




Comparing the Effectiveness of Cognitive Empowerment Based on Cognitive Games and Executive Function–Based Parenting on Working Memory in Children with Executive Function Deficits

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Article Info

Article type:

Original Research

How to cite this article:

Abbaszadeh, F., Salim Bahrami, S.H., & Emadian, S.O. (2026). Comparing the Effectiveness of Cognitive Empowerment Based on Cognitive Games and Executive Function–Based Parenting on Working Memory in Children with Executive Function Deficits. *Journal of Assessment and Research in Applied Counseling*, 8(3), 1-11.

<http://dx.doi.org/10.61838/kman.jarac.5706>



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ABSTRACT

Objective: This study aimed to compare the effectiveness of cognitive empowerment based on cognitive games and executive function–based parenting training on improving working memory among children with executive function deficits.

Methods and Materials: This research employed a quasi-experimental design with a pretest–posttest control group structure. The statistical population consisted of all 5- and 6-year-old children with executive function deficits in the city of Qaemshahr. A total of 60 participants were selected through purposive sampling based on inclusion and exclusion criteria and were randomly assigned to three groups (n = 20 per group): a cognitive game–based cognitive empowerment group, an executive function–based parenting group, and a control group. The first experimental group participated in 11 sessions of 90-minute cognitive game activities designed to enhance working memory, while the second experimental group received 11 sessions of 90-minute executive function–based parenting training. The control group received no intervention during the study period. Working memory was assessed using a standardized Working Memory Test. Data were analyzed using Multivariate Analysis of Covariance (MANCOVA).

Findings: The results of the multivariate analysis of covariance indicated significant differences among the three groups in posttest working memory scores after controlling for pretest performance ($p < .05$). Both cognitive empowerment based on cognitive games and executive function–based parenting interventions significantly improved working memory in children with executive function deficits compared with the control group ($p < .05$). Furthermore, post hoc comparisons demonstrated that the cognitive game–based cognitive empowerment intervention produced significantly greater improvements in

working memory than the executive function–based parenting program ($p < .05$), indicating superior effectiveness in enhancing cognitive performance.

Conclusion: The findings suggest that both cognitive game–based cognitive empowerment and executive function–based parenting interventions are effective approaches for improving working memory in children with executive function deficits. However, cognitive empowerment through structured cognitive games appears to yield stronger outcomes. These results highlight the value of incorporating cognitive training programs and parent-focused executive function interventions into educational and therapeutic settings to support cognitive development in young children experiencing executive function challenges.

Keywords: *Cognitive Empowerment; Cognitive Games; Executive Function–Based Parenting; Working Memory; Executive Function Deficits; Cognitive Development.*

1. Introduction

Executive functions represent a set of higher-order cognitive processes that enable individuals to regulate behavior, maintain goal-directed actions, adapt to changing environmental demands, and coordinate cognitive resources in complex situations. These functions include working memory, inhibitory control, cognitive flexibility, planning, self-monitoring, and problem-solving, all of which contribute to successful adaptation in academic, social, and everyday contexts (Barkley, 2020; Diamond & Ling, 2020). Contemporary developmental research emphasizes that executive functions begin to emerge rapidly during the preschool years and continue to develop throughout childhood and adolescence, making early childhood a particularly sensitive period for intervention and cognitive enhancement (Barkley, 2020; Luna, 2023). Working memory, often considered the central component of executive functioning, plays a pivotal role in temporarily storing and manipulating information necessary for learning, language acquisition, reasoning, and self-regulation (Arjomandnia et al., 2019; Bailey, 2022). Deficits in working memory during early childhood have been associated with academic underachievement, attentional difficulties, behavioral problems, and reduced adaptive functioning, highlighting the need for effective interventions aimed at strengthening this foundational cognitive skill (Bailey, 2022; Luna, 2023; Miller et al., 2026).

Children with executive function deficits often experience substantial challenges across multiple developmental domains. Such impairments are commonly observed in neurodevelopmental conditions including attention-deficit/hyperactivity disorder (ADHD), specific learning disorders, dyslexia, autism spectrum disorder, and related developmental difficulties (Chutko et al., 2022; Megari & Genova, 2026; Smith et al., 2024). Research has consistently demonstrated that executive dysfunction is associated with poor attentional regulation, diminished

inhibitory control, weak working memory performance, difficulties in problem-solving, and impaired academic achievement (Megari & Genova, 2026; Miller et al., 2026; Piccolo et al., 2026). Furthermore, executive function deficits have been linked to emotional dysregulation, social adjustment problems, and increased vulnerability to behavioral disorders (Miller et al., 2026; Smith et al., 2024). The consequences of these impairments can be particularly pronounced during the preschool years because executive functions provide the cognitive foundation upon which later academic and socioemotional competencies are built (Bailey, 2022; Luna, 2023). Consequently, identifying effective and developmentally appropriate interventions for young children with executive function deficits has become a major focus of contemporary cognitive and developmental psychology.

