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Enhancing Working Memory Through Brain Gym: An Experimental Study On Children With Low Academic Achievement

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ABSTRACT

A significant number of children in contemporary culture have cognition related impairments. Memory problems deliver a serious issue for children, including students with learning difficulties, adversely impacting their academic performance and cognitive development. This research examines the efficacy of Brain Gym programs in improving working memory among children with low academic performance. A true-experimental approach was used in the research, sampling 30 children aged 8 to 10 years from English medium schools in Mangalore. Participants were assigned to one control group and experimental group. The experimental group had Brain Gym sessions, whilst the control group got no intervention. The Digit Span Test, Word Recall Test, and Picture Recall Test were standardized devices used for participant analysis. The findings indicated a major boost in visual and sequential memory after the Brain Gym exercises, particularly for students in the experimental group with intervention. These data indicate a considerable improvement in females based on demographic analytical test outcomes after therapy. A superior mean IQ ranking for male students compared to female students demonstrates the advantageous application of non-invasive interventions, such as Brain Gym methods, on neuroplasticity and cognitive development, thereby establishing these interventions as viable strategies for aiding students in overcoming memory related difficulties. Additional research is advised to assess long-term outcomes in a controlled manner, duplicated across many target demographics and settings.

Key Words: *Brain Gym, Working Memory, Development of Cognitive Performance, Neuroplasticity.*

Introduction:

A child's educational development depends heavily on cognitive skills, particularly working memory, which are closely related to executive functioning such as reasoning, and attention. However, a lot of our students struggle with memory related difficulties, which lowers their academic performance. Although they often have trouble managing cognitive skills, leads to distraction, forgetful, or slow in comprehending and follow instructions. To balance their cognitive abilities with academic requirements, they need structured support. Children with working memory impairments are at risk of increasingly declining owing to the escalating cognitive demands of contemporary curricula, which emphasize critical thinking, information integration, and sustained attention (1). In addition to enhancing academic performance, it is crucial to address these difficulties promptly and with evidence-based interventions to restore self-confidence, engagement, and a sense of achievement in the learning process (2).

The intricate connection between sensory integration and cerebral executive functioning has long intrigued researchers, particularly following evidence that developmental impairments in brain function may be addressed by enhancing neural connectivity (3–6). Neuroplasticity, the brain's capacity to reorganize itself, is triggered when the metabolic demands of neurons increase in response to enhanced neural stimulation (7). Among students with poor academic performances or poor cognition, memory deficits especially in working memory are frequently observed and are strongly associated with challenges in processing, retaining, and applying information critical for academic success (8).

Working memory is a key part of cognition that helps us learn by temporarily storing and processing information we need to do hard mental tasks. The Baddeley and Hitch Working Memory Model (1974, modified 2012) says that working memory has four main parts. The Central Executive oversees managing attention, coordinating subsystems, and putting together information. The Episodic Buffer is a place where information from several modalities may be combined and linked to long-term memory (9). The Visual-Spatial Sketchpad stores nonverbal visual and spatial information, such pictures, numbers, and spatial arrangements. It may carry up to four to seven pieces of information at a time, depending on how well you can pay attention (10). The Phonological Loop, on the other hand, helps people learn and understand language by letting them keep and practice verbal and auditory knowledge for a short time (11). All these subsystems work together to help organize, store, and get knowledge back, which helps the learner meet academic obligations in a timely manner.

Although various strategies have been proposed to strengthen memory, research indicates limitations in many of these approaches. Most notably, they often require specialized equipment, controlled environments, or professional facilitation, which may be impractical for educators and parents to implement consistently (12). In contrast, Brain Gym therapy offers a more accessible intervention. This movement-based approach leverages simple physical exercises to improve cognitive functions such as memory, attention, and emotional regulation, making it feasible in both school and home settings (13).

