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The influence of executive function therapy on improving social maturity in children with Attention Deficit Hyperactivity Disorder (ADHD): An experimental study

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Abstract: Children with Attention Deficit Hyperactivity Disorder (ADHD) have non-adaptive behavioral problems related to social maturity, which impact their future lives as adults, thus necessitating access to appropriate treatment. This experimental study aims to examine the effect of executive function therapy on improving social maturity in children with ADHD. It adopts a comprehensive approach, employing a one-group pretest-posttest design on 20 children with ADHD. The social maturity scores of the children in the initial examination ranged from 32 to 86, measured using the Vineland Social Maturity Scale (VSMS), and then analyzed by one-way repeated measures ANOVA using SPSS. The results show an improvement after executive function therapy (Phase III/Post-test, M = 75.90; Phase II, M = 64.00; Phase I, M = 64.30; Pre-test, M = 61.35), thus indicating a significant influence of the therapy on the improvement of the social maturity of children with ADHD, $F(3; 16) = 73.9$; $p < .001$, $\eta_p^2 = .795$ showed moderate level of therapy effectiveness. This study suggested that executive function therapy is effective in improving social maturity in children with ADHD.

Keywords: ADHD social maturity; executive function; VSMS

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Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopment disorder in DSM 5 (American Psychiatric Association, 2013). Indonesia is yet to possess valid data on the prevalence of children with ADHD because little related research has been conducted. However, it is estimated that in the country around 3-5% of children suffer from the condition. In the United States, the figure is around 3-7%, while in Germany, Canada and New Zealand it is around 5-10% of the child population. According to the Health Maintenance Organization, the prevalence of children with ADHD worldwide is between 7-9%, and it is more often found in boys. The estimated ratio of boys to girls is 3:1 in general population and 4:1 in clinical populations. This type of inattention condition is more common in female (children or adults) (Simms, 2004). Over time, the ratio of men to women with ADHD has decreased due to increased early detection and therapy in cases of children with ADHD. Based on these data, in every classroom in the United States, there would have been one or two students with ADHD in 2004 (Simms, 2004).

In Indonesia, especially regarding school-age children with ADHD, the prevalence is quite high, estimated to be 2-7%, and 5% of the population of children at all age (Sayal et al., 2018). The main cause of the condition is dysfunction in the frontal lobe, which has an impulsive and hyperactive impact. Based on this, there are three types of children with ADHD (DSM 5). The first is the predominant inattention type, with six or more inattention symptoms, and affecting children for more than 6 months, who show impulsive and hyperactive symptoms. The predominant type is hyperactive-impulsive, with six or more hyperactive/impulsive symptoms and only a few insignificant inattentive symptoms. Combination Type is when children display both of the in-attention criterion and the hyperactive-impulsive criterion and the symptoms last more than 6 months.

The main characteristic of children with ADHD is executive dysfunction, which results in problems with non-adaptive behavior in the environment (Juke, 2022). Generally, it occurs at a low social level. Some of the associated mental problems include ones with peer relationships; disobedience of rules; impulsive acting without thinking about the risks that can hurt themselves or others; and the inability to stay still (Barkley, 2020). Children with ADHD are often rejected by their peers in terms of playing together or working in groups in class. In addition, academic problems that affect such children include not completing assignments; not focusing when studying; forgetting to take items to class; not being able to organize their assignments; and showing a lack of care when completing assignments (Barkley, 2020). These academic problems can affect the development from childhood to adulthood or become a lifelong disability (Barkley, 2020; Juke, 2022).

Low social skills in children with ADHD cause cognitive, affective, and behavioral dysfunction. Cognitive dysfunction is characterized by symptoms of a lack of focus; the inability to plan and organize daily tasks; frequent forgetfulness; the inability to complete tasks; and the inability to control oneself and manage one's behavior. At the same time, affective dysfunction involves mood problems; difficulties in controlling emotions; and a lack of motivation and self-confidence. Finally, behavioural dysfunction can be manifested by disturbing friends or even sometimes hurting them; being emotional; disobeying the rules; being impulsive in acting, without thinking about the risks that can hurt oneself or others; the inability to stay still; being careless and messy/untidy; and not completing tasks.

