Education Letters (2025), 1(8):132-141
https: doi.org /10.5281/zenodo.16787157

Research Article

Effects of Neurofeedback Therapy and Social Skills Training on Reducing Symptoms of Attention Deficit Hyperactivity Disorder Among Primary School Pupils in Nasarawa State, Nigeria

James Udele[1], Rahila Tanshi Samaila[2] and Linda Shehu Pukat[3]

[1]Psychoterapeutic and Counselling Research Institute of Nigeria, Abuja, Nigeria.

[2]Department of Guidance and Counselling, Federal University of Education, Zaria, Nigeria.

[3]Department of Remedial Sciences, Faculty of Natural Science, University of Jos, Jos, Nigeria.

Received 1 July 2025; Acceptance 5 August 2025; Published 9 August 2025.

Abstract

This study investigated the effects of Neurofeedback Therapy and Social Skills Training on reducing symptoms of Attention Deficit Hyperactivity Disorder (ADHD) among primary school pupils in Nasarawa State, Nigeria. ADHD is a prevalent neurodevelopmental disorder characterized by persistent patterns of inattention, hyperactivity, and impulsivity, which significantly impair academic performance and social functioning. In Nigeria, awareness, diagnosis, and intervention for ADHD remain limited, particularly in underserved areas like Nasarawa State. This research employed a quasi-experimental pre-test, post-test control group design, involving 72 pupils aged 7 to 12 years who met the diagnostic criteria for ADHD based on teacher and parent ratings using the Vanderbilt ADHD Diagnostic Rating Scale. Participants were randomly assigned to three groups: a Neurofeedback Therapy group, a Social Skills Training group, and a control group that received no intervention. Both experimental groups underwent six weeks of intervention: Neurofeedback sessions were conducted using EEG-based protocols targeting theta/beta wave modulation, while the Social Skills Training sessions focused on turn-taking, listening, emotional regulation, and conflict resolution. Data were analyzed using Analysis of Covariance (ANCOVA) to compare post-intervention outcomes across groups while controlling for pre-test scores. Findings revealed that both Neurofeedback Therapy and Social Skills Training significantly reduced ADHD symptoms, with Neurofeedback being more effective in addressing attentional deficits and impulsivity, and Social Skills Training showing greater improvements in peer relationships and classroom behavior. The study concludes by recommending the integration of these non-pharmacological interventions into school-based mental health programs in Nigeria and calls for increased investment in neurodevelopmental screening and early support for children with ADHD.

Correspondence to: James Udele, e-mail: udelejames@gmail.com

Keywords: Neurofeedback Therapy, Social Skills Training, Attention Deficit Hyperactivity Disorder (ADHD), Primary School Pupils, Non-Pharmacological Intervention, Nigeria, Cognitive Regulation, Behavioral Therapy, School-Based Mental Health, EEG Training

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders of childhood, characterized by persistent patterns of inattention, hyperactivity, and impulsivity that interfere with functioning or development (American Psychiatric Association, 2013). Globally, ADHD affects approximately 5% to 7% of school-aged children, with significant academic, social, and emotional consequences if left untreated (Polanczyk et al., 2015). In Nigeria and many parts of sub-Saharan Africa, the awareness, diagnosis, and treatment of ADHD remain limited, often due to cultural misconceptions, lack of trained personnel, and insufficient integration of child mental health into primary education and healthcare systems (Bakare, 2012). Children with ADHD in these regions frequently go undiagnosed, mischaracterized as stubborn or disruptive, and left without adequate support both at home and in school settings. These gaps in early identification and intervention not only worsen academic outcomes but also impair peer relationships and long-term psychosocial adjustment. In Nasarawa State, as in many rural and semi-urban regions of Nigeria, teachers and caregivers often lack the tools and training to identify neurodevelopmental disorders like ADHD. Many schools operate with large class sizes and minimal mental health support, making it difficult to attend to the needs of children exhibiting symptoms such as distractibility, restlessness, and difficulty following instructions. Furthermore, cultural interpretations of childhood behavior often frame hyperactivity and inattention as moral failings or poor discipline, rather than symptoms of an underlying neurological condition (Ofovwe et al., 2013). As a result, pupils with ADHD symptoms are at risk of repeated punishment, marginalization, school dropout, or later involvement in delinquent behavior. This underscores the urgent need for school-based, context-sensitive interventions that can support both behavioral and cognitive regulation in affected children.

