al mubin
ISLAMIC SCIENTIFIC JOURNAL

P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

NEUROSCIENCE INTEGRATION IN PHYSICAL EDUCATION LEARNING: A LITERATURE REVIEW ON THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY, EXECUTIVE FUNCTION, AND LEARNING OUTCOMES

Rahmad Hidayat[1] Muhammad[2] Mahyu Danil[3] Dedi Saputra[4] Farhan[5]
[1/2/3/4] Lecturer, Universitas Islam Kebangsaan Indonesia, Bireuen-Aceh.
[5] Student, Universitas Islam Kebangsaan Indonesia, Bireuen-Aceh.
Corresponding Email: rahmadhidayat042@gmail.com

ABSTRACT
Physical education learning has the potential to develop students' motor abilities as well as their cognitive functions. However, the integration of neuroscientific findings into instructional design still requires conceptual strengthening. This study aims to analyze the relationship between physical activity, executive function, and learning outcomes, and to formulate a neuroscience-based integrative framework for physical education learning. The study employed an *Integrative Literature Review* approach through a critical synthesis of relevant scientific publications on physical activity, cognitive engagement, executive function, and learning achievement. The findings indicate that physical activity involving cognitive demands has the potential to support inhibitory control, working memory, and cognitive flexibility, although its effectiveness varies according to activity characteristics, intervention duration, and students' developmental level. The relationship between executive function and learning outcomes is multidimensional and does not yet consistently demonstrate a causal relationship. This study produces a Motor–Cognitive Integrative Framework that links physical activity characteristics, cognitive engagement, executive function, and learning outcomes. The framework offers a theoretical contribution and pedagogical implications for developing physical education learning that systematically integrates motor and cognitive goals, while requiring further empirical testing.
Keywords: *physical_activity; executive_function; learning_outcomes; neuroscience; physical_education.*

INTRODUCTION

Physical education plays a strategic role in supporting students' physical, motor, cognitive, and social-emotional development. However, physical education learning oriented toward fitness and motor skill mastery has not fully optimized the potential of physical activity to support cognitive processes. (Sember et al., 2020) showed a relationship between physical activity, cognitive function, and children's academic performance, although the strength of this relationship varied. This finding reinforces the urgency of developing physical education that not only emphasizes movement ability but also integrates cognitive aspects as part of the learning experience.

The neuroscience perspective provides a foundation for understanding the relationship between physical activity and executive functions (*executive functions*), which include inhibitory control (*inhibitory control*), working memory (*working memory*), and cognitive flexibility (*cognitive flexibility*). These three components play a role in regulating attention, decision-making, and behavioral control during learning. (Sember et al., 2020) found a relationship between motor competence and executive function in children and adolescents. (Malambo et al., 2022) also identified associations between fundamental movement skills, fitness, physical activity, and executive function. These findings indicate

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL
P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

that physical education activities have the potential to serve as a means of developing both motor and cognitive abilities.

Empirical evidence increasingly supports this relationship. (Vorkapic et al., 2021) identified the potential of physical activity to support children's cognitive function and academic performance. (Shi et al., 2022) showed that physical activity in real-world settings can benefit executive function. (Mao et al., 2024), through a meta-analysis, found a positive effect of physical activity involving cognitive demands on executive function, particularly inhibitory control and working memory. (Wang et al., 2024) further showed differences in the effectiveness of various types of physical activity on the components of executive function. These results indicate that the cognitive benefits of physical activity are determined not only by intensity and duration but are also related to movement characteristics and students' cognitive engagement.

Nevertheless, the relationship between physical activity, executive function, and learning outcomes has not shown fully robust consistency. (Owen et al., 2022) identified a relationship between sport participation and academic performance, while (Zang et al., 2024) found the potential of aerobic exercise to support executive function and academic achievement. (Teng et al., 2025) reported the benefits of physical activity with cognitive engagement but emphasized the need to consider the quality of evidence and the variation in interventions. (Qiu et al., 2026) even showed that the effects of physical activity differ according to the cognitive and academic indicators measured. These differences in findings confirm that increasing physical activity does not automatically improve all components of executive function or learning outcomes.