At the Psychology Department of Ceria Hospital in Kandangan, South Kalimantan, Indonesia, the diagnosis of children with ADHD

begins with establishing an accurate and precise diagnosis. This is done by paying attention to the main criteria of ADHD, namely inattention, impulsivity and hyperactivity. These symptoms must be consistently displayed in at least two consistent present settings. Second, the child will display a short attention span, with a high level of distractibility for a chronological age and developmental level, consistently at some different settings (e.g., home and school). Third, children will often display specific behavior, namely impulsive-ness or explosiveness, emotional instability, explosive reactions, difficulty in focusing, and irritability. Fourth, the symptoms will not be new, but have been continuously present for at least six months. Fifth, the DSM 5 criteria must be met according to the DSM 5 categories (American Psychiatric Association, 2013).

Based on the preliminary data from parent interviews and observations of the children with ADHD in the Psychology Department of Ceria Hospital in Kandangan, South Kalimantan, Indonesia, 8 out of 10 cases were found to be related with history of pregnancy problems such as trauma and bleeding in the third trimester; symptoms of weakness in maintaining attention; language delays; the emergence of echolalia (repetition of meaningless words) and repetitive language; resistance to different routines; shallow emotions; failure to develop peer socialization; and inability to maintain direct social interactions with other children.

There are various instruments to identify the social maturity of children with ADHD, including the Berder-Gestalt Test (Piotrowski, 1995; Sadock et al., 2015); the Denver Developmental Screening Test (DDST); and newer versions of Denver II (Frankenburg & Dodds, 1967; Wijedasa, 2012) and VSMS. VSMS was published by Doll in 1965, and the validity of the items have good correlation value of around .80 to .85 with the Stanford Binet Intelligence Test (Doll, 1936, 1965; Pedrini & Pedrini, 1966; Roopesh, 2019). Doll explained that social maturity refers to children's ability to take care of themselves and their participation in activities that lead to independence as befits an adult. This includes self-help (the ability to help oneself); self-direction (the ability to direct oneself); locomotion (motor movement ability); and occupation (ability to perform occupational tasks). Children with ADHD are said to be socially mature when they can complete developmental tasks commensurate with their calendar age (Kaneko & Okamura, 2006).

Handling of non-adaptive behavioral problems related to the social maturity of children with ADHD can be undertaken with integrative training, the integration of psychoeducational approaches; and behavior modification using media, activities and games that have therapeutic value (Juke, 2022). In hospitals, psychology department generally uses executive function therapy.

Executive function therapy is widely used in treatment of ADHD because it is related to the ability to use executive functions in the brain, precisely the frontal lobe. In this way, individuals can face challenges and complete and achieve goals using cognitive functions; that is, executive skills or functions. Executive functions work together in varied combinations, such as attention, memory, planning, emotion regulation, motion regulation, and meta-cognition (Brown, 2006). As explained above, it includes three main criteria, one of which is predominant inattention type. This type of ADHD can be indicated by the following symptoms: obstacles to responding to specific stimuli (focus); inability to maintain attention; being less selective; obstacles to transferring attention (alternatives); and ambiguous decision making. The condition ultimately means that developmental tasks in social maturity experience barriers or delays.

Treatment can take the following forms: 1) Providing knowledge about ADHD and information about the treatment exercises that will

be undertaken; 2) Exercises to help improve or reduce specific behavior related to deficits in executive function elements; 3) Exercises to improve academic performance; 4) Exercise to develop social and personal skills. Specifically, the nature of treatment for children with ADHD includes short-term measures, aimed at reducing excessive symptoms and increasing expected behaviors and long-term treatment, intended to improve social and academic relationships in family, school and community settings.

This study reveals the novelty of which a consistently scheduled executive function therapy can significantly improve the social well-being of children with ADHD, as well as highlighting the importance of early intervention to prevent the development of further social-emotional and behavioral disorders.

Some previous studies, such as the research of Memisevic and Bisevic (2020), have examined the relationship between executive functions and academic competency and social skills in adolescents with mild intellectual disabilities. The conclusion they draw concerns the importance of early intervention in relation to executive function in order to improve the academic and social competence of children with intellectual disabilities. In addition, the research of Reiter et al. (2005) demonstrates that executive function, in addition to being able to affect motor performance and social maturity, can also affect memory work function, and that related intervention can even help children with dyslexia.