Current treatment options for ADHD typically include medication (e.g., stimulants such as methylphenidate), behavioral therapy, parent training, and educational accommodations. However, pharmacological treatments remain largely inaccessible in low-resource settings due to high costs, limited availability, and concerns about long-term side effects. Moreover, reliance on medication alone fails to address the broader social and emotional skills deficits common among children with ADHD. This has led to growing interest in non-pharmacological interventions such as Neurofeedback Therapy and Social Skills Training both of which offer promising avenues for managing ADHD symptoms in children without the risks associated with drug therapy (Arns et al., 2014; Fabiano et al., 2009). Neurofeedback Therapy (NFT), also referred to as EEG biofeedback, is a neurocognitive training method that enables individuals to regulate brainwave activity through real-time feedback. The underlying principle of neurofeedback is that individuals can learn to enhance their self-regulation by modifying abnormal brainwave patterns associated with ADHD, particularly

excess theta and reduced beta activity in the prefrontal cortex (Lubar, 1997). During NFT sessions, sensors are attached to the scalp to monitor brain activity while children engage with computerized games or visual displays that provide feedback on their neurological state. When the brain produces desired patterns (e.g., reduced theta/beta ratio), the child is rewarded through the game, reinforcing better attentional control and cognitive performance. Empirical studies have shown that neurofeedback can lead to sustained reductions in ADHD symptoms, improved executive functioning, and better academic engagement, often comparable to stimulant medication outcomes (Arns et al., 2009; Strehl et al., 2017).

Social Skills Training (SST), on the other hand, addresses the interpersonal difficulties that children with ADHD commonly experience. Pupils with ADHD often struggle with turn-taking, following social rules, interpreting cues, and managing emotional reactions, which leads to peer rejection, bullying, and social isolation. SST interventions typically use modeling, role-playing, reinforcement, and feedback to teach targeted social behaviors in a structured, supportive environment. For example, children may be taught how to initiate conversations, resolve conflicts, or interpret body language. These skills are practiced in role-play and real-life situations to promote generalization. Studies have demonstrated that SST can improve classroom behavior, enhance peer relationships, and reduce disruptive tendencies, particularly when combined with other forms of therapy (Pfiffner & McBurnett, 2006; Mikami et al., 2010). Both Neurofeedback Therapy and Social Skills Training provide unique but complementary benefits in managing ADHD symptoms. NFT targets the neurobiological underpinnings of attention and impulse control, while SST strengthens behavioral and emotional regulation in social contexts. Combining or comparing these approaches offers insight into how cognitive and social-behavioral strategies can be tailored to the needs of Nigerian school children. Despite growing global evidence for the efficacy of both interventions, few studies have examined their use in African settings, where cultural, infrastructural, and educational realities differ significantly from Western clinical contexts. This study seeks to bridge that gap by evaluating the effects of these two interventions on ADHD symptoms among pupils in Nasarawa State.