In recent years, people have become increasingly aware of how crucial physical activity is for brain development. This point of view is based on the idea that the brain and body work together to help people learn and improve their cognitive abilities. Dr. Paul Dennison and Gail E. Dennison created Brain Gym, which is one of the most well-known and commonly utilized movement-based programs in schools (14). The ideas of educational kinesiology say that physical movements may improve cognitive function and willingness to learn. This is what this method is founded on. A brain gym is a collection of simple, planned physical activities that are meant to get both sides of the brain working better, enhance neuronal activity, and strengthen the link between the brain and the body (15). People say that workouts like "cross crawls," "brain buttons," "hook-ups," and "lazy eights" help with memory, focus, coordination, and processing sensory information. Movement modifies the brain for the best learning by improving communication between various areas of the brain that are responsible for attention, working memory, and executive function. Brain Gym is more than just physical exercise; it's a neurosensory method that looks at the child's total development, both mind and body. It is widely utilized in schools for intervention programs or as a warm-up for class. Brain Gym is a fun, cheap, and non-invasive technique to help children who aren't doing well in school improve their working memory, focus, and ability to stick with tasks. There isn't a lot of agreement on how well Brain Gym works, but more studies show that doing it regularly and in a structured way may help with working memory and getting students more involved in school (16).
The present research intends to examine the beneficial effects of the Brain Gym Intervention on the working memory performance of students with low academic performance. Therefore, the objectives of the present research are: (i) to analyse the impact of brain gym activities on memory enhancement among students with low academic performance (ii) To investigate the role of demographic factors, such as age and gender, in the effectiveness of brain gym exercises on memory enhancement.

Methodology:

This research used an experimental design with a pre-test post-test experimental - control group style to investigate the efficacy of Brain Gym activities on the working memory of children with poor academic performance. A total of 30 children, aged 8 to 10 years, were chosen by purposive selection from two English-medium schools in Mangalore city. The participants were selected based on the quarterly examination scores, namely those who achieved 35% or below, with an average intellectual capacity, as verified by Raven's Coloured Progressive Matrices examinations (17), led to the exclusion of children scoring below 25 or over 100 to maintain a reasonably uniform cognitive baseline. Before the intervention, all participants had a working memory pre-test, subsequent to which they were allocated into two equivalent groups using the matched-group approach. The groups were thereafter assigned at random as the Experimental Group and the Control Group. The Experimental Group underwent a structured Brain Gym intervention for 30 minutes each day for six weeks. The control group maintained their conventional classroom instruction without any assistance. Ethical issues were meticulously adhered to throughout the investigation. Informed permission was acquired from the school officials and parents, and the children were thoroughly informed about the aim, length, and nature of the intervention. Participation was optional, and children were guaranteed the right to withdraw at any time without consequence. The objective of this openness was to guarantee comfort, collaboration, and sustained engagement throughout the research duration.

Prior to the intervention, the researcher received Brain Gym 101 certification and performed a pilot study to evaluate the reliability of the chosen tools using the test-retest approach. Pre- and post-tests were given in a realistic and controlled classroom setting, and all data were recorded systematically on a standardized score sheet to ensure uniformity and impartiality.

Each 30-minute Brain Gym exercise consisted of six Super Space activities believed to boost memory processing: Brain Buttons, Belly Breathing, Earth Buttons, Thinking Cap, Cross Crawl, and Hook-ups. These motions were chosen for their importance in neuronal integration, attention management, and memory improvement. To assess changes in working memory, three subtests from the NIMHANS Battery for Children's Memory were used: 1. DST (Digit Span Forward and Backward); 2. WRT (Word Recall Test) (Meaningful and Non-Meaningful Word Recall); 3. PRT (Picture Recall Test) (Sequential Visual Memory). In the DST, the researcher read a string of digits aloud at a rate of one digit per second, and the children were asked to repeat the sequence (ahead) or remember it in reverse (backward). The longest accurately remembered sequence in both directions was scored. In the WRT, students were presented a word card for 30 seconds and then asked to remember the contents after a 2-minute gap. Verbal memory was assessed using both meaningful and meaningless words. The PRT consisted of seeing a series of photographs (exposed progressively for 2, 3, 4, and 5 seconds) followed by a task to remember the images in the precise sequence of presentation, so testing visual working memory. This research used a mix of verbal and visual memory tests to acquire a full profile of working memory performance. The pre- and post-intervention data were examined to establish the efficacy of Brain Gym in improving various cognitive functions.