Previous studies have contributed by testing the effectiveness of physical activity and comparing various forms of intervention. (González-Del-Castillo & Barbero-Alcocer, 2025) examined school-based physical activity programs in relation to the development of executive function. (Lawson et al., 2025) compared the effects of different types of physical activity and sport on the executive function of children and adolescents. Meanwhile, (Reyes-Amigo, 2025) examined brief physical activity in learning environments. However, the research gap (*research gap*) lies in the limited syntheses that specifically link physical activity characteristics, cognitive engagement, executive function, and learning outcomes into integrated pedagogical principles of physical education. Previous studies have mostly emphasized the effectiveness of interventions, while translating neurocognitive findings into a foundation for instructional design and assessment still requires conceptual strengthening.

The novelty (*novelty*) of this study lies in the formulation of a neuroscience-based integrative conceptual framework that links four main dimensions, namely physical activity characteristics, cognitive engagement, executive function, and learning outcomes, in the context of physical education learning. Unlike studies that focus on measuring the effects of physical activity, this study synthesizes the relationships between motor and cognitive demands, executive control abilities, and their implications for instructional design. The framework is expected to provide a theoretical foundation for developing physical education learning that systematically integrates motor and cognitive development.

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL
P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

Based on this gap, this study aims to analyze and synthesize scientific evidence on the relationship between physical activity, executive function, and learning outcomes through an *Integrative Literature Review* approach. The results are directed toward formulating a conceptual framework of neuroscience integration as a foundation for developing more comprehensive physical education learning strategies and assessments.

METHOD

This study was designed using an *Integrative Literature Review* approach to analyze and synthesize empirical and conceptual findings on the relationship between physical activity, executive function, and learning outcomes in physical education learning. This approach refers to (Whittemore & Knafl, 2005), which positions problem identification, literature search, data evaluation, data analysis, and presentation of the synthesis as the main stages of an integrative review.

The literature search was planned through the Scopus, Web of Science, PubMed, and Google Scholar databases, covering publications from 2020–2026. The keywords used included physical education, physical activity, neuroscience, executive function, cognitive engagement, and academic performance. Keyword combinations were constructed using the Boolean operators AND and OR to identify publications relevant to the research focus.

The inclusion criteria comprised scientific journal articles that discussed physical activity or physical education in relation to students' executive function, cognitive development, and learning outcomes; were published within the specified time range; and provided full text for analysis. Articles not directly related to the educational context, publications without adequate methodological information, and duplicate documents were excluded from the selection process. Quality appraisal was conducted based on the appropriateness of objectives, clarity of methods, validity of findings, and relevance to the research questions.

The analysis was carried out by organizing the findings into four categories, namely physical activity characteristics, cognitive engagement, executive function, and learning outcomes. Each article was analyzed based on research design, participant characteristics, form of physical activity, measurement indicators, main results, and study limitations. Subsequently, thematic synthesis was used to identify patterns of relationships, differences in findings, and pedagogical implications. The results of the synthesis were directed toward formulating a conceptual framework of neuroscience integration in physical education learning.

Stages of the *integrative* review

Stage	Activity
Problem identification	Determining the research questions and the focus of the synthesis
Literature search	Searching for articles in the specified databases
Selection and evaluation	Examining the relevance, duplication, eligibility, and quality of articles
Analysis and synthesis	Identifying themes, relationship patterns, and inconsistencies in the findings

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL
P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

Framework development	Formulating neuroscience integration in PE learning

RESULTS AND DISCUSSION

Synthesis of Empirical Evidence on the Relationship between Physical Activity and Executive Function

The results of the literature synthesis show that physical activity has the potential to make a positive contribution to students' executive function, but its effects are not uniform. These differences relate to activity characteristics, the complexity of cognitive demands, intervention duration, and the executive function components measured. Thus, the relationship between physical activity and executive function cannot be adequately explained by movement intensity alone but must consider the quality of the motor–cognitive experience during learning.

(Kolovelonis & Goudas, 2023) showed that cognitively challenging physical activity games can benefit executive function compared with more fitness-oriented activities. This finding is consistent with (Xu et al., 2025), who reported improvements in inhibitory control and working memory through physical activity interventions with gradually increasing cognitive load. However, cognitive flexibility did not show an equally strong pattern of improvement. This difference in response indicates that the three components of executive function do not always develop simultaneously.