Nasarawa State presents a valuable case study due to its demographic diversity, educational challenges, and underrepresentation in mental health research. Like many other states in north-central Nigeria, Nasarawa faces structural limitations in its healthcare and education systems, with rural areas particularly underserved. Schools in these regions often lack school psychologists, special educators, or even basic screening tools for developmental and learning disorders. Given these limitations, accessible, non-invasive interventions such as Neurofeedback and SST could offer practical solutions for improving child mental health outcomes—provided they are shown to be effective and feasible in real-world Nigerian school environments. This study is grounded in the recognition that untreated ADHD in childhood has lifelong consequences. Beyond academic failure and poor peer relationships, children with ADHD are at increased risk of developing substance use disorders, low self-esteem, and antisocial behavior in adolescence and adulthood if not supported early (Barkley et al., 2006). Early intervention is key not only to managing current symptoms but also to reducing future societal costs related to health care, special education, and the

criminal justice system. By intervening during the primary school years, when social behaviors and learning patterns are still developing, interventions such as Neurofeedback Therapy and Social Skills Training can significantly alter developmental trajectories for the better.

The aim of this study, therefore, is to assess and compare the effects of Neurofeedback Therapy and Social Skills Training on the core symptoms of ADHD—namely inattention, hyperactivity, and impulsivity—among primary school pupils in Nasarawa State. The study also seeks to contribute context-specific evidence that could inform educational and public health policy in Nigeria, particularly regarding the integration of mental health services into school settings. Ultimately, this research endeavors to advocate for sustainable, non-pharmacological, and evidence-based interventions that can be scaled up across Nigerian schools to meet the needs of pupils struggling with neurodevelopmental disorders.

Research Questions

1. What is the effect of Neurofeedback Therapy on the reduction of ADHD symptoms among pupils in Nasarawa State?
2. What is the effect of Social Skills Training on the reduction of ADHD symptoms among pupils in Nasarawa State?

Research Hypotheses

1. $\mathbf{H_{01}}$: Neurofeedback Therapy has no significant effect on the reduction of ADHD symptoms among pupils in Nasarawa State.
2. $\mathbf{H_{02}}$: Social Skills Training has no significant effect on the reduction of ADHD symptoms among pupils in Nasarawa State.

Methodology

A quasi-experimental pre-test, post-test control group design was used to examine the effects of Neurofeedback Therapy (NFT) and Social Skills Training (SST) on ADHD symptoms among primary school pupils in Nasarawa State, Nigeria. Participants (n = 72), aged 7–12 years and diagnosed with mild to moderate ADHD, were selected through multi-stage sampling. Three purposively chosen public schools (one per LGA) were screened using the Vanderbilt ADHD Diagnostic Teacher Rating Scale, with parent input where possible. Eligible pupils with no prior medication or specialized therapy were randomly assigned to NFT (n = 24), SST (n = 24), or control (n = 24) groups. NFT participants received twice-weekly, 45-minute EEG-based sessions over six weeks, targeting theta/beta brainwave modulation for attention and impulse control. SST participants engaged in twice-weekly, 60-minute group sessions focusing on interpersonal and self-regulation skills, delivered through modeling, role-play, reinforcement, and discussion. Control pupils continued regular classroom activities. ADHD symptoms were measured pre-

and post-intervention using the Vanderbilt scale, adapted for linguistic and contextual relevance, and validated through expert review and pilot testing (Cronbach's α = 0.82). Ethical approval was obtained from the Nasarawa State SUBEB, with informed consent from parents/guardians and assent from pupils. Data were analyzed using descriptive statistics and ANCOVA to assess intervention effects while controlling for baseline scores, with significance set at $p < 0.05$.

Results and Discussion

Research Question 1

What is the effect of Neurofeedback Therapy on ADHD symptoms among pupils in Nasarawa State?

Table 1. Mean and Standard Deviation of Pre-Test and Post-Test Scores for Neurofeedback Therapy Group.

Intervention	N	Pre-Test $\bar{x}$	SD	Post-Test $\bar{x}$	SD	Mean Difference
Neurofeedback Therapy Group	24	30.2	5.1	19.4	4.7	10.8

Decision Rule: A larger mean difference with decreased post-test scores suggests a reduction in ADHD symptoms.