Findings:

Data were analysed utilizing SPSS (version26.) Mean and standard deviation were computed for the experimental and control groups. A paired sample t-test compared pre- and post-test scores within each group, while an independent sample t-test assessed the difference in improvement between groups using gain scores. A significance level of $p < 0.05$ was established, and Cohen's d was computed to assess the effect size and practical significance of the Brain Gym intervention on working memory performance.

Working Memory Performance of the experimental group Scores Before to and After Intervention

For the Digit Span Forward (DSF) test, the mean gain was 2.10 (SD = 1.09), indicating that children could recall more digits in sequence after the intervention. The difference was statistically significant, $t(29) = -10.52$, $p < .001$, suggesting enhanced attention span and auditory sequencing. Similarly, in the Digit Span Backward (DSB) test, which demands more complex processing and manipulation of information, the mean gain was 1.67 (SD = 0.88), also yielding a significant result, $t(29) = -10.33$, $p < .001$. This improvement reflects an enhancement in executive functioning and cognitive flexibility, both of which are key aspects of working memory.

Variable	*Mean*	*Std. Deviation*	*t*	*df*	*Sig. (2-tailed)*
DSF	2.1	1.09	-10.52	29	0
DSB	1.67	0.88	-10.33	29	0
WRM_	3.37	1.5	-12.32	29	0
WRNM	4.03	1.83	-12.08	29	0
PICR	5.4	2.31	-12.79	29	0

Table: 1 Experimental Group

In the Word Recall Meaningful (WRM) subtest, participants showed a mean improvement of 3.37 (SD = 1.50), which was statistically significant, $t(29) = -12.32$, $p < .001$. This indicates a notable increase in the ability to remember meaningful verbal content, likely supported by improved encoding and retrieval mechanisms. Even greater gains were observed in the Word Recall Non-Meaningful (WRNM) test, with a mean increase of 4.03 (SD = 1.83), $t(29) = -12.08$, $p < .001$. Since non-meaningful word recall typically relies more heavily on rote memory and attention, this finding suggests that the Brain Gym intervention may significantly support memory functions that are less context dependent.

The most substantial improvement was recorded in the Picture Recall (PICR) test, which assesses sequential visual memory. Participants demonstrated a mean gain of 5.40 (SD = 2.31), $t(29) = -12.79$, $p < .001$. This suggests that the intervention was particularly effective in enhancing visual-spatial working memory, a critical function for academic tasks such as reading, math, and spatial organization.

Overall, the findings show that the Brain Gym intervention had a statistically and practically significant effect on all domains of working memory in the experimental group. These results support the view that structured movement-based programs like Brain Gym can positively impact both verbal and visual aspects of working memory in children with low academic performance.

Comparison of the Experimental group (EG) and Control group (CG)

The experimental group received Brain Gym intervention for 30 minutes daily over a period of six weeks, whereas the control group followed the standard classroom routine without any cognitive intervention. It was hypothesized that working memory enhancement would differ significantly between the two groups following the intervention.

GROUP	Mean	Std. Deviation	N
E G	35.10	5.52	15
C G	20.70	3.39	15

Table 2: *Comparison of the Experimental group (EG) and Control group (CG)*

As seen in Table 2, the experimental group (EXA) reported a higher mean score (M = 35.10, SD = 5.52) than the control group (CON) (M = 20.70, SD = 3.39) in post-test working memory assessment. An independent sample t-test was conducted to evaluate the hypothesis that both groups would perform similarly following the intervention. The results indicated a significant difference, t (58) = 24.06, $p < .001$, with a very large effect size (Cohen's d = 6.21).

These findings provide strong evidence to reject the null hypothesis, confirming that the Brain Gym intervention had a significant and positive impact on working memory. The notably higher mean in the experimental group suggests that consistent, daily intervention leads to measurable cognitive gains. This supports the efficacy of movement-based learning strategies in improving foundational cognitive skills among children with low academic performance.

Figure 1 shows the diagrammatical representation of the improvement in memory after brain gym intervention.