The findings of (Silva, 2026) reinforce the importance of this distinction. A 12-week cognitive game-based physical education intervention benefited inhibitory control but did not produce a significant difference in working memory between the intervention and control groups. Meanwhile, (Xu, 2026) reported the benefits of a physical activity intervention with cognitive engagement on the executive function of school-age children. This variation in results indicates that intervention success is better understood as a specific response to activity design rather than as a universal effect of all forms of physical exercise.

The study by (Zhang, 2023) also demonstrated the relevance of structured physical exercise programs in developing children's fitness and executive function. A study of *dual-task* training in school-age children (2026) likewise showed that combining motor and cognitive tasks can improve performance under dual-task conditions. Nevertheless, dual-task performance is not identical to all components of executive function, so the results need to be interpreted according to the instruments used.

Overall, this synthesis yields the finding that the cognitive characteristics of physical activity are an important dimension in explaining variation in executive function responses. However, the available evidence does not yet justify the conclusion that increasing task complexity always produces greater cognitive improvement. This relationship is influenced by the fit between activity demands and students' developmental abilities.

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL
P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

Table 1. Critical Synthesis of the Relationship between Physical Activity, Executive Function, and Learning Outcomes

Researcher (Year)	Research Focus	Main Findings	Implications for PE Learning
Zhang et al. (2023)	Physical exercise and executive function	Structured physical exercise shows potential for improving children's executive function.	Physical activity needs to be designed systematically.
Kolovelonis & Goudas (2023)	Physical games with cognitive challenges	Games that demand cognitive engagement benefit executive function.	Integrating decision-making and changes in game rules.
Xu et al. (2025)	Physical activity with cognitive engagement	Responses to the intervention differ by executive function component.	Setting targets for inhibition, working memory, or cognitive flexibility.
Silva et al. (2026)	Cognitive games in physical education	Benefits for inhibitory control are not always accompanied by improvements in working memory.	Assessing executive function components separately.
Xu et al. (2026)	Cognitively engaging physical activity intervention	Activities that combine motor and cognitive demands have the potential to support executive function.	Designing movement activities with cognitive challenges.
Olive et al. (2024)	Physical activity and cognitive development	Physical activity interventions show benefits for inhibitory control and language development.	Attending to specific learning outcomes, not only motor skills.
Pesce et al. (2021)	Physical education and self-control	Specially designed physical education interventions support the development of self-control.	Integrating behavioral regulation into movement activities.
Ariyanto et al. (2020)	Traditional games and movement skills	Traditional games support improvement in fundamental movement skills.	Using local games as contextual motor activities.
Kurniawan et al. (2025)	Game-based PE learning	The game-based approach shows benefits for physical education learning outcomes.	Developing active and participatory learning.
Wijaya & Fitri (2023)	E-learning-based traditional	Instructional development is directed toward	Combining learning technology with motor activities.

This work is licensed under a Creative Commons Attribution 4.0 International License.

P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

	games	improving locomotor movement skills.

Source: Literature synthesis by the researchers (2026).

Mechanisms of Motor–Cognitive Integration in Physical Education Learning

The relationship between physical activity and executive function can be explained through activity characteristics that require students to coordinate movement with processes of attention, response control, and decision-making. In physical education learning, these processes emerge when students must remember game rules, adjust strategies, respond to changing situations, and inhibit actions that do not align with the activity's goals.

(Kolovelonis & Goudas, 2023) showed that physical activity games with cognitive demands can be used to stimulate executive function in physical education learning. (Pesce et al., 2021) also demonstrated the relevance of physical education interventions designed to develop self-control. Both studies confirm that motor activity can serve as a learning context that combines movement regulation and behavioral regulation.

From a pedagogical perspective, activities with motor–cognitive demands can be designed through rule changes, role switching, response selection, and movement problem-solving. Such activities are relevant to inhibitory control when students must withhold automatic responses; to working memory when students must maintain rules or movement sequences; and to cognitive flexibility when students must adjust their strategies in response to changing game situations.

Indonesian studies provide a contextual foundation for applying these principles. (Ariyanto et al., 2020) showed that traditional games can improve the fundamental movement skills of elementary school students. (Andriadi & Saputra, 2021) developed a game-based learning model for basic jumping movements, while (Hidayat et al., 2020) demonstrated the use of the circuit method to improve basic athletic movement abilities. (Yuliandra et al., 2020) also showed the relevance of instructional interventions in improving specific basic movement skills.