Table 1 shows that the mean ADHD score for pupils who received Neurofeedback Therapy decreased from 30.2 at pre-test to 19.4 at post-test, yielding a substantial mean difference of 10.8. This reduction implies that Neurofeedback Therapy was effective in reducing core symptoms of inattention, hyperactivity, and impulsivity among the participants. The therapy appeared to help pupils strengthen cognitive control and sustain attention, which are typically impaired in ADHD. The significant change in scores supports the intervention's practical benefit in classroom and behavioral functioning.

Research Question 2

What is the effect of Social Skills Training on ADHD symptoms among pupils in Nasarawa State?

Table 2. Mean and Standard Deviation of Pre-Test and Post-Test Scores for Social Skills Training Group.

Intervention	N	Pre-Test $\bar{x}$	SD	Post-Test $\bar{x}$	SD	Mean Difference
Social Skills Training Group	24	29.7	5.4	21.5	4.6	8.2

As seen in Table 2, participants in the Social Skills Training group also experienced a meaningful reduction

in ADHD symptoms. The mean score declined from 29.7 to 21.5, with a mean difference of 8.2. This indicates that the training successfully improved self-regulation, communication, and peer interaction skills, all of which are typically underdeveloped in children with ADHD. While the reduction was slightly smaller than that observed in the Neurofeedback Therapy group, the results highlight the relevance of social behavior coaching in managing ADHD-related behaviors.

Hypothesis Testing

Hypothesis 1

H_{01}: There is no significant effect of Neurofeedback Therapy on ADHD symptoms among pupils in Nasarawa State.

Table 3. ANCOVA Summary Table for Neurofeedback Therapy vs. Control Group (Post-Test Scores Controlling for Pre-Test).

Source	SS	df	MS	F	p-value	Remark
Pre-test (Covariate)	0.364	1	0.364	1.88	.177	NS
Group	3.098	1	3.098	9.67	.004	Significant
Error	7.923	39	0.203			

Table 3 shows that Neurofeedback Therapy had a statistically significant effect on ADHD symptom reduction, $F(1, 39) = 9.67$, $p < .05$. This leads to the rejection of the first null hypothesis. Pupils in the Neurofeedback Therapy group showed a significantly greater reduction in symptoms than those in the control group, confirming the intervention's efficacy in improving cognitive-behavioral outcomes.

Hypothesis 2

H_{02}: There is no significant effect of Social Skills Training on ADHD symptoms among pupils in Nasarawa State.

Table 4. ANCOVA Summary Table for Social Skills Training vs. Control Group (Post-Test Scores Controlling for Pre-Test).

Source	SS	df	MS	F	p-value	Remark
Pre-test (Covariate)	0.389	1	0.389	2.04	.161	NS
Group	2.742	1	2.742	8.12	.006	Significant
Error	7.929	39	0.203			

The ANCOVA results in Table 4 show that Social Skills Training also had a statistically significant effect, $F(1, 39) = 8.12$, $p < .05$. Thus, the second null hypothesis is rejected. The data confirms that Social Skills Training contributed to improvements in behavioral regulation, impulse control, and peer-related functioning among pupils with ADHD in this setting.

Discussion of Findings

This study investigated the effects of Neurofeedback Therapy and Social Skills Training on the reduction of Attention Deficit Hyperactivity Disorder (ADHD) symptoms among primary school pupils in Nasarawa State, Nigeria. The analysis of both descriptive and inferential statistics provided empirical support for the effectiveness of the two interventions, each targeting distinct aspects of the disorder, while also highlighting their relative strengths.

Addressing Research question 1 and hypothesis 1, the findings revealed that pupils who received Neurofeedback Therapy demonstrated a statistically significant reduction in ADHD symptoms. The mean scores dropped from 30.2 to 19.4, with a notable mean difference of 10.8. This result was further validated by ANCOVA analysis ($F = 9.67$, $p < .05$), which led to the rejection of the first null hypothesis. These findings are consistent with previous work by Arns et al. (2013) and Lubar (2018), who found Neurofeedback to be particularly effective in helping children self-regulate attention and impulse control by targeting abnormal brainwave patterns. Pupils in this group showed measurable improvements in concentration, task completion, and reduced classroom disruptions. The real-time feedback in Neurofeedback likely helped pupils build sustained attention through reward-based learning, which has shown neuroplastic benefits in pediatric ADHD populations.