Over the past decade, cognitive training and cognitive rehabilitation approaches have received considerable attention as promising methods for enhancing executive functioning in children. Cognitive training programs are typically designed to provide repeated practice on tasks targeting working memory, attention, inhibition, and cognitive flexibility, with the expectation that these improvements will generalize to broader domains of functioning (Diamond & Ling, 2020; Scionti et al., 2020). Systematic reviews and meta-analyses have reported encouraging evidence regarding the effectiveness of executive function training interventions, particularly among preschool and school-aged children (Bombonato et al., 2024; Scionti et al., 2020). Similarly, working memory training programs have demonstrated positive effects on executive functioning and related cognitive skills across a variety of clinical and non-clinical populations (Bharadwaj et al., 2022; Diamond & Ling, 2020). Recent technological advances have expanded the range of available interventions, incorporating computerized cognitive training, virtual reality platforms, augmented reality

environments, and game-based learning systems specifically designed to improve executive functioning (Guler et al., 2026; Vinci et al., 2026). Studies have shown that cognitively engaging interventions can enhance working memory, inhibitory control, attention, and problem-solving abilities in children with neurodevelopmental disorders and executive function impairments (Bombonato et al., 2024; Gurlek & Bumin, 2026; Mao et al., 2024). Nevertheless, questions remain regarding the comparative effectiveness of different intervention modalities and the extent to which cognitive gains can be maintained over time.

Among contemporary intervention approaches, cognitive games have emerged as particularly attractive tools for enhancing executive functions in young children. Play-based activities provide an engaging, motivating, and developmentally appropriate context for practicing cognitive skills while maintaining children's interest and participation (Kaduson, 2024; Rachanioti et al., 2018). Cognitive games can stimulate multiple executive processes simultaneously, including attention allocation, working memory updating, planning, inhibition, and cognitive flexibility (Ebrahimi et al., 2026; Mostafaei et al., 2022). Research has demonstrated that game-based interventions can improve executive functions in children with learning difficulties, attentional disorders, and developmental challenges (Mostafaei et al., 2022; Rachanioti et al., 2018). In addition, play therapy and child-centered play interventions have shown positive effects on executive functioning, particularly among children with ADHD and related neurodevelopmental disorders (Kaduson, 2024; Shin et al., 2020; Wong et al., 2023). Studies examining cognitive-behavioral play therapy have further reported improvements in academic and cognitive outcomes among children with learning disorders (Jafari et al., 2022). Recent investigations have also indicated that intellectual games and cognitively stimulating activities can strengthen executive functions and problem-solving abilities in children with developmental difficulties (Ebrahimi et al., 2026). Collectively, these findings suggest that cognitive game-based interventions may provide an effective mechanism for enhancing working memory and related executive processes during early childhood.

While child-focused cognitive interventions have received substantial empirical support, an increasing body of literature highlights the critical role of the family environment and parenting practices in the development of executive functions. Executive functioning does not emerge solely as a consequence of neurological maturation; rather, it is shaped by ongoing interactions between children and

their caregivers within the broader social environment (Wang & Zhao, 2026; Wilson & Gross, 2018). Parents influence executive function development through scaffolding, modeling self-regulation, establishing routines, promoting autonomy, and providing cognitively stimulating experiences (Wang & Zhao, 2026; Wilson & Gross, 2018). Research has demonstrated significant associations between parenting quality and children's executive functioning, with supportive and structured parenting practices contributing to improved cognitive and behavioral outcomes (Lau et al., 2025; Wang & Zhao, 2026). In recent years, executive function-based parenting interventions have been developed specifically to help parents support the development of attention, working memory, inhibitory control, and self-regulation in children with neurodevelopmental disorders. Evidence suggests that such interventions can reduce parental stress, improve family functioning, and enhance children's cognitive and behavioral outcomes (Granmaye et al., 2022; Lau et al., 2025). Video-based and parent-mediated executive function programs have also demonstrated promising effects on executive functioning among preschool children, highlighting the value of involving caregivers directly in intervention efforts (Lau et al., 2025; Wilson & Gross, 2018).

Despite growing evidence supporting both cognitive game-based interventions and executive function-based parenting programs, several important gaps remain in the literature. First, many studies have evaluated these approaches independently rather than comparing their relative effectiveness within a single experimental framework (Bombonato et al., 2024; Scionti et al., 2020). Second, although cognitive training interventions frequently demonstrate short-term benefits, the durability of treatment effects and their maintenance during follow-up periods continue to be debated (Bharadwaj et al., 2022; Diamond & Ling, 2020). Third, relatively few investigations have focused specifically on preschool-aged children with executive function deficits, despite evidence suggesting that interventions implemented during this developmental period may yield particularly meaningful outcomes (Bailey, 2022; Luna, 2023). Moreover, recent findings concerning executive function interventions in populations with ADHD, learning disorders, autism spectrum disorder, and other neurodevelopmental conditions underscore the importance of identifying the most effective strategies for improving working memory and broader executive functioning (Guler et al., 2026; Gurlek & Bumin, 2026; Hansen et al., 2025; Megari & Genova, 2026; Piccolo et al., 2026). Given the

central role of working memory in cognitive development and academic readiness, determining whether direct cognitive empowerment through game-based training or indirect enhancement through executive function-based parenting yields greater benefits has significant theoretical and practical implications.