Methods

The research used an experimental method, with a one group repeated measures design. The design involved repeatedly testing all subjects in each treatment to investigate their behavioral trends in relation to the criterion variables over time (Verma, 2015). The goal was to determine the level of effectiveness of executive function therapy in improving the social maturity of children with ADHD, with manipulation of an independent variable to observe its effect on other variables. The independent variable in this research was executive function therapy; that is, treatment integrating psychoeducational approaches and behavior modification using media play activities with therapeutic value. The dependent variable was social maturity, namely the children's ability to take care of themselves and their participation in activities that lead to independence.

The research used child subjects who had previously been diagnosed by a doctor or psychologist as having ADHD and whose parents were willing for them to take part.

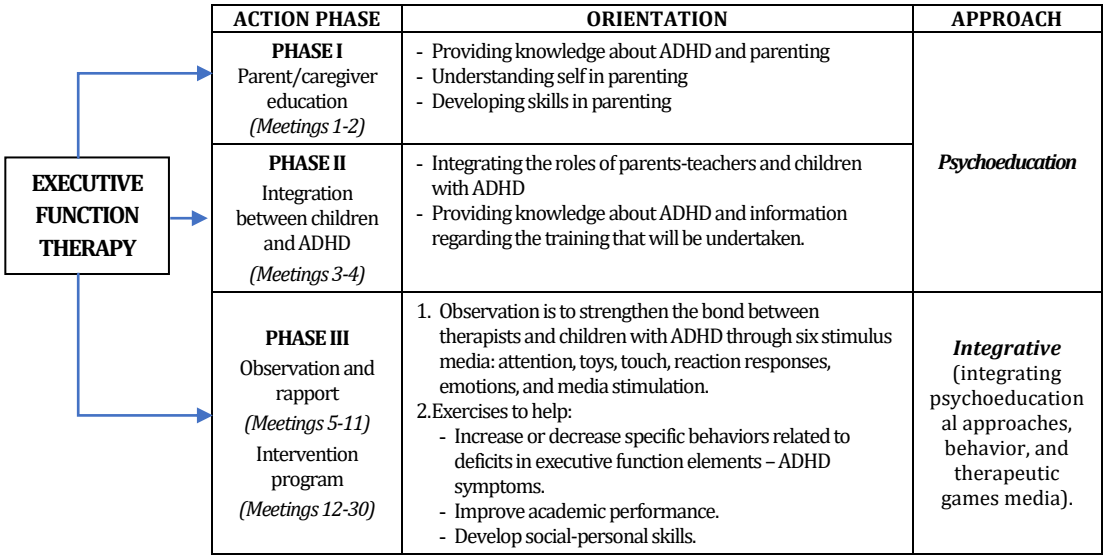
High and low social maturity intervals were measured using the VSMS developed by Doll (1936, 1965) and updated by Sparrow (2011). The reliability of the scale ranges from the low .70s to high .80s, with split-half reliability ranging from .93 to .97, and subdomains from the .80s to .90s.

The social maturity scores of the children with ADHD in the initial examination were between 32 and 86, with an average (median) score of 59.50. Their social maturity fell in the categories of low and very low. Executive function therapy, as an experimental intervention, was conducted on the 20 children, taking into account the characteristics of chronological age (CA) or calendar age, gender, and education. The diagnosis was by a pediatrician using DSM 5 diagnostic criteria.

Executive function therapy was designed for 30 meetings, with two interventions per week. The treatment began with an initial assessment, rapport building, and observation (eight stimuli observed) over six meetings, followed by a training program of 24 meetings. The intervention comprised three phases: Phase I (Parental Education); Phase II (Parent and Child Integration); and Phase III (Executive Function Intervention Program) (see Figure 1).

Figure 1

Intervention Phases of Executive Function Therapy



ACTION PHASE	ORIENTATION	APPROACH
PHASE I Parent/caregiver education *(Meetings 1-2)*	- Providing knowledge about ADHD and parenting - Understanding self in parenting - Developing skills in parenting	***Psychoeducation***
PHASE II Integration between children and ADHD *(Meetings 3-4)*	- Integrating the roles of parents-teachers and children with ADHD - Providing knowledge about ADHD and information regarding the training that will be undertaken.	
PHASE III Observation and rapport *(Meetings 5-11)* Intervention program *(Meetings 12-30)*	1. Observation is to strengthen the bond between therapists and children with ADHD through six stimulus media: attention, toys, touch, reaction responses, emotions, and media stimulation. 2.Exercises to help: - Increase or decrease specific behaviors related to deficits in executive function elements – ADHD symptoms. - Improve academic performance. - Develop social-personal skills.	***Integrative*** (integrating psychoeducational approaches, behavior, and therapeutic games media).