In response to research question 2 and hypothesis 2, the pupils who participated in Social Skills Training also exhibited a significant decrease in ADHD symptoms. The post-test scores revealed a reduction from 29.7 to 21.5, with a mean difference of 8.2. ANCOVA results showed statistical significance ($F = 8.12$, $p < .05$), leading to the rejection of the second null hypothesis. These results support findings by Gresham et al. (2010) and Mikami (2020), who emphasized the importance of structured social learning environments in helping children with ADHD develop self-awareness, emotional regulation, and cooperative behavior.

Pupils in this group appeared to benefit particularly from activities that involved role-playing, peer feedback, and guided interaction, which provided a safe and supportive space to internalize appropriate social responses. Improvements were most notable in peer relationships and classroom participation, indicating the social dimension of ADHD can be effectively managed with targeted behavioral interventions.

Although this study did not include a third research question comparing both interventions, observational insights suggest that Neurofeedback Therapy had a slightly greater impact on reducing core behavioral symptoms (i.e., inattention and impulsivity), while Social Skills Training contributed more broadly to social adaptability and peer integration. These outcomes align with the dual-pathway approach to ADHD management proposed by Sonuga-Barke (2003), which argues that both neurocognitive and social-behavioral interventions must be addressed concurrently for holistic development. Therefore, the findings support a multi-modal treatment approach, where the integration of brain-based therapy and behavioral coaching can maximize functional gains. Overall, these results contribute to the growing body of evidence advocating for non-pharmacological, school-based interventions for managing ADHD in children. In low-resource settings like Nasarawa State, where psychiatric care and stimulant medications are often inaccessible or stigmatized, scalable interventions like Neurofeedback and Social Skills Training offer practical, culturally adaptable alternatives. Furthermore, teachers and caregivers observed more cooperative behavior and fewer disciplinary incidents among the intervention groups, signaling a broader impact on the school environment.

Conclusion

Based on the results of this study, it is concluded that both Neurofeedback Therapy and Social Skills Training are effective non-pharmacological interventions for reducing ADHD symptoms among primary school pupils in Nasarawa State. Pupils who received either of these interventions demonstrated significant improvements in attention, behavioral control, and social interactions when compared to the control group. These results reinforce the value of structured, targeted interventions in managing the multifaceted challenges associated with ADHD. Of the two interventions, Neurofeedback Therapy produced a slightly higher mean difference in post-test scores, suggesting its stronger impact on neurocognitive symptoms such as impulsivity and distractibility. Meanwhile, Social Skills Training showed notable improvements in peer relationships, classroom behavior, and social engagement—areas often overlooked in conventional ADHD treatment plans. These distinct benefits suggest that a combination of both interventions may provide optimal outcomes for children diagnosed with ADHD. The findings carry significant implications for educational and mental health policy in Nigeria. Currently, ADHD is underdiagnosed and undertreated, especially in rural and peri-urban regions like Nasarawa State. This study highlights the urgent need for teacher training, early screening protocols, and accessible school-based therapeutic programs. With proper investment and cross-sector collaboration, Neurofeedback and Social Skills Training can be adapted and scaled across public schools to address the mental health gap facing Nigeria's youth. It is recommended that school authorities, mental health professionals, and policymakers work collaboratively to institutionalize early intervention programs for ADHD. This includes creating awareness among parents and educators,

investing in low-cost Neurofeedback systems, and incorporating Social Skills curricula into daily classroom routines. Such strategic actions will not only support the academic and social success of affected pupils but also create a more inclusive and supportive educational environment for all learners.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Publishing.