Therefore, the present study aimed to compare the effectiveness of cognitive empowerment based on cognitive games and executive function-based parenting on improving working memory in children with executive function deficits.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a quasi-experimental design using a pretest–posttest control group framework with a 45-day follow-up assessment. The target population consisted of all children aged 5 to 6 years with executive function deficits who attended kindergartens and therapeutic clinics in Qaemshahr, Iran, during the 2024–2025 academic year and were receiving specialized developmental or psychological services. According to local health statistics, approximately 200 children met these criteria. Sample size estimation was conducted during the study planning phase using G*Power version 3.1 based on a significance level of 0.05, statistical power of 0.80, and a medium effect size of 0.25. A total of 60 children were recruited through purposive sampling after screening for eligibility. Following recruitment, participants were randomly assigned to one of three groups: a cognitive game-based cognitive empowerment group ($n = 20$), an executive function-based parenting group ($n = 20$), and a control group ($n = 20$). Inclusion criteria required participants to be between 5 and 6 years of age, demonstrate executive function deficits according to psychological assessment and DSM-5 diagnostic criteria, possess intellectual functioning within the normal range as determined by standardized intelligence assessments, not receive concurrent similar interventions, and have parental informed consent for participation. Exclusion criteria included the presence of severe developmental or psychiatric disorders such as autism spectrum disorder requiring extensive support, intellectual disability, schizophrenia, the use of medications that could substantially influence executive functioning, lack of active participation in intervention sessions, parental noncompliance with intervention procedures, or major life events such as

migration or severe family crises that could significantly affect cognitive performance.

2.2. Instruments

Executive function deficits were identified using the Neuropsychological Assessment Battery for Children (NEPSY), a comprehensive neuropsychological instrument developed to evaluate developmental functioning in preschool and school-aged children. The assessment examines five major domains, including executive functions and attention, language, sensorimotor functioning, visuospatial processing, and memory and learning. For the purposes of the present study, particular emphasis was placed on executive function and attention-related subtests, including Tower, Auditory Attention and Response Set, Visual Attention, Statue, Design Fluency, and Knock and Tap. These subtests assess planning, self-regulation, inhibition, attentional control, cognitive flexibility, problem-solving, and behavioral monitoring. Previous psychometric investigations have demonstrated satisfactory reliability coefficients across executive function domains, with test–retest reliability estimates ranging from 0.60 to 0.90. The Persian version of the NEPSY has been standardized for Iranian preschool children and has demonstrated acceptable validity and reliability for clinical and research applications.

Working memory was assessed using the Working Memory Test Battery for Children (WMTB-C), originally developed by Pickering and Gathercole based on Baddeley and Hitch's multicomponent model of working memory. The instrument is designed for children and adolescents aged 5 to 15 years and evaluates the three primary components of working memory, namely the phonological loop, visuospatial sketchpad, and central executive. The battery consists of nine subtests, including Digit Recall, Word List Matching, Word List Recall, Nonword Recall, Block Recall, Mazes Memory, Listening Recall, Counting Recall, and Backward Digit Recall. Scores from these subtests are combined to generate indices for each working memory component as well as an overall working memory quotient. The Persian adaptation and standardization of the test have demonstrated satisfactory psychometric properties, with test–retest reliability coefficients reported at 0.83 for the total scale and acceptable reliability values across individual subtests. Evidence of construct validity and internal consistency has also been reported, supporting its use in evaluating working memory performance among Iranian children.

2.3. *Interventions*

Participants in the first experimental group received cognitive empowerment training through structured cognitive games implemented using the Captain’s Log Cognitive Rehabilitation Software. This intervention consisted of 11 sessions, each lasting approximately 90 minutes. The software includes a large collection of adaptive cognitive exercises targeting working memory, attention, visuospatial processing, executive control, and processing speed. Activities incorporated sequential recall tasks, visual recognition and memory exercises, visuospatial navigation tasks, categorization and matching exercises, and selective and sustained attention games. Training followed an errorless learning approach, whereby tasks progressed from simple to complex levels, participants received immediate feedback and corrective guidance, and difficulty levels were adjusted according to individual performance.

The second experimental group participated in an executive function–based parenting program consisting of 11 weekly 90-minute sessions delivered to parents. The program focused on increasing parental knowledge of executive functions, strengthening positive parent–child interactions, improving active listening and emotional responsiveness, promoting strategies for enhancing children’s attention and working memory, establishing structured daily routines, fostering self-regulation and inhibitory control, and encouraging collaborative family problem-solving. The program emphasized practical home-based implementation of executive function–supportive parenting techniques. Participants in the control group received no intervention during the study period. All

participants completed assessments at pretest, posttest, and a 45-day follow-up stage.