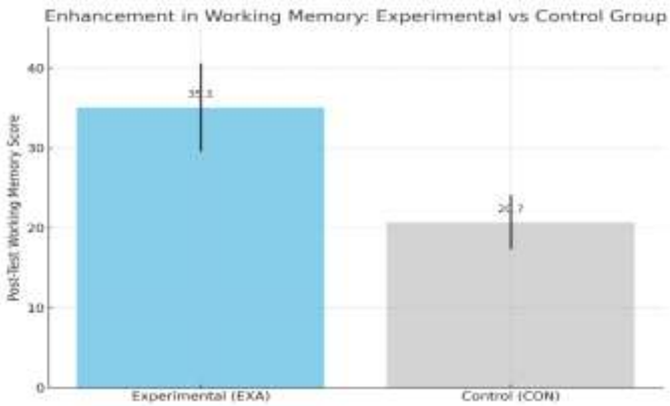

Figure 1: Levels of Memory Enhancement

Demographic Findings

Demographic analysis revealed that 47% of students had IQ levels ranging from 85 to 100, while 53% exhibited lower IQ scores. Gender-based analysis indicated that male students had significantly higher IQ scores (Mean = 86.83, SD = 9.67) than female students (Mean = 67.00, SD = 9.81), t (13) = 2.80, p = 0.015.

Discussion

The present study examined the effect of Brain Gym exercises on the working memory performance of children with low academic achievement. The findings revealed a statistically significant improvement in working memory scores in the experimental group compared to the control group, supporting the hypothesis that movement-based interventions such as Brain Gym can positively impact cognitive functioning.

The experimental group, which participated in structured Brain Gym exercises for 30 minutes daily over six weeks, demonstrated a mean post-test score of 35.10 (SD = 5.52), whereas the control group, which followed a standard classroom routine without intervention, recorded a mean score of 20.70 (SD = 3.39). The large difference in mean scores was confirmed by an independent sample t-test (t (58) = 24.06, $p < .001$) and a very large effect size (Cohen's d = 6.21), indicating that the intervention had not only statistical but also practical significance.

These findings are consistent with prior research suggesting that movement-based programs improve neurological connectivity and cognitive performance in school-age children (19). Brain Gym, grounded in the principles of educational kinesiology, emphasizes cross-lateral and midline-crossing movements that stimulate both hemispheres of the brain, promoting better attention, concentration, and memory retention. The current results support the theoretical premise that physical movement is closely linked to brain activation, particularly in areas associated with memory and executive function.

Furthermore, the analysis of subtest scores (Digit Span, Word Recall, and Picture Recall) revealed significant improvements across both verbal and visual memory domains, suggesting that the benefits of Brain Gym are comprehensive and not limited to a specific type of memory. Notably, the highest gain was observed in Picture Recall, indicating strong activation of visual-spatial working memory processes, which are critical for learning tasks like reading comprehension, mathematics, and problem-solving.

The control group's lack of improvement over time further underscores the effectiveness of the intervention. Their limited gains likely reflect the influence of natural developmental progress and repeated exposure to testing formats rather than any structured cognitive enhancement. This supports the view that targeted interventions are necessary for children with low academic performance, as standard classroom instruction may not be sufficient to address their underlying cognitive challenges.

Despite the promising outcomes, the study is not without limitations. The sample was restricted to English-medium schools in Mangalore city, which may limit generalizability. Additionally, the study focused only on working memory and did not explore long-term retention or transfer to academic performance. Future studies could incorporate follow-up assessments and examine academic outcomes such as test scores, classroom behaviour, or teacher ratings of improvement.

Conclusion

The results of this experimental study provide compelling evidence that Brain Gym exercises can significantly enhance working memory in children with low academic achievement. The experimental group showed marked improvement compared to the control group, with gains evident across multiple memory domains including verbal and visual recall. These findings support the inclusion of Brain Gym as a low-cost, non-invasive, and school-friendly intervention for children struggling with cognitive and academic challenges (20). The study contributes to the growing body of literature advocating for the integration of movement-based learning strategies into the educational framework. Given its accessibility and effectiveness, Brain Gym holds promise as a valuable tool for educators, psychologists, and special educators aiming to bridge cognitive gaps in the classroom (21). Further research with larger, more diverse populations and longitudinal follow-up is recommended to fully understand the scope and sustainability of Brain Gym's cognitive benefits.

