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Role of School-Based Physical Literacy Programs in Shaping Cognitive Determinants of Physical Activity Participation

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Abstract: Early infancy is a crucial developmental stage for building the motivational and cognitive underpinnings of lifetime physical activity. This study, which was based on Margaret Whitehead's physical literacy paradigm, looked at how well an organised movement education program improved the cognitive determinants of confidence, motivation, and comprehension in children at the grassroots level between the ages of 6 and 8. Additionally, the study supports the United Nations Sustainable Development Goals 3 (Health and Well-Being) and 4 (Quality Education). Purposively recruited, a total of 100 youngsters (N = 100) were randomised to either the Ex-Group (n = 50) or the CG (n = 50). CG completed their usual physical education, while the Ex-group did a 12-week movement education intervention (three sessions per week). Physical Literacy Observation for Youth tools tested cognitive aspects. Paired-sample t-tests and ANCOVA were used to adjust for baseline values. Effect sizes were determined using Cohen's d and η^2. The Ex-group showed significant improvements in all cognitive determinants ($p < .001$), with effect sizes ($|d| = 2.80–7.22$). Significant group effects were seen in confidence, motivation, comprehension, and composite cognitive score ($F(1, 97) = 306.00$, $\eta^2 = .363$; 116.00, $\eta^2 = .233$; 47.00, $\eta^2 = .115$; 388.00, $\eta^2 = .226$. The findings suggest systematic movement education improves early childhood cognitive involvement in physical activity. Elementary cognitive-oriented physical literacy may improve schooling and health.

Keywords: Physical Literacy; Movement Education Program; Cognitive Engagement; Effect Size; Sustainable Development Goals; Cognitive Determinants; Quality Education.

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1. Introduction

Childhood physical inactivity has become one of the most critical public health challenges of the twenty-first century. Global estimates indicate that more than 80% of school-aged children do not meet the recommended levels of daily physical activity [15]. This worrying trend is linked to obesity, cardiometabolic diseases, psychological suffering, and poor academic performance. To encourage lifetime physical activity, early, evidence-based treatments are needed. Childhood inactivity

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commonly persists into adulthood. In response to this growing concern, physical literacy has emerged as a comprehensive, integrative foundation for lifelong physical activity. Cognitive and affective aspects influence behaviour beyond motor skill development in physical literacy. Longmuir et al. [8] describe physical literacy as drive, confidence, physical skill, and knowledge and understanding that promote lifelong physical activity. This multimodal method aligns with modern educational and public health paradigms that prioritise child development over skill acquisition. Cognitive variables influence children's physical activity among physical literacy components. Confidence and self-efficacy affect conduct. Social Cognitive Theory asserts that self-efficacy affects effort, tenacity, and persistence in tough conditions [1]. Children who think they can move well conduct more moderate-to-vigorous activities. Children's physical activity is substantially correlated with perceived motor ability [2]. Children with confidence in their movement abilities participate in structured and unstructured physical activities. Prolonged physical exercise also requires motivation. Self-Determination Theory states that intrinsically motivated activities characterised by enjoyment, curiosity, and personal satisfaction are more likely to persist [6].

Children's intrinsic motivation increases in autonomous, competent, and connected educational environments. In school-based physical education, autonomy-supportive teaching approaches increase student engagement, effort, and persistence [12]. Recent comprehensive reviews confirm that a favourable motivating climate increases juvenile physical activity engagement and long-term adherence [14]. Physical literacy requires knowledge, comprehension, confidence, and motivation. This requires an understanding of movement principles, activity recommendations, and the health benefits of regular exercise. Children with cognitive competency can make educated judgments, engage securely, and be active. Education is important in physical activity programmes because it can influence physical competence and participation [8]; [3]. Therefore, enhancing children's knowledge of physical exercise improves their conduct. Motor competence, perceived competence, and behavioural engagement are linked in physical activity development theories. Positive early movement experiences enhance confidence and drive, leading to more voluntary physical exercise, according to Stodden et al. [13]. Negative experiences might lead to inactivity, loss of self-esteem, and disengagement. Early cognitive and physical therapy lays a solid foundation for lifelong exercise. Children's physical literacy promotes sustainability globally. Enhancing the cognitive determinants of physical activity reduces the burden of non-communicable diseases and improves mental health, thereby promoting SDG 3 (Good Health and Well-Being). Sustainable Development Goal 4 (Quality Education) is supported by student participation, self-regulation, and holistic development. Thus, targeted physical literacy interventions in schools and communities address health and educational challenges sustainably and scalably.

Despite its growing importance, little is known about how physical literacy affects cognitive characteristics, including confidence, motivation, and comprehension. Much research has focused on motor skills, ignoring the cognitive-behavioural factors that support persistent physical exercise. In poor countries, grassroots communities have limited access to structured and theory-driven initiatives [10]. Thus, a comprehensive study on the effects of physical literacy treatments on psychological preparation for long-term physical activity is needed. From a sustainable development perspective, this study examines how a structured physical literacy intervention affects the cognitive determinants of grassroots children's physical activity participation. The study measures confidence, motivation, and comprehension using a controlled pre–post experimental design. The study addresses a research gap and emphasises an integrated cognitive framework to promote physical literacy and juvenile physical activity, with a focus on theory, practice, and policy. Global health systems need more than physical education to address childhood physical inactivity. Previous models focused on behavioural data, while recent research highlights cognitive, affective, and developmental processes that affect children's physical activity. Revolutionary physical literacy integrates movement, psychology, and cognition. It must study its key components and broader sub-themes, especially in early childhood and grassroots contexts, to prosper. Physical literacy emphasises motor skills. Physical literacy includes cognitive and affective skills, but motor competence impacts kids' self-image. Growth in one area benefits another in developmental models [13]. Basic movement skills boost confidence and help kids exercise. Poor motor abilities might lower self-esteem and interest.