2.4. *Data analysis*

Data were analyzed using IBM SPSS statistical software. Descriptive statistics, including means and standard deviations, were calculated to summarize participant characteristics and outcome variables across measurement occasions. Prior to inferential analyses, assumptions of normality, homogeneity of variances, and sphericity were examined. To evaluate changes in working memory across time and between groups, repeated-measures analysis of variance (RM-ANOVA) was conducted. Significant interaction effects were further explored using Bonferroni-adjusted post hoc comparisons to identify specific differences between assessment points and intervention groups. Statistical significance was established at $p < .05$ for all analyses.

3. **Findings and Results**

The study sample consisted of 60 children with executive function deficits who were randomly assigned to a cognitive game–based cognitive empowerment group ($n = 20$), an executive function–based parenting group ($n = 20$), and a control group ($n = 20$). Demographic analyses indicated no statistically significant differences among the three groups regarding children's age, parental educational attainment, or parental employment status ($p > .05$). Therefore, the groups were considered homogeneous at baseline, suggesting that any subsequent differences in working memory outcomes could be attributed to the intervention effects rather than pre-existing demographic disparities.

Table 1

Means and Standard Deviations of Working Memory Scores Across Assessment Stages

Variable	Assessment Stage	Cognitive Game–Based Cognitive Empowerment M ± SD	Executive Function–Based Parenting M ± SD	Control M ± SD
Working Memory	Pretest	20.02 ± 3.10	19.40 ± 3.97	20.09 ± 2.84
Working Memory	Posttest	27.60 ± 3.68	25.10 ± 4.38	20.80 ± 2.90
Working Memory	Follow-up	27.10 ± 3.81	24.20 ± 4.01	20.80 ± 2.97

Table 1 presents the descriptive statistics for working memory across the three measurement occasions. At pretest, mean working memory scores were relatively similar across the cognitive empowerment, parenting, and control groups,

indicating comparable baseline functioning. Following the interventions, both experimental groups demonstrated notable increases in working memory scores at posttest compared with the control group. These improvements were

largely maintained at the 45-day follow-up assessment. The cognitive game-based cognitive empowerment group exhibited the highest mean scores at both posttest and follow-up, followed by the executive function-based parenting group, whereas the control group showed minimal change across the study period.

Prior to conducting repeated-measures analyses, statistical assumptions were examined. Results of the Shapiro-Wilk test indicated that the distribution of working memory scores did not significantly deviate from normality at any assessment point ($p > .05$). Box's M test demonstrated

homogeneity of covariance matrices across groups, Box's $M = 14.90$, $F = 1.11$, $p = .345$. Levene's tests confirmed homogeneity of variances at pretest, posttest, and follow-up assessments ($p > .05$). Furthermore, the homogeneity of regression slopes assumption was satisfied, $F = 1.29$, $p = .286$. Examination of linearity indicated a significant linear relationship between pretest and follow-up scores, $F = 82.40$, $p < .001$, while deviation from linearity was not significant, $F = 1.12$, $p = .365$. Collectively, these findings supported the suitability of repeated-measures analysis of variance for hypothesis testing.

Table 2

Repeated-Measures Analysis of Variance for Working Memory

Source	SS	df	MS	F	p	η^2
Time	8091.70	1.63	494.30	263.60	< .001	.822
Group	563.10	2	281.50	8.04	< .001	.220
Time \times Group	308.30	3.27	94.10	50.20	< .001	.638

The repeated-measures ANOVA revealed a significant main effect of time on working memory, $F = 263.60$, $p < .001$, $\eta^2 = .822$, indicating substantial changes in working memory scores across assessment stages. A significant main effect of group was also observed, $F = 8.04$, $p < .001$, $\eta^2 = .220$, demonstrating overall differences among the intervention and control conditions. Most importantly, the

Time \times Group interaction was statistically significant, $F = 50.20$, $p < .001$, $\eta^2 = .638$, suggesting that changes in working memory over time differed across groups. The large effect sizes indicated that both interventions produced meaningful improvements in working memory compared with the control condition.