These national findings indicate the availability of instructional approaches that can be adapted for motor–cognitive integration. However, the improvement in motor skills in these studies cannot be treated as direct evidence of improved executive function because the measurement indicators differ. Therefore, the contribution of national studies lies mainly in strengthening the pedagogical context, whereas explaining the relationship with executive function still requires support from studies that measure cognitive abilities directly.

(Nevitaningrum et al., 2023) demonstrated the relevance of traditional games in shaping students' character, while (Wijaya & Fitri, 2023) examined *e-learning*-based traditional games to support basic locomotor movements. Both studies broaden the possibilities for applying game activities in physical education learning. However, character, locomotor movement, and executive function are distinct constructs, so the relationships among them should not be assumed without empirical measurement.

Thus, integrating neuroscience into physical education learning is not merely a matter of including games or varied physical activities. Such integration requires designing activities with explicit motor and cognitive goals, adjusting the level of

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL
P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

challenge, and conducting evaluations capable of distinguishing the development of movement skills from that of executive function. This explanation is pedagogical and cognitive in nature; changes in brain structure or activity cannot be inferred without neurobiological measurement.

The Relationship between Physical Activity, Executive Function, and Learning Outcomes

The literature synthesis shows that the relationship between physical activity and learning outcomes is more complex than the relationship between physical activity and specific components of executive function. Learning outcomes are a multidimensional construct that may include motor skills, conceptual understanding, decision-making ability, and academic achievement. Therefore, the relationship between physical activity, executive function, and learning outcomes needs to be analyzed according to the type of outcome measured.

(Olive et al., 2024) found that physical activity interventions in early childhood can support the development of inhibitory control and language. This finding suggests possible benefits of physical activity that extend beyond motor skills. However, improvements in inhibitory control and language development do not automatically prove that executive function mediates the relationship between physical activity and academic achievement.

Research on active learning and physical activity breaks among elementary school students (2025) provides an additional perspective on integrating movement into learning activities. Nevertheless, the effectiveness of interventions should be interpreted based on the cognitive performance and learning outcome indicators actually measured, not on the assumption that all forms of physical activity improve academic achievement.

In the Indonesian context, (Kurniawan et al., 2025) reported the effectiveness of game-based learning on physical education learning outcomes. (Kustiawan, 2019) examined the improvement of learning outcomes in basic manipulative movements through modified learning aids. (Widodo, 2017) developed a game-based integrative thematic learning model for physical education. These three studies show that instructional design plays an important role in achieving physical education goals, although they do not directly explain the mechanisms of executive function.

Studies on improving basic throwing movements through a play approach (Anggraeni & Sutiyarsih, 2018) and on learning outcomes in throwing and catching in *kasti* (a traditional bat-and-ball game) through a play approach (Daulay, 2021) also support the importance of activity characteristics in movement skill learning. However, these results remain within the domain of motor learning and cannot be generalized into improvements in academic achievement across subjects.

Based on this comparison, three patterns of relationships need to be distinguished. First, physical activity may be associated with improved motor ability as a direct outcome of physical education learning. Second, activities involving cognitive demands have the potential to support specific components of executive function. Third, executive function is potentially related to learning ability, but this relationship does not always result in measurable improvements in academic achievement. This finding indicates that executive

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL
P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

function is more appropriately positioned as a potential cognitive mechanism rather than an established causal mediator. Demonstrating its mediating role requires longitudinal or experimental studies that simultaneously measure physical activity, executive function, and learning outcomes with appropriate indirect-effect analyses.

Integrative Synthesis and Development of the Conceptual Framework

The results of the synthesis identify a gap between studies demonstrating the benefits of physical activity for executive function and studies developing physical education learning strategies. International studies tend to emphasize the effectiveness of interventions on cognitive abilities, whereas some national studies focus more on developing movement skills, game-based approaches, and physical education learning outcomes. This difference in orientation indicates the need for a conceptual framework that connects cognitive evidence with instructional design principles.

