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Effect of ten-week directive play activities on motor coordination and executive function of school children

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Abstract
The purpose of this study was to investigate the effect of directive play activities on the cognitive and motor development of primary school children. Cognitive variables such as concentration and executive function, and motor development variables such as locomotor skills and object control skills were selected as dependent variables. Three hundred (N = 300) school children from Kannur District, India, were selected as subjects. The Experimental Group (Directive Play Activity Group – DPAG) consisted of 150 students (equal numbers of boys and girls) who underwent an ten-week Directive Play Activity Program, while the Control Group (CG) comprised 150 students (equal numbers of boys and girls) who followed their regular school schedule without additional intervention. The participants were aged between 5 and 8 years. Pre-test and post-test data on all dependent variables were collected before and after the ten-week experimental period. Standardized instruments: the Concentration Grid Test, Trail Making Test (TMT), and the Test of Gross Motor Development-2 (TGMD-2) were employed to assess cognitive and motor variables. Analysis of Covariance (ANCOVA) revealed significant improvements in the motor variables (locomotor and object control skills) and in the cognitive variable of executive function. However, improvement in concentration was not statistically significant. The findings indicate that directive play activities effectively enhance both motor coordination and executive function among primary school children.

Keywords: Directive play activities, motor development, executive function, primary school children

1. Introduction
The foundational years of primary schooling, spanning ages 5 to 8, are critical for the development of both Fundamental Movement Skills (FMS) and Executive Function (EF) two essential domains that support a child's adaptation to schooling and long-term health outcomes. This period represents a developmental window where neurological systems governing motor control and higher-order cognition are highly plastic and responsive to targeted interventions.

Motor development during these years establishes the base of physical literacy, influencing a child's motivation to engage in physical activity throughout life. FMS are broadly classified into Locomotor Skills (e.g., running, jumping, hopping, leaping) and Object Control Skills (e.g., throwing, kicking, catching, striking). However, the increasing prevalence of sedentary lifestyles and reduced time for physical education have contributed to deficits in FMS, often linked to poor health, low self-esteem, and reduced participation in organized sports. Research consistently highlights that structured, directive instruction rather than free play alone is crucial for mastering these fundamental skills.

At the same time, cognitive development in early childhood is driven by the maturation of the prefrontal cortex, which governs executive function. EF includes cognitive processes such as inhibitory control, working memory, and cognitive flexibility, which are essential for academic achievement and adaptive behavior. Children with underdeveloped EF often face challenges in focusing, planning, and problem-solving.

Recent research has demonstrated a strong motor-cognition connection, suggesting that physical activity acts not only as recreation but also as a powerful driver of cognitive growth. Activities that combine movement with strategic thinking requiring planning, inhibition, and task-switching are more effective for improving EF than simple repetitive exercises. This principle underpins the Directive Play Activity Program (DPAG).

Unlike unstructured play, DPAG is an adult-guided, structured approach that integrates fundamental motor tasks with cognitive challenges. For instance, children may be asked to throw a ball only upon receiving a specific signal (testing inhibitory control) or alternate targets (testing cognitive flexibility). This coupling stimulates both motor and cognitive control systems simultaneously, promoting synergistic development.

Despite increasing global evidence on the link between motor and cognitive growth, limited empirical research has examined the combined and specific effects of directive play activities on FMS and EF among young children in the Indian context. Therefore, the present study aims to empirically evaluate the effectiveness of an eight-week DPAG intervention on locomotor skills, object control skills, concentration, and executive function among primary school children in Kannur District, Kerala.

1.1 Statement of the Problem

To determine the effectiveness of an eight-week Directive Play Activity Program (DPAG) in improving:

1. Locomotor and Object Control Skills (Motor Variables).
2. Concentration and Executive Function (Cognitive Variables) among primary school children aged 5–8 years, compared to a control group.

2. Objectives of the Study

1. To determine the effect of the ten-week DPAG on locomotor skills (running, hopping, jumping, leaping, sliding, galloping) of primary school children.
2. To determine the effect of the ten-week DPAG on object control skills (throwing, kicking, catching, striking, bouncing, rolling) of primary school children.
3. To determine the effect of the ten-week DPAG on the concentration of primary school children.
4. To determine the effect of the ten-week DPAG on the executive function of primary school children.

3. Materials and Methods

3.1 Research Design and Statistical Approach

A Quasi-Experimental Design using a Pre-test, Post-test Control Group Design was adopted. This design is appropriate for assessing intervention effects in educational settings where randomization is constrained.

3.2 Subjects and Sampling

A total of 300 primary school children aged 5–8 years were selected from schools in Kannur District, Kerala, using purposive sampling, based on school and parental consent.

Group	N	Description
Experimental Group (DPAG)	150	Underwent the ten-week Directive Play Activity Program.
Control Group (CG)	150	Continued regular school activities without additional intervention.