Cognitive-oriented therapies must increase confidence, competence, and participation abilities, as shown in this exchange. Enjoyment of physical activity influences children's motivation, long-term adherence, and motor abilities. Enjoyment drives children's exercise preferences. Fun, engaging, and rewarding activities boost intrinsic motivation, which fuels behavioural commitment. Since enjoyment mediates the relationship between self-efficacy and physical activity, even confident kids may disengage if activities are not emotionally rewarding, according to Ickes and Sharma [9]. Thus, enjoyable features in physical literacy therapies motivate and engage, especially in early infancy when affective responses strongly influence behaviour. Another key sub-theme is the pedagogical atmosphere and instructional approaches in physical activity environments. Instructors' learning surroundings strongly affect physical literacy interventions. Autonomy-supportive education increases intrinsic motivation and engagement through choice, discovery, and positive feedback [12]. According to Self-Determination Theory, such settings satisfy children's psychological needs for autonomy, competence, and relatedness [6]. However, performance-focused or controlling organisations may demotivate and discourage participation. Thus, the pedagogical context affects how children respond to physical exercise interventions. The physical literacy framework is expanding as the neurocognitive benefits of exercise are recognised. Early movement experiences alter executive function, attention, and memory.

Physical activity enhances brain connections and cognitive processing, boosting academic and behavioural outcomes. Embodied cognition says sensory experiences build cognition. Variety and purposeful movement activities help kids develop cognitive and physical skills for learning and decision-making. This neurocognitive paradigm expands physical literacy instruction beyond health. Understanding physical literacy interventions involves long-term behaviour persistence. Childhood influences habits, attitudes, and self-consciousness. Lifelong activity can be encouraged by confidence, desire, and understanding. Childhood physical activity patterns persist, according to longitudinal studies. Cognitive determinants must be tackled at this point to ensure physical literacy advantages last. Sustainability aligns with global public health strategies that emphasise cost-effective prevention and early intervention to reduce the burden of non-communicable diseases. These sub-themes matter more to the grassroots. Such kids lack systematic exercise, infrastructure, and skill development. Interventions must address physical, psychological, and contextual barriers to involvement. Physical literacy therapies are effective and adaptive when they include motor competence development, enjoyment, supportive pedagogical practices, and cognitive learning. These sub-themes demonstrate how physical, cognitive, affective, and environmental factors increase physical literacy. They stress that motivating children to exercise involves a multifaceted approach that addresses multiple development domains. This study combines these perspectives to strengthen its theoretical foundation and to apply them to physical education, public health research, and practice.

1.1. Conceptual Framework

The International Physical Literacy Association defines physical literacy as motivation, confidence, physical competence, and knowledge and understanding for lifelong physical activity. Within this multidimensional approach, grassroots children aged 6–8's cognitive aspects of physical exercise participation, confidence, motivation, and comprehension are examined. These psychological factors determine kids' readiness for exercise. The main independent variables are structured physical literacy interventions that increase cognitive outcomes through developmentally appropriate movement experiences, mastery-oriented task designs, and autonomy-supportive instructional techniques. Intervention helps kids learn, become competent, and build self-esteem. Exercise cognition is affected by these elements. Psychological concepts underpin it. Social Cognitive Theory states that children who believe they can move are more likely to start and stay active [1]. To modulate intervention exposure and behaviour, self-efficacy impacts effort, tenacity, and resilience. The Self-Determination Theory also states that autonomy-supportive situations increase intrinsic motivation, which is necessary for long-term physical exercise [6]. An informational framework for active involvement stems from cognitive-physical literacy. Children may make informed decisions, exercise safely, and develop positive attitudes about physical activity by learning movement principles, restrictions, and health benefits (Figure 1).

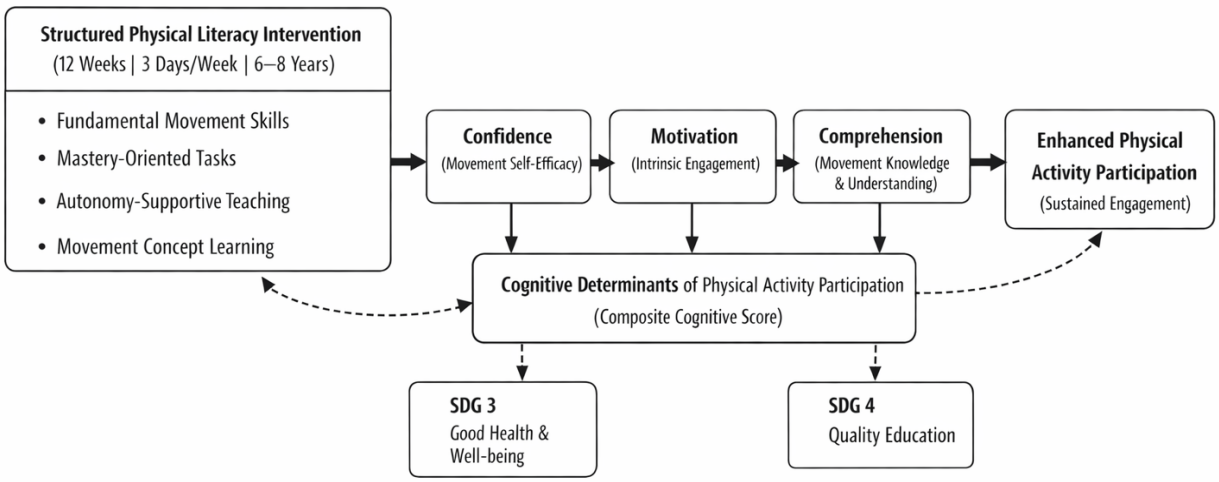

Figure 1: Conceptual model illustrating the influence of physical literacy intervention on cognitive determinants of physical activity participation and its alignment with SDG 3 and 4

