improvements across multiple cognitive domains, including memory retention, attention and concentration, problem-solving and reasoning, and academic skills.

Respondents reported that children involved in instrumental music demonstrated better ability to recall instructions, sustain attention, apply logical reasoning, and perform in language and mathematics tasks. These observations suggest that musical engagement enhances executive functioning, cognitive flexibility, and learning outcomes.

The study further highlights the socio-emotional benefits of musical training, as children were observed to show improved self-confidence, discipline, teamwork, and communication skills.

These findings reinforce the view that musical education is not merely an artistic activity but a holistic developmental tool that supports both intellectual and social-emotional growth.

Within the Nigerian educational context, the findings underscore the relevance of integrating structured musical training into school curricula, particularly given the cultural significance of music and its potential to enrich cognitive and academic outcomes despite challenges such as limited resources and trained personnel.

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