3.3 Experimental Procedure

The total duration of the study was twelve weeks, consisting of:

- Week 1: Pre-test assessments
- Weeks 2–11: 10-week DPAG intervention
- Week 12: Post-test assessments

Table 1: Dependent Variables and Tools

Variable Category	Dependent Variables	Measurement Tool	Type of Measure
Motor Development	Locomotor & Object Control Skills	Test of Gross Motor Development-2 (TGMD-2)	Process-oriented criterion score
Cognitive Development	Concentration	Concentration Grid Test	Number of correct targets identified
	Executive Function	Trail Making Test (TMT) – Part B	Time to complete alternating sequence (lower time = better performance)

3.4 Training Plan (DPAG)

The DPAG intervention was conducted three times per week for 10 weeks, each session lasting 60 minutes. The activities combined motor tasks with cognitive challenges (e.g., changing locomotor patterns based on auditory or visual cues, reacting selectively to specific colours or shapes during object control tasks). These tasks encouraged both motor planning and executive control.

Table 2: Training Plan

Week	Locomotor Skills (Motor)	Object Control Skills (Motor)	Cognitive-Motor Integration (Cognitive)	Progression
1	Basic running, hopping	Catching & throwing at stationary targets	Simon Says (simple instructions)	Familiarization with activities and rules
2	Leaping, galloping, sliding	Kicking rolling balls	Relay with one-step commands	Introduce basic sequencing and coordination
3	Obstacle courses (2-step patterns)	Throwing to colored targets	Remember 2-step movement cues	Build memory and attention during movement
4	Hopping & skipping combinations	Catching moving balls	Alternating target games	Enhance coordination and timing
5	Timed running & jumping	Striking at moving targets	Switch tasks based on auditory cue	Introduce speed and multitasking
6	Obstacle courses with hopping/leaping	Throw-catch-kick sequence	Relay with two-step instructions	Increase complexity in motor-cognitive integration
7	Patterned movement sequences	Rolling & catching to specific zones	Respond to color/shape cues while moving	Cognitive flexibility and decision-making focus
8	Paired movement games	Partner passing & striking	Problem-solving relay with decision-making	Introduce social coordination and team play
9	Complex obstacle course combining previous skills	Target throwing with movement	Multiple cues with task switching	Integrate all learned motor and cognitive skills
10	Timed obstacle course	Full skill integration (throw, catch, kick, strike)	Mini-games combining motor & executive tasks	Assessment & mastery; evaluate improvements

- Warm-up: 10 min (jogging, dynamic stretching, Follow the Leader)
- Locomotor Skills: 15 min
- Object Control Skills: 15 min
- Cognitive-Motor Integration: 15 min
- Cool-down: 5 min (stretching, breathing, reflection)

3.5 Statistical Techniques

- **Dependent t-test:** Assessed within-group pre- and post-test changes.
- **ANCOVA:** Compared post-test means between groups using pre-test scores as covariates, isolating the true effect of the intervention.
- The significance level was set at $p<0.05$.

4. Results of the Study

Table 3: Descriptive Statistics of Pre-test and Post-test Scores of Experimental and Control Groups

Variable	Group	N	Pre-test Mean±SD	Post-test Mean±SD	Mean Difference
Locomotor Skills	DPAG	150	35.42±4.15	46.38±4.02	10.96
	CG	150	35.18±4.28	36.02±4.11	0.84
Object Control Skills	DPAG	150	33.56±3.98	45.02±4.07	11.46
	CG	150	33.40±4.06	34.12±3.97	0.72
Concentration	DPAG	150	22.84±3.72	23.56±3.60	0.72
	CG	150	22.90±3.68	22.74±3.55	-0.16
Executive Function (TMT – Time in Sec)	DPAG	150	92.40±12.84	80.02±11.60	-12.38
	CG	150	91.96±12.55	90.48±12.20	-1.48

The descriptive data indicate that the DPAG group demonstrated notable improvements across most variables compared to the control group. Locomotor and object control skills increased significantly, suggesting improved motor proficiency. Executive function performance (TMT time) also improved markedly, reflecting faster cognitive processing. Concentration scores showed minor gains but not of meaningful magnitude.