Cognitive awareness creates a psychological system by increasing engagement, confidence, and motivation. The paradigm also claims that confidence, motivation, and understanding boost physical activity through the physical literacy intervention. Self-confidence, drive, and a greater understanding of physical activity motivate kids to participate in scheduled and unstructured physical activities. This mediator emphasises targeting cognitive and physical competencies in intervention design. The conceptual framework promotes global sustainability. By reducing inactivity-related health risks, increasing physical activity, and preparing psychologically for involvement, support Sustainable Development Goal 3 (Good Health and Well-Being). It

supports Sustainable Development Goal 4 (Quality Education) by encouraging child engagement, self-regulation, and holistic development. Physical literacy is promoted as a sustainable approach to child development, drawing on educational and health perspectives. The conceptual model shows that a structured physical literacy intervention improves cognitive determinants (confidence, motivation, and comprehension) and increases grassroots children's engagement in physical activity. This integrated approach emphasises cognitive-behavioural factors in lifelong physical activity and provides a theoretical foundation for this study.

2. Review of Related Literature

2.1. Physical Literacy and Physical Activity Participation

Physical literacy underpins lifelong physical exercise. Physical literacy blends motivation, confidence, physical ability, and knowledge to enable lifelong physical exercise, according to Longmuir et al. [8]. Empirical research supports this multidimensional structure. Cairney et al. [3] provided evidence that physical literacy is linked to physical activity and health outcomes. Physical literacy–based school interventions produce broader developmental results than skill-focused physical education programs, according to Valle-Munoz et al. [7]. These findings show that physical literacy improves behavioural and psychological aspects of physical exercise engagement.

2.2. Confidence (Self-Efficacy) and Physical Activity

Self-efficacy—confidence—is a major cognitive factor in physical activity. According to Social Cognitive Theory, self-efficacy is a person's belief in their competence to do tasks [1]. Research consistently links self-efficacy to physical activity in childhood. Barnett et al. [2] discovered that perceived motor ability strongly predicts moderate-to-vigorous physical exercise. Ickes and Sharma [9] found that self-efficacy was a substantial predictor of youth physical activity. Confident children are more likely to participate actively, persist in difficult tasks, and be resilient, which reinforces physical exercise.

2.3. Motivation and Physical Activity Behaviour

Starting and maintaining exercise needs motivation. Genuinely driven behaviours continue longer, according to Self-Determination Theory [6]. White et al. [12] found that autonomy-supportive instruction increases intrinsic motivation and effort in physical education. Ntoumanis [10] found that autonomy, competence, and relatedness enhance students' attitudes toward and involvement in physical activity. According to Zarrett et al. [14], supportive motivational environments boost children's involvement and long-term commitment to physical literacy treatments.

2.4. Knowledge and Understanding in Physical Activity Participation

Physical literacy influences educated decision-making and safe exercise. Longmuir et al. [8] noted that cognitive competency raises children's awareness of movement principles and their health benefits, encouraging active lifestyles. Knowledge, though indirectly and to a lesser extent, influences physical competence and exercise behaviour, according to Cairney et al. [3]. Physical activity-based educational interventions increase cognition and conduct, according to Valle-Munoz et al. [7]. The findings stress knowledge-based learning in exercise regimens.

2.5. Developmental Perspectives on Motor Competence and Physical Activity

Developmental models link motor, perceptual, and physical activity. A conceptual model by Stodden et al. [13] showed how early motor skill development affects perceived competence and physical activity. Positive childhood exercise experiences enhance confidence and motivation, increasing involvement, whereas negative ones may lead to inactivity. Early motor competence greatly predicts subsequent physical activity and health, according to Robinson et al. [11]. Studies show that early motor and cognitive therapy are essential.

2.6. Effectiveness of Physical Literacy Interventions

Recent intervention studies have examined how structured physical literacy programs influence children's mental and physical health. Physical literacy intervention programs motivated and competent youngsters, according to Vuletic et al. [5]. Integrated physical literacy interventions boost motor skills, confidence, and engagement, according to Antonio et al. [4]. Though promising, most studies have focused on physical performance and have overlooked cognitive traits such as confidence, motivation, and comprehension. Cognitive-behavioural research must be integrated.

2.7. Research Gap

Despite strong evidence for the individual components of physical literacy, few studies have examined their combined effects on cognitive predictors of physical activity engagement. Most research has concentrated on discrete factors, especially motor competence, rather than a comprehensive framework. There is very little empirical evidence from grassroots populations in impoverished countries where institutionalised physical literacy initiatives are scarce. Further research is needed on confidence, motivation, and comprehension due to the lack of controlled experimental trials.

3. Method

3.1. Research Design

A pre–posttest control-group experimental design was used to assess the cognitive determinants of physical activity involvement among grassroots children following a structured physical literacy intervention. Participants were randomly assigned to the Ex-group, which received the intervention, or to the control group, which maintained ordinary physical activity. Following the intervention period, this approach enabled evaluation of variations in cognitive outcomes across and within groups.

3.2. Participants

A total of 100 grassroots children aged 6–8 were recruited from primary schools and community sports settings in Kanyakumari District, Tamil Nadu, India. Participants were selected purposively and randomly assigned to the experimental (n = 50) or control (n = 50) groups. Participants had to meet certain eligibility requirements, including being within the designated age range, consistently participating in physical education classes at school, and being free of any musculoskeletal, neurological, or cognitive conditions that would restrict their ability to engage in physical exercise. Children's verbal assent and parents' or legal guardians' written informed consent were obtained before data collection. Every technique adhered to the institutional ethical guidelines governing research with children.