Based on these findings, this study proposes the Motor–Cognitive Integrative Framework in Physical Education Learning. This framework positions physical activity characteristics as the dimension of pedagogical design, cognitive engagement as a characteristic of the learning process, executive function as the targeted cognitive ability, and learning outcomes as the evaluated outputs.

The relationships among these dimensions are not viewed as a linear process that applies universally. Learner characteristics, developmental level, motor experience, and the appropriateness of activity difficulty are conditions that can influence learning responses. Thus, physical activity that is effective in motor terms does not necessarily produce the same cognitive benefits, and improvements in executive function are not necessarily reflected directly in academic achievement.

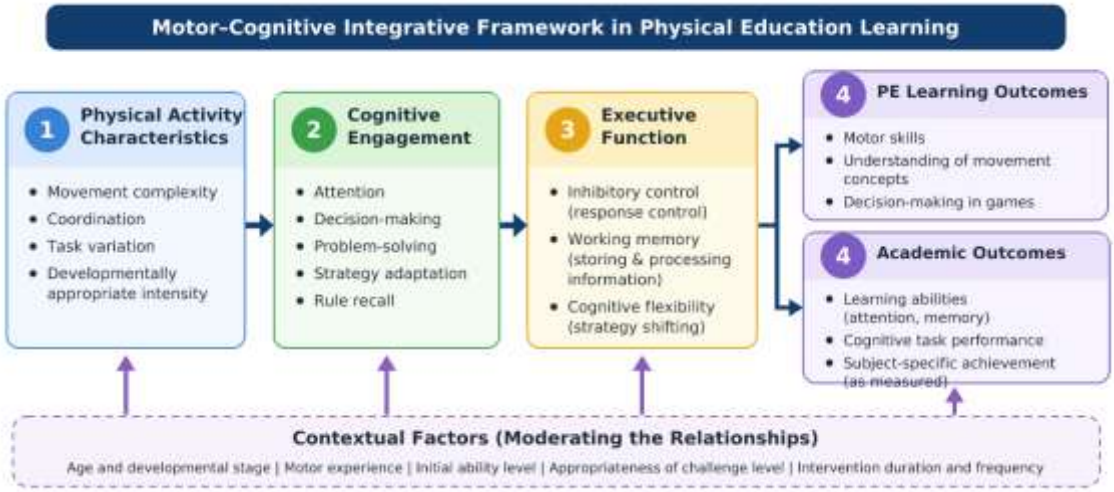


Figure 1. Motor–Cognitive Integrative Framework in Physical Education Learning.

The framework generates three conceptual propositions. First, physical activity containing cognitive demands that match students' abilities has the potential to yield greater benefits for specific components of executive function than activities not designed for that purpose. Second, the cognitive benefits of physical activity are influenced by the fit between task characteristics and students' developmental abilities. Third, the relationship between executive function and learning outcomes needs to be evaluated specifically according to the type of learning achievement.

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL
P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

The theoretical contribution of this study lies in establishing the conceptual relationships between physical activity, cognitive demands, executive function, and learning outcomes in the context of physical education. Its practical contribution takes the form of design principles for learning activities that integrate motor and cognitive goals without neglecting the differences in measurement indicators for each ability.

The proposed novelty does not lie in discovering the relationship between physical activity and executive function, since this relationship has been studied previously, but rather in a synthesis that translates this evidence into a pedagogical framework with clear distinctions between activity characteristics, cognitive processes, executive abilities, and learning outcomes. This framework is conceptual in nature, so its effectiveness and the causal relationships among its dimensions still require empirical testing.

Overall, the results of this review indicate that integrating neuroscience into physical education learning has a promising empirical basis, particularly through physical activity with cognitive engagement. However, its application requires caution in distinguishing evidence of motor benefits, changes in executive function, and academic achievement. Accordingly, the development of neuroscience-based physical education learning should be oriented toward the quality of activity design, alignment with students' developmental level, and multidimensional evaluation.

CONCLUSION

Based on the results of the Integrative Literature Review, it can be concluded that physical activity has the potential to support the development of students' executive function, particularly inhibitory control, working memory, and cognitive flexibility. However, these benefits are not uniform because they are influenced by activity characteristics, the level of cognitive engagement, intervention duration, and students' developmental abilities. Physical activity that integrates motor and cognitive demands has the potential to support the learning process, but improvements in executive function do not automatically result in improved academic achievement. Therefore, the relationship between physical activity, executive function, and learning outcomes needs to be understood multidimensionally by distinguishing motor, cognitive, and academic achievements.