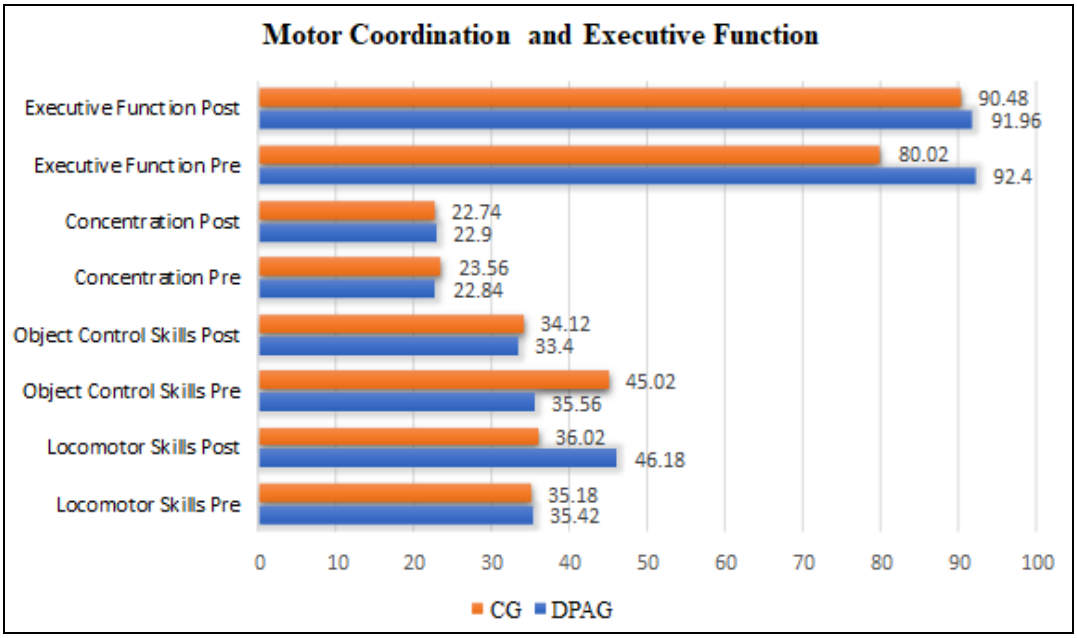

Fig 1: Graphical Representation of Motor Coordination and Executive Functions of Experimental and Control Group

Table 4: Results of Dependent t-test and ANCOVA for Experimental and Control Groups

Variable	Group	Mean Difference (Post–Pre)	t-value	p-value	F (1,297)	p-value
Locomotor Skills	DPAG	10.96	21.74	0.000*	72.34	0.000*
	CG	0.84	1.28	0.203		
Object Control Skills	DPAG	11.46	22.18	0.000*	79.55	0.000*
	CG	0.72	1.14	0.257		
Concentration	DPAG	0.72	1.95	0.053	2.10	0.148
	CG	-0.16	0.84	0.401		
Executive Function (TMT – Time in Sec)	DPAG	-12.38	18.06	0.000*	68.34	0.000*
	CG	-1.48	1.12	0.264		

(*$p<0.05$ indicates significant difference)

The dependent *t*-test results revealed that the DPAG group showed statistically significant improvements ($p<0.05$) in locomotor skills, object control skills, and executive function. ANCOVA results further confirmed significant differences between groups after controlling for pre-test scores, with high *F*-values and significant *p*-values. However, concentration did

not differ significantly between groups. These findings demonstrate that directive play activities are effective in enhancing both motor and executive functions, but have limited influence on short-term improvements in concentration.

4.1 Discussion of Findings

The findings of the present study indicate that the ten-week Directive Play Activity Program (DPAG) was effective in significantly improving locomotor skills, object control skills, and executive function among primary school children, whereas concentration showed only minor, non-significant improvements. The results suggest that structured, cognitively engaging physical activities can positively influence both motor and cognitive domains during early childhood.

The significant improvement in locomotor and object control skills among the DPAG participants highlights the efficacy of adult-guided, skill-focused interventions in developing Fundamental Movement Skills (FMS). This supports the conclusions of Robinson *et al*. (2015) [4], who found that structured motor skill programs in school-aged children enhanced coordination, balance, and object control abilities. Similarly, Fisher *et al*. (2005) [2] emphasized that explicit instruction, rather than unstructured play alone, is critical for the acquisition of locomotor and manipulative skills in young children. These motor gains are important as they lay the foundation for lifelong physical activity and overall physical literacy.

The improvement in executive function, as evidenced by faster completion times on the Trail Making Test (TMT), is consistent with previous research demonstrating the strong motor-cognition link. According to Best (2010), interventions combining physical activity with cognitive demands can enhance inhibitory control, working memory, and cognitive flexibility in children. Hillman *et al*. (2008) [3] also reported that regular engagement in structured physical activities improves attentional processes, cognitive control, and information processing speed. The DPAG's design, which required participants to integrate motor tasks with cognitive rules and alternating challenges, likely stimulated the prefrontal cortex, resulting in improved executive functioning.

Interestingly, concentration scores did not show a statistically significant improvement. This may indicate that short-term interventions may be insufficient for enhancing sustained attention or that the program's design placed more emphasis on cognitive flexibility and inhibitory control than on continuous focus. This finding aligns with Tomporowski *et al*. (2011) [5], who suggested that improvements in attention may require longer, repetitive, and cognitively demanding activities to achieve measurable gains.

Overall, the study provides empirical evidence that directive play activities, which combine motor and cognitive challenges, effectively enhance both physical and cognitive development in primary school children. The findings underscore the importance of structured, developmentally appropriate physical activity programs in early childhood education, not only for promoting physical competence but also for fostering executive function and cognitive growth. Integrating such programs into school curricula could yield long-term benefits in both academic performance and overall child development.

5. Conclusion

The study concludes that an ten-week Directive Play Activity Program significantly enhances locomotor skills, object control skills, and executive function in primary school children aged 5–8 years. While concentration showed minimal improvement, the findings emphasize that structured, cognitively engaging physical activities effectively promote both motor coordination and higher-order cognitive development.

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