Table 3

Bonferroni Post Hoc Comparisons for Working Memory

Comparison	Mean Difference	p
Pretest vs. Posttest	-4.71	< .001
Pretest vs. Follow-up	-4.25	< .001
Posttest vs. Follow-up	0.46	.298
Cognitive Empowerment vs. Parenting	1.97	.219
Cognitive Empowerment vs. Control	4.32	< .001
Parenting vs. Control	3.35	< .001

Bonferroni-adjusted pairwise comparisons demonstrated significant improvements in working memory from pretest to posttest ($MD = -4.71$, $p < .001$) and from pretest to follow-up ($MD = -4.25$, $p < .001$). However, the difference between posttest and follow-up assessments was not statistically significant ($MD = 0.46$, $p = .298$), indicating that treatment gains were maintained over time. Comparisons among groups revealed that both the cognitive game-based cognitive empowerment intervention and the executive function-based parenting intervention produced significantly greater improvements in working memory than

the control group ($p < .001$). However, the difference between the two intervention groups was not statistically significant ($MD = 1.97$, $p = .219$). These findings suggest that both interventions were equally effective in enhancing working memory among children with executive function deficits, and that the beneficial effects remained stable during the follow-up period. Therefore, the hypothesis proposing differential effectiveness between the two intervention approaches was not supported, whereas the sustained effectiveness of both interventions over time was confirmed.

4. Discussion

The present study aimed to compare the effectiveness of cognitive empowerment based on cognitive games and executive function-based parenting on working memory among children with executive function deficits. The findings demonstrated that both intervention approaches significantly improved working memory compared with the control group. Furthermore, the observed improvements remained stable during the 45-day follow-up period, indicating the persistence of treatment gains over time. However, although the cognitive game-based intervention produced slightly higher mean scores than the executive function-based parenting intervention, the difference between the two intervention groups was not statistically significant. Therefore, both approaches were found to be similarly effective in enhancing working memory among preschool children with executive function deficits.

The significant improvement in working memory observed in the cognitive game-based cognitive empowerment group is consistent with contemporary theories of executive function development that emphasize the plasticity of cognitive systems during early childhood. Executive functions, particularly working memory, are highly responsive to environmental stimulation and structured practice during the preschool years because neural networks associated with cognitive control remain under active development (Diamond & Ling, 2020; Luna, 2023). Cognitive games create repeated opportunities for children to engage in information storage, updating, manipulation, inhibition of irrelevant stimuli, and strategic problem-solving. Through continuous engagement in these cognitively demanding activities, children strengthen neural pathways associated with executive control and memory processes. The present findings are consistent with evidence reported by (Scionti et al., 2020), whose meta-analysis demonstrated that cognitive training programs can effectively improve executive functioning in preschool-aged children. Similarly, the findings support the conclusions of (Bharadwaj et al., 2022), who reported significant improvements in working memory following structured cognitive training interventions across diverse pediatric populations.

The effectiveness of cognitive game-based empowerment can also be explained by the motivational and developmental characteristics of play. Young children learn most effectively when educational activities are embedded within enjoyable and meaningful experiences. Cognitive

games reduce resistance to learning, sustain attention for longer periods, and promote active engagement with cognitive tasks. Unlike traditional drill-based exercises, game-based interventions provide immediate feedback, adaptive difficulty levels, and intrinsically rewarding experiences that encourage persistence and effort. These characteristics increase opportunities for successful cognitive practice and facilitate skill acquisition. The current findings are therefore aligned with the observations of (Rachanioti et al., 2018), who highlighted the potential of cognitive games as powerful tools for executive function training in children with and without learning difficulties. Likewise, studies by (Ebrahimi et al., 2026) and (Mostafaei et al., 2022) demonstrated that cognitive and attentional games can improve executive functions, inhibitory control, memory performance, and problem-solving abilities among children with developmental challenges.

Another explanation for the effectiveness of the cognitive game intervention relates to the multidimensional nature of the training activities. The intervention utilized exercises targeting attention, visuospatial processing, working memory, executive control, and information processing speed simultaneously. Contemporary cognitive theories suggest that executive functions are interrelated rather than isolated abilities. Consequently, strengthening one executive process may produce beneficial effects on other cognitive domains. This explanation is supported by research indicating that interventions targeting multiple executive function components often produce stronger outcomes than interventions focused on a single cognitive process (Bombonato et al., 2024; Diamond & Ling, 2020). Furthermore, recent technological developments have enabled increasingly sophisticated cognitive training programs that provide adaptive and individualized learning experiences. Similar positive outcomes have been reported for virtual reality-based interventions, cognitive orientation approaches, and other technology-enhanced executive function programs designed for children with neurodevelopmental disorders (Guler et al., 2026; Gurlek & Bumin, 2026; Vinci et al., 2026).

The findings also revealed that executive function-based parenting significantly improved children's working memory compared with the control group. This result underscores the important role of the family environment in shaping cognitive development. Executive functions emerge through dynamic interactions between biological maturation and environmental experiences. Parents provide many of the opportunities through which children learn self-regulation,

attention control, planning, and memory strategies. Consequently, interventions that equip parents with executive function–supportive practices may indirectly strengthen children's cognitive functioning. The present findings support the theoretical perspective that executive functions are socially scaffolded skills that develop within caregiver-child interactions (Wang & Zhao, 2026; Wilson & Gross, 2018). Through structured routines, guided problem-solving, supportive communication, and consistent behavioral expectations, parents create conditions that facilitate the development of working memory and related executive abilities.