The effectiveness of the executive function therapy in improving the social maturity of children with ADHD at the Psychology Clinic of Ceria Hospital in Kandangan was determined by one-way repeated measures ANOVA using SPSS. This analysis method allows for the comparison of social maturity scores across multiple time points (Verma, 2015), including pre-test (before therapy), Phase I, Phase II, and Phase III (post-test) a week after the final intervention.

The research received approval from the Research Ethics Committee of Ceria Hospital in Kandangan, and all the subjects gave their consent to participating in the experiment.

Results

The distribution of the characteristics of the 20 children with ADHD who were given executive function can be seen in the following Table 1. Among these, 17 were children aged 2.5 years and above, representing 85% of the sample, while three were toddlers (< 2.5 years old), accounting for 15%. Regarding gender, 14 were male (70%), and six female (30%). With regard to education, two participants had an elementary school education (10%), four a kindergarten education (20%), ten were in the preschool category, and the remaining four were not yet attending school.

One week after intervention, the VSMS scale was given again to the children, with the help of their parents or caregivers. This aised to observe any differences in levels of social maturity. The mean scores showed progressive improvement from the pre-test phase (61.35) through to Phase I (63.30) and Phase II (64.00), with a notable increase after Phase III (post-test, mean = 75.90). This can be translated descriptively, as the processed data showed a difference in the mean or average value between the pre-test and post-test VSMS of the children as a result of the interventional executive function therapy. Higher mean or average post-test and pre-test values indicate increased competence in developmental tasks, resulting in changes to the normative social maturity criteria through the executive function therapy. The differences in the children's social maturity levels before training (pre-test) and after training (post-test) can be seen in Table 2.

Table 1

Characteristics of the children with ADHD at the Psychology Department, Ceria Hospital, South Kalimantan, Indonesia

No.	Characteristics	*f*	%
1	Age		
	Children (2.5 years<)	17	85 %
	Toddlers (2.4 years>)	3	15 %
2	Gender		
	Male	14	70 %
	Female	6	30 %
3	Level of education		
	Elementary school	2	10 %
	Kindergarten	4	20 %
	Preschool	10	50 %
	Not yet at school	4	20 %

Table 2

Children's Social Maturity Levels in Each Phase of the Training

No.	Action Phase	Mean	SD	N
1	Pre-test	61.35	15.191	20
2	Phase I	63.30	14.291	20
3	Phase II	64.00	14.142	20
4	Phase III (post-test)	75.90	12.653	20

Before conducting the analysis of variance using repeated measures ANOVA, the researchers performed assumption testing for normality and sphericity. A data normality test was conducted to fulfil the prerequisites for data analysis. This aimed to determine whether the processed data were normally or abnormally distributed, ensuring symmetrical data distribution around the mean. The results showed that according to the Kolmogorov-Smirnov criteria, a significance level of .200 was obtained for each phase of treatment. Therefore, it can be concluded that the distribution of pre-test scores (D(20) = .119, p = .200) and post-test scores (D(20) = .128, p = .200) were both normally distributed.

With regard to sphericity, the assumption required equal variances of the differences between all combinations of related groups, meaning the correlations between the repeated measures had to be equal. Unfortunately, the sphericity assumption, as shown in Table 3, was violated because the p-value associated with the Chi-Square statistic was .00, which is lower than .05. Therefore, a corrective analysis needed to be applied in order to test the significance of the F-value, namely the Greenhouse-Geisser.

The results show that after applying the Greenhouse-Geisser correction, the F value was still significant, with an associated p-value of .00, which is less than .01, as shown in Table 4. Notably, the F-value remained significant across all conditions, indicating that the findings were unaffected by any violations of the sphericity assumption. With a partial Eta Square of .795, which is considered high, the effect of therapy on improving the social maturity of children with ADHD was substantial.

As shown in Table 5, there was a specific improvement in the social maturity of the children during the pre-test and across Phase I, Phase II, and Phase III therapy, with p values of .007, .001 and .000, indicating significance at the p < .01 level. It can also be observed that there was an

improvement in the social maturity of the children from Phase I to Phase II, and from Phase II to Phase III, with p values of .006 and .000 respectively, also indicating significance at the $p < .01$ level.

Furthermore, the researchers conducted additional analyses to determine whether gender and age differences influenced the levels of social maturity in the children with ADHD. As shown in Table 6, the results indicate no significant differences in social maturity based on gender ($p = .830$, $p > .05$) or age ($p = .495$, $p > .05$).