3.3. Physical Literacy Intervention Programme

The Ex-group attended 45–60-minute Physical Literacy Intervention Programmes three times a week for 12 weeks. Developmentally appropriate and focused on physical literacy, the training included:

3.3.1. Movement Competence Development

- Fundamental Motor Skills (Locomotor, Object Control, Stability)
- Progressive Skill Challenges

3.3.2. Confidence Enhancement

- Mastery-Oriented Tasks
- Positive Feedback
- Scaffolded Skill Progression

3.3.3. Motivation Promotion

- Game-Based Learning
- Autonomy-Supportive Instruction
- Peer Interaction and Cooperative Tasks

3.3.4. Comprehension Development

- Explanation of Movement Concepts
- Simple Rule-Based Games
- Health and Activity Awareness Discussions

To boost cognitive engagement, the training stressed pleasure, autonomy, competence support, and reflective inquiry. Without established physical literacy tools, the control group followed their physical education program.

3.4. Measures

Cognitive factors of physical exercise involvement were investigated using the PLAY Coach. PLAY Coach is an observational assessment method that uses structured coach ratings to assess children and youth's physical literacy. The instrument evaluates cognitive and emotive aspects of physical exercise involvement. For this study, the cognitive domain included:

- Confidence (Perceived Competence in Movement Participation)
- Motivation (Willingness and Enthusiasm Toward Physical Activity)
- Comprehension (Understanding of Movement Concepts, Rules, and Strategies)

The PLAY Coach guidebook provides defined scoring standards for each component. Each domain had 0–4 values, with higher scores suggesting stronger cognitive determinants. Summarising the three subdomains yielded a composite cognitive score (maximum 12). The PLAY tools were originally developed and validated by Sport for Life (Canada) to provide a structured, reliable assessment of physical literacy domains in children and youth.

3.5. Reliability

Cronbach's alpha coefficients for the cognitive domain components were calculated to ensure sample consistency. An alpha level of ≥.70 was deemed appropriate for the study.

3.6. Procedure

Baseline (pretest) evaluations were done one week before the intervention. Posttests were given immediately after the 12-week program under uniform settings. All assessments were done by PLAY Coach-trained evaluators.

3.7. Statistical Analysis

Jamovi (Version 2.6.22) was used for all statistical analyses. Means and standard deviations (M ± SD) were calculated for all research variables at pretest and posttest. To examine within-group changes over time, paired-sample t-tests were performed separately for the experimental and control groups. Analyses of covariance (ANCOVA) were performed with posttest scores as the dependent variable, group (experimental vs control) as the fixed factor, and pretest scores as covariates to assess intervention efficacy while controlling for baseline differences. This method, which adjusted for initial group differences, improved estimates of intervention impact. According to Cohen's d, effect sizes of 0.20, 0.50, and > 0.80 indicate modest, medium, and substantial changes, respectively. Statistical significance was determined at $p < .05$ for all analyses.

4. Results

A comparison of the pretest and posttest descriptive data for both groups' levels of confidence, motivation, understanding, and overall cognitive performance is presented in Table 1. Before treatment, baseline means indicated that the experimental and control groups were similar, suggesting equal groups.

Table 1: Descriptive statistics for cognitive determinants at pretest and posttest

Variable	Group	Test	N	Mean	Median	SD	SE
Confidence	Experimental	Pre	50	2.12	2	0.627	0.089
		Post	50	3.26	3	0.443	0.063
	Control	Pre	50	2.24	2	0.657	0.093
		Post	50	2.28	2	0.573	0.081
Motivation	Experimental	Pre	50	2.22	2	0.545	0.077
		Post	50	3.58	4	0.499	0.071
	Control	Pre	50	2.2	2	0.571	0.081
		Post	50	2.26	2	0.633	0.09
Comprehension	Experimental	Pre	50	1.86	2	0.351	0.05
		Post	50	3.22	3	0.418	0.059
	Control	Pre	50	1.98	2	0.515	0.073
		Post	50	2.02	2	0.515	0.073
Composite Cognitive Score	Experimental	Pre	50	6.2	6	1.107	0.157
		Post	50	10.06	10	1.058	0.15

	Control	Pre	50	6.42	7	1.214	0.172
		Post	50	6.56	6	1.264	0.179

Figure 2 presents the comparison of mean pre- and posttest scores between the experimental and control groups for factors including confidence, motivation, comprehension and composite scores. The posttest results are always higher than the pretest values, and the experimental group shows greater gains, particularly in the composite scores.