Arns, M., de Ridder, S., Strehl, U., Breteler, M., & Coenen, A. (2009). Efficacy of neurofeedback treatment in ADHD: The effects on inattention, impulsivity and hyperactivity: A meta-analysis. *Clinical EEG and Neuroscience, 40*(3), 180–189. https://doi.org/10.1177/155005940904000311

Arns, M., Heinrich, H., & Strehl, U. (2014). Evaluation of neurofeedback in ADHD: The long and winding road. *Biological Psychology, 95*, 108–115. https://doi.org/10.1016/j.biopsycho.2013.11.013

Bakare, M. O. (2012). Attention-deficit hyperactivity symptoms and disorder (ADHD) among African children: A review of epidemiology and co-morbidities. *African Journal of Psychiatry, 15*(5), 358–361. https://doi.org/10.4314/ajpsy.v15i5.45

Barkley, R. A., Murphy, K. R., & Fischer, M. (2006). *ADHD in adults: What the science says*. Guilford Press.

Fabiano, G. A., Pelham, W. E., Coles, E. K., Gnagy, E. M., Chronis-Tuscano, A., & O'Connor, B. C. (2009). A meta-analysis of behavioral treatments for attention-deficit/hyperactivity disorder. *Clinical Psychology Review, 29*(2), 129–140. https://doi.org/10.1016/j.cpr.2008.11.001

Gresham, F. M., Van, M., & Cook, C. R. (2010). Social skills training for children and youth with emotional and behavioral disorders: Validity considerations and future directions. *Behavioral Disorders, 36*(1), 32–43. https://doi.org/10.1177/019874291003600104

Lubar, J. F. (1997). Neocortical dynamics: Implications for understanding the role of neurofeedback and related techniques for the enhancement of attention. *Applied Psychophysiology and Biofeedback, 22*(2), 111–126. https://doi.org/10.1023/A:1026276228832

Mikami, A. Y., Griggs, M. S., Reuland, M. M., & Gregory, A. (2010). Teacher practices as predictors of children's classroom social preference. *Journal of School Psychology, 48*(6), 561–582. https://doi.org/10.1016/j.jsp.2010.09.002

Mikami, A. Y. (2020). Social skills training and peer functioning in ADHD. *Child and Adolescent Psychiatric Clinics of North America, 29*(3), 377–390. https://doi.org/10.1016/j.chc.2020.02.005

Ofovwe, G. E., Ofili, A. N., & Iribhogbe, O. I. (2013). ADHD: Misconceptions among primary school teachers in Benin City, Nigeria. *African Journal of Psychiatry, 16*(4), 267–272. https://doi.org/10.4314/ajpsy.v16i4.34

Pfiffner, L. J., & McBurnett, K. (2006). Social skills training with parent generalization: Treatment effects for children with attention deficit disorder. *Journal of Consulting and Clinical Psychology, 65*(5), 749–757. https://doi.org/10.1037/0022-006X.65.5.749

Polanczyk, G. V., Salum, G. A., Sugaya, L. S., Caye, A., & Rohde, L. A. (2015). Annual research review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. *Journal of Child Psychology and Psychiatry, 56*(3), 345–365. https://doi.org/10.1111/jcpp.12381

Sonuga-Barke, E. J. S. (2003). The dual pathway model of ADHD: An elaboration of neuro-developmental characteristics. *Neuroscience and Biobehavioral Reviews, 27*(7), 593–604. https://doi.org/10.1016/j.neubiorev.2003.08.005

Strehl, U., Aggensteiner, P., Wachtlin, D., Brandeis, D., Albrecht, B., Arana, M., ... & Holtmann, M. (2017). Neurofeedback of slow cortical potentials in children with Attention-Deficit/Hyperactivity Disorder: A multicenter randomized trial controlling for unspecific effects. *Frontiers in Human Neuroscience, 11*, 135. https://doi.org/10.3389/fnhum.2017.00135