Reference

1. Raver, C. C., & Blair, C. (2016). Neuroscientific insights: Attention, working memory, and inhibitory control. *The Future of Children*, 95-118.
2. Marzocchi, G. M., Usai, M. C., & Howard, S. J. (2020). Training and enhancing executive function. *Frontiers in Psychology*, *11*, 2031.Lyon, G. R. (1996). Learning disabilities. *The future of children*, 54-76.
3. Streeck-Fischer, A., & van der Kolk, B. A. (2000). Down will come baby, cradle and all: Diagnostic and therapeutic implications of chronic trauma on child development. *Australian & New Zealand Journal of Psychiatry*, *34*(6), 903-918.
4. Romero-Ayuso, D., Toledano-González, A., Segura-Fragoso, A., Triviño-Juárez, J. M., & Rodríguez-Martínez, M. C. (2020). Assessment of sensory processing and executive functions at the school: Development, reliability, and validity of epyfei-escolar. *Frontiers in Pediatrics*, *8*, 275.
5. Jyoti, D. F., Frongillo, E. A., & Jones, S. J. (2005). Food Insecurity Affects School Children's Academic Performance, Weight Gain, and Social Skills–. *The Journal of nutrition*, *135*(12), 2831-2839.
6. Mundkur, N. (2005). Neuroplasticity in children. *The Indian Journal of Pediatrics*, *72*, 855-857.
7. Peijnenborgh, J. C., Hurks, P. M., Aldenkamp, A. P., Vles, J. S., & Hendriksen, J. G. (2016). Efficacy of working memory training in children and adolescents with learning disabilities: A review study and meta-analysis. *Neuropsychological rehabilitation*, *26*(5-6), 645-672.
8. Linck, J. A., Osthus, P., Koeth, J. T., & Bunting, M. F. (2014). Working memory and second language comprehension and production: A meta-analysis. *Psychonomic bulletin & review*, *21*, 861-883.
9. Logie, R. H. (2014). The visual and the spatial of a multicomponent working memory. In *Spatial working memory* (pp. 19-45). Psychology Press.
10. Bishop, D. V. (2006). Beyond words: Phonological short-term memory and syntactic impairment in specific language impairment. *Applied Psycholinguistics*, *27*(4), 545-547.
11. Loesl, S. (2010). Introduction to the special issue on art therapy in the schools: Art therapy+ schools+ students=?. *Art Therapy*, *27*(2), 54-56.
12. Lieberman, R. E., Champagne, T., Wang, E. Y., & Rushlo, K. (2020). Understanding and Applying a Neurodevelopmental Approach in Residential Interventions. In Transforming Residential Interventions (pp. 197-234). Routledge.
13. Adimayanti, Eka, Dewi Siyamti, and Susi Irwasih. "The Effectiveness of Brain Gym on the Development of Preschool are being Hospitalized." *Proceedings of Conference on Health Universitas Ngudi Waluyo*. Vol. 1. 2022.
14. Anderson, D. I. (2020). Re-education: What can complementary and alternative approaches to movement education teach kinesiology?. *Kinesiology Review*, *9*(3), 181-189.

15. Dennison, P. E., Dennison, G., Wilutzky, U., & Petres-Lesch, H. (1994). *Brain gym*. Ventura, CA: Edu-Kinesthetics.
16. Raven, J., Raven,J.C., and Court, J.H.Raven's(1998). Coloured Progressive matrices (section 1 and 2). Oxford Psychologist Press Ltd.
17. Elaziem Mohamed, A., Abdallah Mohammed, H., Mohamed Ahmed Ayed, M., Alghamdi, W., Elsayed Awad Negm, H., & Ahmed Mahmoud, S. (2021). Effect of Brain Gym Training on Intelligence, Knowledge and Information Retention among Children with Developmental Disabilities. *Egyptian Journal of Health Care*, *12*(1), 1591-1603.
18. Bedard, C. (2020). *The Effects of Movement-based Interventions for Children* (Doctoral dissertation).
19. Israsena, P., Jirayucharoensak, S., Hemrungrojn, S., & Pan-Ngum, S. (2021). Brain exercising games with consumer-grade single-channel electroencephalogram neurofeedback: Pre-post intervention study. *JMIR Serious Games*, *9*(2), e26872.
20. Wilson, D., & Conyers, M. (2020). *Five big ideas for effective teaching: Connecting mind, brain, and education research to classroom practice*. Teachers College Press.