The positive effects of executive function–based parenting observed in the present study are consistent with previous empirical evidence. (Granmaye et al., 2022) reported that executive function–based parenting interventions improved parental functioning and outcomes among families of children with neurodevelopmental disorders. Similarly, (Lau et al., 2025) demonstrated that parent-mediated executive function programs significantly enhanced executive functioning in preschool children. These findings suggest that parents can serve as effective agents of cognitive intervention when provided with appropriate training and support. Executive function–based parenting programs may be particularly valuable because they extend intervention effects beyond formal treatment sessions and integrate cognitive stimulation into everyday family interactions. Unlike child-focused interventions that are limited to structured training sessions, parent-focused approaches influence children's cognitive experiences across multiple contexts and over extended periods.

An important finding of the present study was that the gains achieved by both intervention groups remained stable during the follow-up period. The absence of significant differences between posttest and follow-up assessments suggests that participants maintained the cognitive benefits acquired during treatment. This result is particularly meaningful because the long-term sustainability of executive function interventions remains a topic of ongoing debate within the literature. Some researchers have argued that cognitive training effects may diminish over time if skills are not actively reinforced (Diamond & Ling, 2020). However, the present findings suggest that both interventions produced durable changes in children's cognitive functioning. In the cognitive game group, continued benefits may reflect the strengthening of underlying executive processes through repeated practice. In the parenting intervention group, maintenance effects may

be attributable to ongoing implementation of executive function–supportive parenting behaviors after the formal intervention had ended. These explanations are consistent with evidence indicating that interventions promoting meaningful behavioral and environmental changes are more likely to produce lasting outcomes (Bombonato et al., 2024; Lau et al., 2025).

Another noteworthy finding was the absence of a statistically significant difference between the two intervention groups. Although the cognitive game–based intervention yielded slightly higher working memory scores, both interventions demonstrated comparable levels of effectiveness. This result suggests that executive function deficits may be addressed successfully through different mechanisms. Cognitive games may exert their influence through direct training of cognitive processes, whereas executive function–based parenting may produce improvements indirectly by optimizing children's daily environments and learning experiences. The comparable effectiveness of these approaches highlights the multifactorial nature of executive function development. Executive functioning is influenced by neurological, cognitive, behavioral, emotional, and environmental factors; therefore, interventions targeting different levels of this system may produce similar outcomes. This interpretation is consistent with ecological and developmental models of executive function that emphasize the interaction between individual capacities and environmental supports (Barkley, 2020; Luna, 2023).

The findings of the present study also contribute to the growing literature on executive function interventions for children with neurodevelopmental difficulties. Previous investigations have documented associations between executive function deficits and a wide range of developmental disorders, including ADHD, dyslexia, specific learning disorders, and autism spectrum disorder (Chutko et al., 2022; Megari & Genova, 2026; Smith et al., 2024). Working memory impairments often contribute to academic difficulties, reduced self-regulation, and poor adaptive functioning in these populations. Consequently, interventions capable of improving working memory may yield broad developmental benefits extending beyond cognitive performance alone. Research has shown that executive function enhancement can positively influence academic achievement, emotional regulation, social functioning, and adaptive behavior (Bailey, 2022; Piccolo et al., 2026; Sabzi et al., 2022). Therefore, the observed improvements in working memory may have implications

for broader developmental outcomes among children with executive function deficits.

5. Conclusion

The present findings are compatible with emerging evidence supporting the role of engaging and experiential learning activities in cognitive development. Recent studies have shown that executive functions can be strengthened through a variety of cognitively stimulating experiences, including cognitively engaging physical activities, play-based interventions, educational programs, and technology-assisted training approaches (Kaduson, 2024; Mao et al., 2024; Wong et al., 2023). Moreover, educational interventions designed for children with developmental disorders have increasingly emphasized active participation, adaptive instruction, and individualized learning experiences (Hansen et al., 2025). The success of the cognitive empowerment program in the present study supports these contemporary approaches and reinforces the importance of creating developmentally appropriate, engaging, and cognitively demanding learning environments for young children.

6. Limitations & Suggestions

Several limitations should be considered when interpreting the findings of this study. First, the sample was limited to children with executive function deficits from a single city, which may restrict the generalizability of the findings to other populations and cultural contexts. Second, the sample size, although adequate for the study design, was relatively modest and may have limited the detection of smaller differences between intervention groups. Third, the follow-up period was limited to 45 days, preventing conclusions regarding the long-term maintenance of intervention effects over several months or years. Fourth, the study relied primarily on standardized assessments of working memory and did not include broader measures of academic achievement, social functioning, or behavioral outcomes. Finally, factors such as family characteristics, parental involvement, and home learning environments may have influenced treatment outcomes but were not examined in detail.