Table 3
Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
phase	.014	76.206	5	.000	.387	.397	.333

Table 4
Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
phase	Sphericity Assumed	2616.9	3	872.3	73.9	.000	.795
	Greenhouse-Geisser	2616.9	1.1	2251.3	73.9	.000	.795
Error (phase)	Sphericity Assumed	672.8	57	11.8			
	Greenhouse-Geisser	672.8	22.0	30.4			

Table 5
Pairwise Comparisons

(I) phase	(J) phase	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Pre-test	Phase I	-1.950*	0.510	.007	-3.452	-0.448
	Phase II	-2.650*	0.549	.001	-4.266	-1.034
	Phase III (post-test)	-14.550*	1.671	.000	-19.469	-9.631
Phase I	Pre-test	1.950*	0.510	.007	0.448	3.452
	Phase II	-0.700*	0.179	.006	-1.227	-0.173
	Phase III (post-test)	-12.600*	1.387	.000	-16.683	-8.517
Phase II	Pre-test	2.650*	0.549	.001	1.034	4.266
	Phase I	0.700*	0.179	.006	0.173	1.227
	Phase III (post-test)	-11.900*	1.332	.000	-15.820	-7.980
Phase III (post-test)	Pre-test	14.550*	1.671	.000	9.631	19.469
	Phase I	12.600*	1.387	.000	8.517	16.683
	Phase II	11.900*	1.332	.000	7.980	15.820

Table 6

Tests of between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	315119.474	1	315119.474	583.465	.002	.997
Sex	32.000	1	32.000	.059	.830	.029
Age	12124.423	16	757.776	1.403	.495	.918

Discussion

Based on the results of the one group repeated measures design test, it was shown that there was a significant effect of executive function therapy on increasing the social maturity of children with ADHD. From high to low, this was Phase III post-test (M = 75.90; SD = 12.65); Phase II (M = 64.00; SD = 14.14); Phase I (M = 63.30; SD = 14.29); and pre-test (M = 61.35; SD = 15.19). The findings indicate that the social maturity score in Phase III (post-test) was significantly higher after the executive function therapy intervention compared to the pre-test. This is in line with the findings of Evans et al. (2024) who demonstrated that psychoeducation and teacher-parent programs yielded significant group-by-time benefits in adolescent self-rated social skills.

However, the findings diverge from those of Morris et al. (2021), who conducted a systematic review and meta-analysis of interventions for adolescents with ADHD to improve their peer social functioning. While their study found no statistically significant differences in social functioning between groups, our research obtained significant results.

Faheem et al. (2022) state that the prevalence of ADHD is higher in boys. Therefore, to ensure that the effect of the intervention was truly homogeneous and not affected by any confounding, a difference analysis was conducted based on characteristic variables, namely the gender and age of children with ADHD. The results showed that there was no difference in the level of social maturity of children with ADHD based on gender ($p = .830$, $p > .05$) or age ($p = .495$, $p > .05$). This was further strengthened by the results of the partial eta squared (.795) influence test, which were relatively high, with the influence of therapy on improving the social well-being of children with ADHD relatively high.

Executive function is a multifaceted neuro-psychological construct, a set of high-level neuro-cognitive processes consisting of information, a set of maintenance, and a set of shifting. According to Suchy (2009), the set of information is related to the aspects of reasoning and problem-solving, which cons ist of working memory and generativity. The maintenance set focuses on maintaining motivation for certain tasks given, such as response, selection, inhibition, initiation and attentional vigilance, while set-shifting emphasizes the ability to change goals in response to changes in the environment, such as cognitive flexibility. Executive function therapy inter-ventions allow children with ADHD to practice formulating a plan; implement appro-priate actions according to the context of the stimulation; generate efforts to overcome the problems they face; modify ongoing behaviors in response to changes in the environment; and regulate emotions to produce purposeful and future-oriented behaviors (Suchy, 2009; Zelazo & Cunningham, 2007).

Research by Moon (2012) shows that ADHD research from the perspective of therapists and educators in the United States centers on the behavior of children who are less able to focus and

pay attention effectively; cannot settle down; are difficult to manage when given a task; and display excessive movement. In addition, the children may be aggressive towards others, both physically and verbally. According to therapists and educators in Korea, the most significant challenges are children's inability to control themselves, being stubborn when directed, and not paying attention to rules or instructions. It is natural to be worried about the future of children with ADHD, especially regarding social problems and their future social roles as adults, so access to appropriate treatment should be available.