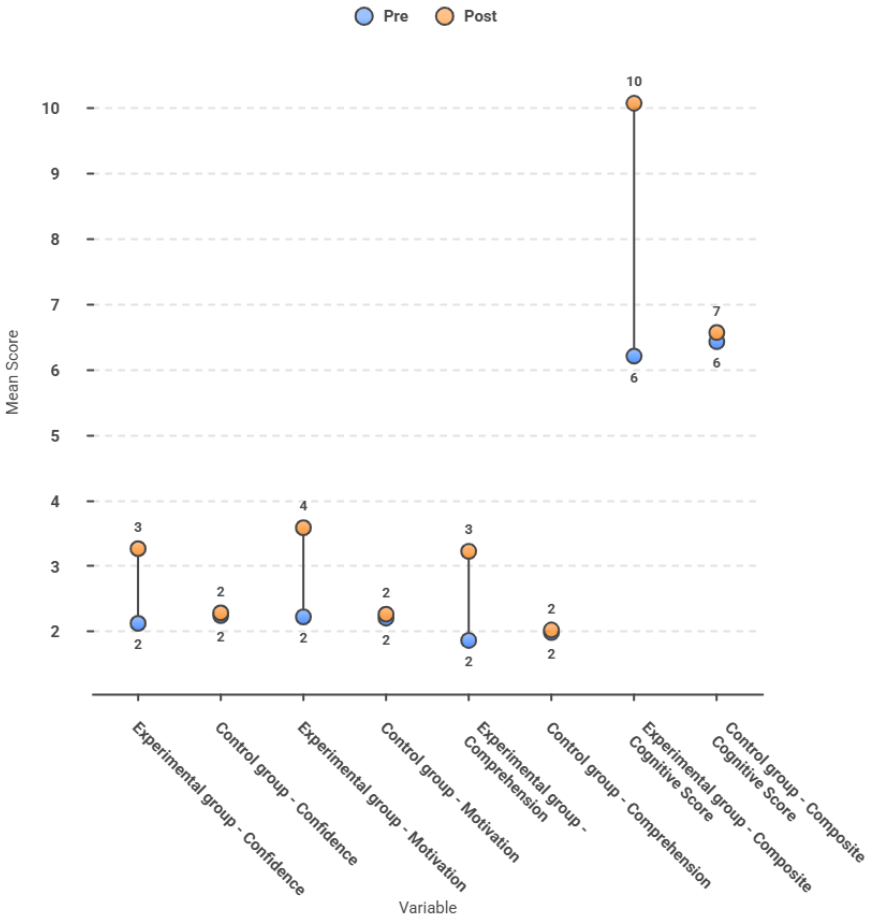

Figure 2: Shows the mean values of the criterion variables

All cognitive factors improved in the experimental group after 12 weeks of movement education. The composite cognitive score showed the greatest increase (ΔM = 3.86), followed by motivation (ΔM = 1.36), understanding (ΔM = 1.36), and confidence (ΔM = 1.14). The experimental group had lower posttest standard deviations, indicating better response consistency. The control group had minimal mean changes across all variables, with differences falling within measurement variability. These findings indicate a significant intervention-related increase in cognitive engagement with physical activity among experimental children.

Table 2: Paired-sample t-test results for within-group changes

Variable	Group	Mean Difference	t (49)	p	SE Difference	Cohen's d
Confidence	Experimental	-1.14	-23	< .001	0.05	-3.25
	Control	-0.04	-1	0.322	0.04	-0.14
Motivation	Experimental	-1.36	-19.8	< .001	0.069	-2.8
	Control	-0.06	-1.35	0.182	0.044	-0.19
Comprehension	Experimental	-1.36	-19.8	< .001	0.069	-2.8
	Control	-0.04	-0.81	0.42	0.049	-0.12

Composite Cognitive Score	Experimental	-3.86	-51	< .001	0.076	-7.22
	Control	-0.14	-1.85	0.07	0.076	-0.26

Table 2 shows time-dependent within-group variations from paired-sample t-tests. The experimental group showed substantial gains across all cognitive factors ($p < .001$). The shift was enormous, as shown by large effect sizes (Cohen's d 2.80–7.22). The intervention has considerable practical importance since its effect sizes exceed established criteria ($d \geq 0.80$). The aggregate cognitive score improved the most, indicating advances in confidence, drive, and understanding. In comparison, the control group showed no statistically significant changes in any cognitive trait ($p > .05$) and small effect sizes. This pattern minimises the possibility that maturation, testing, or external influences could cause improvements in the experimental group. Within-group studies show that the movement education intervention improved cognitive predictors of physical activity engagement.

Table 3: Analysis of covariance (ANCOVA) for posttest cognitive determinants controlling for pretest scores

Dependent Variable	Adjusted Mean (Experimental)	Adjusted Mean (Control)	F (1, 97)	p	Partial η^2
Post Confidence	3.3	2.24	306	< .001	0.363
Post Motivation	3.57	2.27	116	< .001	0.233
Post Comprehension	3.26	1.98	47	< .001	0.115
Post Composite Cognitive Score	10.16	6.46	388	< .001	0.226

Table 3 presents ANCOVA results comparing posttest outcomes between groups while controlling for corresponding pretest scores. This technique accounts for baseline variability, thereby improving estimates of intervention impact. Significant group effects were observed for all dependent variables ($p < .001$). After adjusting for baseline values, the intervention had the greatest impact on posttest confidence ratings ($F (1, 97) = 306.00$, partial $\eta^2 = .363$), accounting for 36.3% of the variance. The impact sizes for motivation and composite cognitive score were substantial ($\eta^2 = .233$ and .226), whereas understanding had a moderate-to-large effect ($\eta^2 = .115$). The partial eta-squared values suggest considerable practical effects across most outcomes, according to established standards (.01 = small, .06 = medium, .14 = high). The corrected mean differences show that the experimental group outperformed the control group on all cognitive variables. The ANCOVA results show that the 12-week movement education intervention improved children's cognitive engagement with physical exercise, regardless of baseline scores.

5. Discussion on Findings

5.1. Discussion

The present study explored how a 12-week structured physical literacy intervention affected confidence, motivation, and understanding in grassroots children aged 6–8 years. All three measures improved for the experimental group, with high effect sizes in paired comparisons and ANCOVA analyses. These findings suggest that multimodal physical literacy interventions improve early childhood psychological preparation for physical activity, a crucial developmental time for lifelong behaviour. The findings confirm Longmuir et al. [8] definition of physical literacy, which emphasises motivation, confidence, physical ability, and knowledge and comprehension for sustained physical activity. This study emphasises cognitive and emotional skills rather than motor skills in physical education. This study demonstrated that physical literacy interventions improve children's emotional and cognitive development beyond mechanical skill development by boosting confidence and comprehension. This reinforces the growing evidence that holistic physical education encourages meaningful and lasting exercise. Self-efficacy, a key predictor of behaviour in Social Cognitive Theory, boosts participants' confidence. Children who believe they can move are more likely to start, maintain, and succeed in exercise [1]. Plans for progressive intervention, with mastery-oriented activities and realistic difficulties, likely encouraged recurrent success and increased competence. Barnett et al. [2] found that perceived motor skill predicts moderate-to-vigorous exercise in children. Robinson et al. [11] found that early perceived competence predicts later engagement and health. This study found that structured physical literacy treatments boost children's confidence and psychological preparedness to exercise.