Future studies should examine the effectiveness of cognitive game-based empowerment and executive function-based parenting interventions using larger and more diverse samples drawn from multiple geographical regions. Longer follow-up periods would help determine the

durability of intervention effects and identify factors associated with sustained cognitive improvement. Researchers may also investigate the combined effects of cognitive training and parenting interventions to determine whether integrated approaches produce additive or synergistic benefits. Additional outcome measures, including academic performance, emotional regulation, social competence, adaptive functioning, and quality of life, should be incorporated to evaluate the broader impact of executive function interventions. Furthermore, future studies could compare different technological platforms, such as virtual reality, augmented reality, and mobile-based cognitive training systems, to identify the most effective delivery methods for young children.

The findings suggest that both cognitive game-based empowerment programs and executive function-based parenting interventions can be incorporated into educational, clinical, and rehabilitation settings for children with executive function deficits. Preschool centers, schools, counseling clinics, and child development centers may benefit from implementing structured cognitive training programs that target working memory and related executive processes through engaging and developmentally appropriate activities. Practitioners should also consider involving parents in intervention programs, as caregiver participation appears to provide meaningful support for children's cognitive development. Training workshops that teach parents strategies for promoting attention, self-regulation, memory, and problem-solving in everyday contexts may enhance the effectiveness of child-focused interventions. Integrating cognitive training with family-based support services may offer a comprehensive and sustainable approach to improving executive functioning among young children.

Acknowledgments

We would like to express our appreciation and gratitude to all those who cooperated in carrying out this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

Authors' Contributions

All authors equally contributed in this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

References

- Arjomandnia, A. A., Talebi, S., & Miri, M. A. (2019). Construction and preliminary norming of the Tehran Working Memory Assessment Test. *Applied Psychological Research, 10*(4), 141-160.
- Bailey, R. (2022). Working memory and attention in preschool children: Relations to early academic achievement. *Developmental science, 25*(2), e13109.
- Barkley, R. A. (2020). *Executive Functions: What They Are, How They Work, and Why They Evolved*. Guilford Press.
- Bharadwaj, S. V., Yeatts, P., & Headley, J. (2022). Efficacy of Cogmed working memory training program in improving working memory in school-age children with and without neurological insults or disorders: A meta-analysis. *Applied Neuropsychology: Child, 11*(4), 891-903. <https://doi.org/10.1080/21622965.2021.1920943>
- Bombonato, C., Del Lucchese, B., & Ruffini, C. (2024). Far transfer effects of trainings on executive functions in neurodevelopmental disorders: A systematic review and meta-analysis. *Neuropsychology Review, 34*, 98-133. <https://doi.org/10.1007/s11065-022-09574-z>
- Chutko, L. S., Surushkina, S. Y., Yakovenko, E. A., Anisimova, T. I., Didur, M. D., & Chekalova, S. A. (2022). Impairments to executive functions in children with dyslexia. *Neuroscience and Behavioral Physiology, 52*(1), 1-7. <https://doi.org/10.1007/s11055-022-01200-y>
- Diamond, A., & Ling, D. S. (2020). Review of the evidence on, and fundamental questions about, efforts to improve executive functions, including working memory. In J. M. Novick, M. F. Bunting, M. R. Dougherty, & R. W. Engle (Eds.), *Cognitive and Working Memory Training: Perspectives from Psychology, Neuroscience, and Human Development* (pp. 143-431). Oxford University Press. <https://doi.org/10.1093/oso/9780199974467.003.0008>
- Ebrahimi, R., Hashemi, Z., & Hekmati, I. (2026). Effectiveness of intellectual games in the brain executive functions and problem-solving ability of children with specific learning disorders. *Journal of Research in Psychopathology, 7*(1).
- Granmaye, S., Arjomandnia, A. A., Akbari, M., Kakabaraei, K., & Moradi, O. (2022). Development of an executive-function-based parenting training package and its effect on parenting stress and mental health of mothers of children with neurodevelopmental disorders. *Empowering Exceptional Children, 13*(2), 22-34.
- Guler, E. C., Kose, B., Temelturk, R. D., Aynigul, K. D., Pekcetin, S., & Oztop, D. B. (2026). Investigation of the effect of second-generation virtual reality interventions on hot and cold executive functions in children with attention-deficit/hyperactivity disorder: Single-blind randomized controlled study. *Games for Health Journal, 15*(2), 106-113. <https://doi.org/10.1177/2161783X251378645>
- Gurlek, S., & Bumin, G. (2026). The effect of cognitive orientation to daily occupational performance in children with attention deficit hyperactivity disorder: A pilot randomized controlled study. *Applied Neuropsychology: Child, 15*(2), 169-178. <https://doi.org/10.1080/21622965.2024.2385679>
- Hansen, B. A., Phipps, L. E., Andersen, A. S., Schissel, M. E., & Shillingsburg, M. A. (2025). A feasibility study of Headsprout Reading Program in children with autism spectrum disorder and reading delay. *Journal of Behavioral Education, 34*(2), 454-477. <https://doi.org/10.1007/s10864-023-09529-1>
- Jafari, N., Roshani, T., & Shahbazi, G. (2022). The effectiveness of cognitive-behavioral play therapy on reducing handwriting and math problems in students with specific learning disorders. *Research in School and Virtual Learning, 9*(3).
- Kaduson, H. G. (2024). Play therapy for children with attention-deficit/hyperactivity disorder. *The ADHD Resource Hub, 2*(5), 161-175. <https://doi.org/10.1521/adhdhub.2024.2.5.2>
- Lau, E. Y. H., Wu, X., Siu, C. T. S., Williams, K. E., & Bautista, A. (2025). Examining the effectiveness of a video-based parent-child program on executive functions for children 5 to 6 years old: A randomized controlled trial. *Child development, 96*(2), 781-796. <https://doi.org/10.1111/cdev.14208>
- Luna, B. (2023). The development of executive functions in early childhood: Implications for academic success. *Developmental Cognitive Neuroscience, 47*, 100937.
- Mao, F., Huang, F., Zhao, S., & Fang, Q. (2024). Effects of cognitively engaging physical activity interventions on executive function in children and adolescents: A systematic review and meta-analysis. *Frontiers in psychology, 15*. <https://doi.org/10.3389/fpsyg.2024.1454447>
- Megari, K., & Genova, K. D. (2026). Cognitive pathways in atypical development: Executive functions in children with attention-deficit/hyperactivity disorder and specific learning disorders. *International Journal of Developmental Neuroscience, 86*(1), e70094. <https://doi.org/10.1002/jdn.70094>
- Miller, M. C., Jean-Francois, E., Hembree, K. E., Peugh, J. L., Epstein, J. N., Tamm, L., & Becker, S. P. (2026). Cognitive disengagement syndrome symptoms and ADHD dimensions in relation to children's daily life executive functioning deficits. *Research on Child and Adolescent Psychopathology, 54*(2), 36. <https://doi.org/10.1007/s10802-026-01436-z>
- Mostafaei, A., Oraki, M., & Asadi, S. (2022). The effect of attentional games on motor memory consolidation and inhibitory control in children with executive function disorders. *Neuropsychology, 8*(30), 51-67.
- Piccolo, A., La Fauci, M., De Domenico, C., Di Cara, M., Fulgenzi, A., Mancuso, N., & Cucinotta, F. (2026). The impact of executive functions on metaphonological skills: Correlation and treatment implication for ADHD children. *Journal of clinical medicine, 15*(2), 906. <https://doi.org/10.3390/jcm15020906>