However, changing old habits into new ones is not easy and requires extra effort. According to Gardner and Rebar (2019), changes in behavior are determined by the individual's awareness of their maladaptive or problematic behavior and their wait for the will and motivation to change. Research by Lally et al. (2010) concluded that it takes 254 days for individuals to form new behaviors and habits.

Based on the observation of the intervention journey with executive function therapy, it is seen that the loyalty of parents or caregivers is very high. They consistently follow the schedule set during the therapy process. The meeting schedule is designed, controlled and set according to the goals of the therapy. Treatment performed specifically for ages 2-10 years is formal therapy. Each treatment always applies the following pattern: 1) Readiness, aimed at preparing children to enter the training process and encouraging and raising awareness that they will take part in helpful self-awareness training; 2) Activity: children can reflect on themselves through activities arranged according to their conditions (self-reflection); and 3) Closing: this is also the time for giving children rewards, feedback and support according to their training process. Applying the patterns of readiness-self-awareness; activity-self-reflection; closing reward and feedback in this research was relatively influential in shaping the social maturity of children with ADHD.

In line with the description and explanation above, the improving social maturity of children with ADHD shows positive proof that executive function therapy has an effective influence as an intervention process to change behavior, and that the associated tasks are adequate for the development of children's social maturity, even at a moderate level.

Concerning the findings, there are several research implications that indicate that cognitive dysfunction in children with ADHD is closely related to the performance of the frontal lobe, which affects the ability to control thoughts, behavior and emotions, even though other aspects of the child's ability can still function effectively. However, children with ADHD experience some difficulties in controlling and regulating their emotions and behavior; they are easily stressed, and face difficulties in social interaction. Intervention with executive function therapy for such children can predict and control their responses to the three characteristics of attentiveness, impulsiveness and hyperactivity. Furthermore, regular scheduling of therapy in the modification of children's behavior shows that more consistent participation in the executive function therapy program, it will be more effective to change behavior. This is in line with Goldstein, and Naglieri (2014), explaining that the problem of the social inclusion of children with ADHD was triggered by executive function which appears to be responsive to the situation around them. Such social-emotional and behavioral disorders need to be managed early so that they do not develop in a worse direction in adulthood.

The research was conducted according to the systematic experimental procedures. However, it does have certain limitations. For example, using one sample group means there is no control group for comparison. The absence of a control group

restricted the ability to establish causal relationships and to assess the true impact of the treatment. In future research, including a well-designed control group would enhance the internal validity of the findings and provide a more robust basis for drawing conclusions.

Conclusion

The characteristics of the children with ADHD who contributed to this research were primarily male, aged 2.5 years <, and of preschool education level. Based on the results of the analysis using the repeated measure ANOVA via SPSS, it was found that the average social maturity score of the children after following executive function therapy (post-test) was higher than pre-test, indicating an increase in their social maturity after the therapy.

The results demonstrate the effectiveness of the various interventions implemented. First, the psychoeducational approach, providing parents, caregivers and teachers with knowledge about ADHD and effective strategies to support social development, proved beneficial. Second, engaging in physical exercises and activities, such as tactile stimulation or emotion regulation activities, also contributed to the improvement in social skills. Third, observing behaviors related to executive function deficits was a crucial part of the efforts to enhance the social maturity of children with ADHD. Although our study did not include a control group, the findings offer insights into the potential of effective interventions in improving social maturity, especially in Psychology Department at Ceria Hospital, Kandangan, South Kalimantan, Indonesia.[]

Author Contribution Statement

Taufik Hidayat: Conceptualization; Data Curation; Formal Analysis; Funding Acquisition; Investigation; Methodology; Project Administration; Resources; Validation; Visualization; Writing Original Draft; Writing, Review & Editing. **Imadduddin Imadduddin:** Conceptualization; Data Curation; Formal Analysis; Funding Acquisition; Methodology; Visualization; Writing Original Draft; Writing, Review & Editing. **Maha Al-Hendawi:** Conceptualization; Funding Acquisition; Methodology; Validation; Writing, Review & Editing. **Abdullah Azzam Al Afghani:** Conceptualization; Funding Acquisition; Methodology; Validation; Visualization; Writing, Review & Editing.

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