A closer look at these studies shows that motor ability mediates the link between physical literacy interventions and cognitive outcomes. This study did not assess motor competence, yet structured movement in the intervention likely improved it. Motor and perceived competence are related in developmental theories such as those of Stodden et al. [13], so improving one enhances the other. Kids gain confidence and engagement as they master movement challenges. This reciprocal reinforcement system develops early movement patterns and self-perceptions. Early motor skill competency is linked to lifetime physical activity and greater health, according to Robinson et al. [11]. This study's confidence gains may be attributable to improvements in psychological and motor competence, underscoring the need to integrate physical and cognitive domains in physical literacy interventions. Self-Determination Theory meets autonomy, competence, and relatedness needs to boost intrinsic motivation [6]. Children were encouraged to investigate movement tasks, make choices, and enjoy engaging activities in a regulated yet

flexible atmosphere. Ownership, competence, and social connection motivate employees in such workplaces. Autonomy-supportive PE training boosts intrinsic motivation and engagement, according to White et al. [12]. Enjoyment, personal growth, and social support sustain exercise, according to Ntoumanis [10]. These beliefs are reinforced by comprehensive physical literacy programs that motivate young children. In addition to cognitive and motivational factors, physical exercise requires affective engagement—especially enjoyment. Kid-friendly, diverse, and engaging activities matched their interests and delighted them.

Infants' intrinsic motivation comes from enjoyment. Pleasure is an excellent form of energy, according to Valle-Munoz et al. [7]. Enjoyment links psychological concepts to physical activity, suggesting kids who love it are more likely to participate. Thus, higher enjoyment during the intervention may have increased motivation in this study. Positive emotions improve immediate engagement and long-term adherence, so physical literacy programs need them. This study shows significant increases in comprehension of physical literacy, supporting cognitive literacy. When the intervention included education and physical activity, children learned movement concepts and rules, as well as the health benefits of physical activity. This supports Longmuir et al. [8] who emphasised the importance of knowledge and understanding for safe, informed physical exercise. Cairney et al. [3] found that cognitive knowledge mediates physical competence and behavioural engagement, underlining the need for educational intervention design. Embodied cognition says sensory experiences drive cognitive development. Data support this. Active movement helps toddlers understand and appreciate physical activity by building cognitive processes. Early childhood learning is experiential and context-dependent; integration of movement and cognition is crucial. Improvements in confidence, drive, and comprehension demonstrate that cognitive variables in physical literacy are dynamic and interrelated. These variables influence physical activity synergistically. Good movement experiences boost perceived competence, which, in turn, boosts motivation and involvement, according to Stodden et al. [13] developmental model. This study extends this concept by showing that structured interventions can simultaneously influence several cognitive pathways, increasing physical exercise participation.

Long-term behavioural sustainability is a fundamental contribution of this study. Since childhood tendencies persist into adolescence and adulthood, cognitive determinants of improvement may affect physical activity behaviour. The intervention gives youngsters the psychological tools to start and maintain physical activity by building confidence, intrinsic drive, and comprehension. Global health guidelines advocate early action to avoid non-communicable diseases and promote lifelong well-being [15]. The findings emphasise the need to address psychological underpinnings rather than short-term behavioural outcomes for sustainability. Self-regulation and decision-making help sustainability. As they gain confidence and understanding, kids can set goals, track progress, and choose activities. Lifelong physical activity demands this shift from external to self-regulated. Cognitive and motivational physical literacy programs that teach youngsters how to manage their health best encourage this change. Though robust, the study has weaknesses. Brief interventions struggle to measure retention of cognitive and behavioural change. Due to age group focus, conclusions may not apply to other groups. Evaluating intervention effects and contextual factors, including the sociocultural milieu and parental support, requires a longitudinal study. This study suggests that systematic physical literacy interventions can improve cognitive determinants of young children's physical activity. Motor competence, enjoyment, and cognitive development, when combined in one framework, encourage rapid engagement and lifelong physical activity. For health, well-being, and sustainable development, holistic, theory-driven physical education and literacy are needed.

5.2. Alignment with Sustainable Development Goals

The UN Sustainable Development Goals (SDGs) 4 (Quality Education) and 3 (Good Health and Well-Being) emphasise comprehensive human development and lifelong well-being, which this study supports. The study reveals how structured physical literacy interventions can promote early childhood education and health by focusing on cognitive qualities like confidence, motivation, and comprehension. This study supports SDG 4's inclusive, equitable, and good education for lifelong learning by increasing cognitive engagement. Modern education emphasises holistic development, integrating cognitive, emotional, and physical domains to facilitate learning. Physical literacy interventions improved physical competence, cognitive comprehension, intrinsic motivation, and self-confidence in this study. They boost classroom engagement, self-regulation, and learning readiness, which are essential to education.