- Rachanioti, E., Bratitsis, T., & Alevriadou, A. (2018). Cognitive games for children's executive functions training with or without learning difficulties: An overview. Proceedings of the 8th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-Exclusion,
- Sabzi, R., Mihandoost, Z., Nademi, A., & Parandin, S. (2022). The effectiveness of executive function training on emotional self-regulation and test anxiety of female students with writing disorders. *Journal of Health Promotion Management*, 11(3).
- Scionti, N., Cavallero, M., Zogmaister, C., & Marzocchi, G. M. (2020). Is cognitive training effective for improving executive functions in preschoolers? A systematic review and meta-analysis. *Frontiers in psychology*, 10, 2812. <https://doi.org/10.3389/fpsyg.2019.02812>
- Shin, S. M., Choi, S., & Park, S. Y. (2020). Play therapy in South Korea: History, current practices, research, and future directions. *International Journal of Play Therapy*, 29(1), 54-64. <https://doi.org/10.1037/pla0000112>
- Smith, J. N., Jusko, M. L., Fosco, W. D., Musser, E. D., & Raiker, J. S. (2024). A critical review of hot executive functioning in youth attention-deficit/hyperactivity disorder: Methodological limitations, conceptual considerations, and future directions. *Development and Psychopathology*, 36(2), 601-615. <https://doi.org/10.1017/S0954579422001432>
- Vinci, L. A., Passaro, A., & Stasolla, F. (2026). Augmented, virtual, and mixed reality assessment and training for executive functions in children with ADHD: A scoping review. *Information*, 17(2), 186. <https://doi.org/10.3390/info17020186>
- Wang, H., & Zhao, J. (2026). The association between parental resilience and emotional/behavioural problems in children with autism spectrum disorders: The mediating role of parenting style. *PLoS One*, 21(2), e0329989. <https://doi.org/10.1371/journal.pone.0329989>
- Wilson, D. M., & Gross, D. (2018). Parents' executive functioning and involvement in their child's education: An integrated literature review. *The Journal of School Health*, 88(4), 322-329. <https://doi.org/10.1111/josh.12612>
- Wong, T. Y., Chang, Y. T., Wang, M. Y., & Chang, Y. H. (2023). The effectiveness of child-centered play therapy for executive functions in children with attention-deficit/hyperactivity disorder. *Clinical Child Psychology and Psychiatry*, 28(3), 877-894. <https://doi.org/10.1177/13591045221128399>