Physical literacy initiatives boost cognitive development and student engagement, according to Valle-Munoz et al. [7]. SDG 4 stresses critical thinking, decision-making, and independent learning, which autonomy-supportive teaching techniques foster. The findings complement SDG 3, which encourages healthy living and well-being for all ages, as well as education. The study's large confidence and intrinsic drive gains are important, as long-term physical activity has been shown to boost these psychological traits. Self-efficacy and intrinsic drive are major predictors of prolonged physical activity in children and adolescents, according to Ickes and Sharma [9]. Physical literacy interventions can promote healthy habits that lower the risk of non-communicable diseases like obesity, cardiovascular disease, and diabetes by improving cognitive factors in early infancy. Moreover, the study emphasises the need for preventative and developmental health promotion. Cognitive-oriented

physical literacy programs address psychological mechanisms that drive behaviour rather than treatment or short-term outcomes. Early confidence, motivation, and understanding help youngsters select an active lifestyle. This supports worldwide public health initiatives that emphasise early intervention as a cost-effective and sustainable strategy to enhance population health. Schools can scale and sustain physical literacy interventions. Schools can implement such efforts to ensure diversity and inclusivity, especially for grassroots groups.

Physical literacy in the curriculum helps policymakers and educators meet educational and health goals, contributing to numerous SDG targets. This shows physical literacy's transdisciplinary relevance as an educational tool and public health strategy. This study emphasises cognitive determinants, adding a critical dimension to the rhetoric of sustainable development. Physical activity promotion has historically focused on behavioural results, but our data show that psychological preparation is crucial to ongoing involvement. Physical literacy interventions help children take charge of their health and well-being, which is essential to sustained development. The study shows that structured physical literacy interventions can promote holistic child development, cognitive engagement, and lifelong healthy behaviours, helping achieve SDG 3 and SDG 4. The integration of cognitive, educational, and health outcomes into a single intervention paradigm shows that physical literacy may address global education and public health issues sustainably and effectively. These findings suggest that physical literacy in early childhood education should be prioritised as a strategy for sustainable development.

6. Conclusion

A structured 12-week physical literacy intervention was tested for its effects on cognitive predictors of physical activity participation—confidence, motivation, and comprehension—in grassroots children aged 6–8. Due to substantial impact sizes and controlled analyses, the experimental group showed significant gains in all cognitive metrics. These findings suggest that developmentally appropriate, mastery-oriented, and autonomy-supportive physical literacy treatments improve children's psychological preparedness for physical activity. Physical literacy is multimodal because cognitive and physical skills affect involvement. Kids start, continue, and enjoy exercise with self-confidence, intrinsic desire, and knowledge. The integrated cognitive-behavioural approach covers a literature gap in grassroots settings with minimal interventions. The data suggest that physical literacy enhances lifelong activity and child development.

6.1. Practical Implications

This research has substantial implications for early childhood physical education and grassroots sports coaches, teachers, and practitioners. Changing from skill-focused to cognitive, motivational, and emotional learning is a primary consequence. Traditional physical education programs have focused on motor skills rather than on how students think, feel, and perceive their potential in physical activity. This study finds that confidence, motivation, and comprehension equally affect involvement. Practitioners must adopt multidimensional teaching strategies that encompass these characteristics to meaningfully and sustainably engage young children in physical activity. This study underlines the need for developmentally appropriate, engaging, and inclusive activities for 6–8-year-olds with diverse needs and skills. Children at this age respond well to fun, curious, and successful experiences. Rigorous, competitive, or performance-driven activities may deter less-talented kids. But slow advancement, appropriate pace, and manageable challenges can enhance confidence and accomplishment. Repetition of movement task success promotes children's self-efficacy, which increases their participation in scheduled and unstructured physical activities. Practitioners should foster supportive situations where all children, regardless of aptitude, can flourish and feel valued. An important finding is that autonomy-supportive teaching methods increase intrinsic motivation. The study reveals that motivation is not merely a result of involvement but a major factor in children engaging in exercise.

Meeting children's essential psychological needs for autonomy, competence, and relatedness increases intrinsic motivation, according to Self-Determination Theory. This means teachers and coaches should provide youngsters choices, movement, and self-directed learning. Let youngsters choose activities, adjust rules, or design their own games to increase ownership and enjoyment. Give constructive, positive feedback that emphasises work and progress rather than comparisons, to promote competence. A welcoming classroom and teacher environment motivates and engages kids. Environments that promote autonomy increase short- and long-term physical activity. The study could also be used to include cognitive learning in exercise. Strong evidence suggests that kids benefit from knowing the “why” of physical activity, not just the “how.” Learning about movement principles, game rules, and the health benefits of physical activity helps kids make better decisions and engage more meaningfully. Kids can appreciate physical activity by learning how activities build strength, balance, and coordination. Discussing the health benefits of regular exercise can also encourage active living. Explaining, showing, and discussing knowledge-based components in physical education programs requires little theoretical training. Cognitive and physical learning enhance education and promote rapid engagement and long-term behaviour change. The studies also underscore the importance of enjoyment and positive feelings during exercise. Enjoyment drives intrinsic motivation, especially in early life when emotions strongly influence conduct.

Kids enjoy fun, varied, and interesting activities. Thus, practitioners should use games, imaginative play, and creative movement to encourage children's curiosity and delight. Avoid boredom and disengagement by avoiding repetitive tasks. Instead, variety and novelty can intrigue people. Kids gain confidence and delight in experimenting and making mistakes in a safe, supportive environment. Children will participate more voluntarily if they absorb positive emotions during physical activities. This study also found early intervention important. Physical activity attitudes, beliefs, and actions are still developing in 6–8-year-olds. This period is perfect for developing healthy habits and positive mindsets. Early childhood cognitive characteristics, such as confidence, motivation, and comprehension, may set the stage for lifelong physical exercise. This demonstrates why elementary schools and communities should promote physical literacy. Negative attitudes and inactivity may hinder later intervention. Thus, early childhood is critical for promoting movement and preventing inactivity-related health issues. This study's intervention model is scalable and adaptable. The grassroots structured physical literacy program functioned effectively, suggesting it may be implemented in schools, community centres, and sports organisations. The intervention is simple and flexible, so practitioners with diverse resources and skills can utilise it. Customise activities for different venues, groups, and equipment. In low-resource areas with scant specialist facilities and equipment, adaptability is essential. Using fundamental movement skills, cognitive engagement, and motivating strategies allows the intervention to be delivered with minimal infrastructure.

This makes it a practical and scalable technique to get diverse people to exercise. The survey found that educators and coaches need training and capacity building. Psychological, pedagogical, and movement skills are needed to teach physical literacy. Therefore, training programmes should target motivation, self-efficacy, cognitive development, autonomy-supportive and inclusive learning environments. Professional development improves program delivery and keeps practitioners up to date. Collaboration among educators, coaches, and health professionals can also improve physical literacy programs by sharing knowledge and resources. Finally, this research can encourage lifelong exercise. Physical literacy interventions can help children live self-regulated, active lifestyles by addressing cognitive factors and offering positive early experiences. This affects public and individual health, as physical activity reduces the burden of non-communicable diseases and increases well-being. Children learn how to work out and stay motivated from practitioners. The study concludes that early childhood physical education and sports development need a paradigm shift. Instead of skill-based frameworks, holistic, cognitive, and motivational ones help increase youngsters' physical activity. Create inclusive and joyful activities, encourage autonomy and intrinsic motivation, integrate cognitive learning, and prioritise early intervention to modify children's physical exercise habits. This study proposes a scalable technique to get young toddlers active and healthy.

6.2. Policy Recommendations

This study emphasises the need for policy-level integration of physical literacy into educational and public health systems to encourage lifelong activity and holistic child development. Policies on elementary school physical literacy are important. Early childhood is crucial for developing physical activity attitudes, behaviours, and competencies, so structured and purposeful physical literacy programs in schools can ensure that all children, regardless of socioeconomic background, have meaningful and developmentally appropriate physical activity experiences. Beyond traditional physical education paradigms, this integration emphasises motor skill development, cognitive comprehension, motivation, and confidence to support holistic growth across physical, psychological, and cognitive domains. Curriculum reform, teacher education and professional training must be reinforced to implement physical literacy programs. Teachers' holistic, engaging, and inclusive instruction shapes children's physical activity experiences, making such therapies successful. Therefore, pre-service and in-service teacher training should include physical literacy courses covering its theoretical foundations, pedagogical methodologies, and practical applications. Teachers should learn how to create autonomy-supportive learning environments where students can explore, choose, and self-direct. Training should encourage inclusive practises that welcome all talents and backgrounds so all children can participate. Teachers must continue professional development to stay current with physical literacy, child development research, and best practices.

Improving coordination between education and health to get kids moving is another policy suggestion. Public health issues such as physical inactivity require coordinated, interdisciplinary approaches. Linking educational policy to public health goals helps governments create integrated learning and health programs. Physical literacy uses elements from both professions. Physical literacy programs can teach youngsters about exercise, and school-based interventions can encourage preventative health. Global development goals such as SDG 3 (Good Health and Well-Being) and SDG 4 (Quality Education) require collaboration to achieve comprehensive, sustainable child development. The study emphasises targeted policy support for grassroots activity. Poor children generally don't exercise due to a lack of facilities, skilled staff, and structured involvement. To bridge these gaps, policymakers should subsidise community-based physical literacy programs. Included are playgrounds, open spaces, sports facilities, and resources for program delivery. Policies should also train local instructors and volunteers to run programs in their areas, improving accessibility and sustainability. Focusing on grassroots implementation, policymakers can disseminate the benefits of physical literacy initiatives, especially to inactive people. Another major policy challenge is

standardising the frameworks for physical literacy interventions. Without guidelines, program quality and effectiveness may vary, limiting their impact.

National or regional guidelines on physical literacy program components, objectives, and delivery can help ensure quality and consistency. These guidelines should be evidence-based and child-friendly. They should also suggest a program design for cognitive, emotional, and physical integration, along with monitoring and assessment. Standardisation boosts program efficiency and helps grow and replicate successful initiatives. Physical literacy initiatives need long-term evaluation to determine their efficacy and sustainability. Policies should track progress, quantify results, and identify areas for improvement using rigorous assessment frameworks. Quantitative and qualitative measurements measure physical activity, cognition, and well-being. Follow-up studies can demonstrate the long-term benefits of interventions and behaviour change. These evaluations improve policies and resource allocation through evidence-based decision-making. Transparent result reporting boosts policy accountability and trust. The development and scaling of physical literacy programs require partnerships and collaboration. Policymakers should promote physical activity by fostering collaboration between schools, local governments, community organisations, and NGOs. Collaborations increase resource sharing, program reach, and the availability of culturally relevant therapies.

School partnerships with local sports groups and community organisations can provide extracurricular physical exercise, while health agencies can develop and assess treatments. Parents and caregivers can reinforce healthy physical activity behaviours at home, so engage them as stakeholders. Policy should prioritise active lifestyle-enabling environments. Cities and infrastructure should support safe and accessible parks, walking paths, and recreation facilities. Kid exercise can be encouraged by walking and biking to school. Policymakers can assist school- and community-based efforts by addressing environmental and structural factors that promote activity. Our study strongly recommends integrating physical literacy into policy frameworks at multiple levels. Policymakers can encourage comprehensive and sustainable physical activity in children by incorporating physical literacy into school curricula, improving teacher training, fostering intersectoral collaboration, investing in grassroots programs, standardising guidelines, and implementing robust monitoring systems. These endeavours support education, public health, and sustainable development while improving individual health. Physical literacy as a policy goal could transform child development across countries by equipping future generations with the skills, knowledge, and motivation to be active and healthy.

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