The main contribution of this study is the formulation of the Motor–Cognitive Integrative Framework in Physical Education Learning, which links physical activity characteristics, cognitive engagement, executive function, and learning outcomes as a conceptual foundation for developing neuroscience-based learning. This framework has implications for educators in designing movement activities that are oriented not only toward fitness and motor skills but also involve decision-making, response control, and strategy adjustment. Given that this study is a literature review, the effectiveness of the proposed framework still requires empirical testing through experimental or longitudinal research to confirm its contribution to students' executive function and learning outcomes.

BIBLIOGRAPHY

Andriadi, & Saputra. (2021). Pengembangan model pembelajaran gerak dasar melompat berbasis permainan untuk anak sekolah dasar. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v17i1.35422

Anggraeni, & Sutiyarsih. (2018). Peningkatan hasil belajar gerak dasar melempar melalui pendekatan bermain. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v14i1.21340

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL
P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

Ariyanto, A., Triansyah, A., & Gustian, U. (2020). Penggunaan permainan tradisional untuk meningkatkan keterampilan gerak fundamental siswa Sekolah Dasar. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v16i1.30785

Daulay. (2021). Hasil belajar lempar tangkap bola kasti dengan pendekatan bermain bagi siswa Sekolah Dasar. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v17i2.54423

González-Del-Castillo, J., & Barbero-Alcocer, I. (2025). Effects of school-based physical activity programs on executive function development in children: a systematic review. *Frontiers in Psychology*, *16*, 1658101. https://doi.org/10.3389/fpsyg.2025.1658101

Hidayat, Pratama, & Hardiono. (2020). Peningkatan kemampuan gerak dasar atletik dengan menggunakan metode sirkuit pada siswa Sekolah Dasar. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v16i1.30792

Kolovelonis, A., & Goudas, M. (2023). The effects of cognitively challenging physical activity games versus health-related fitness activities on students' executive functions and situational interest in physical education: A group-randomized controlled trial. *European Journal of Investigation in Health, Psychology and Education*. https://doi.org/10.3390/ejihpe13050060

Kurniawan, R., Mahyudi, Y. V, & Sinulingga, A. R. (2025). Efektivitas pembelajaran berbasis permainan terhadap hasil belajar pendidikan jasmani. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v21i2.86683

Kustiawan. (2019). Peningkatkan hasil belajar gerak dasar manipulatif menggunakan modifikasi alat bantu pembelajaran sederhana di sekolah dasar. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v15i1.25488

Lawson, G. V., Ugrinowitsch, C., Costa, R., & Lamas, L. (2025). Effects of different types of chronic physical activities and sports on executive functions among children and adolescents: A systematic review and meta-analysis. *Journal of Sports Sciences*, *43*(6), 565–579. https://doi.org/10.1080/02640414.2025.2468587

Malambo, C., Nová, A., Clark, C., & Musálek, M. (2022). Associations between Fundamental Movement Skills, Physical Fitness, Motor Competency, Physical Activity, and Executive Functions in Pre-School Age Children: A Systematic Review. *Children*, *9*(7), 1059. https://doi.org/10.3390/children9071059

Mao, F., Huang, F., Zhao, S., & Fang, Q. (2024). Effects of cognitively engaging physical activity interventions on executive function in children and adolescents: a systematic review and meta-analysis. *Frontiers in Psychology*, *15*, 1454447. https://doi.org/10.3389/fpsyg.2024.1454447

Nevitaningrum, N., Mulyatno, C. B., & Nopembri, S. (2023). Implementasi pembelajaran pendidikan jasmani berbasis permainan tradisional dalam membentuk karakter peserta didik sekolah dasar. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v19i1.73492

Olive, L. S., Telford, R. M., Westrupp, E., & Telford, R. D. (2024). Physical activity intervention improves executive function and language development during early childhood: The active early learning cluster randomized controlled trial. *Child Development*. https://doi.org/10.1111/cdev.14014

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL
P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

Owen, K. B., Foley, B. C., Wilhite, K., Booker, B., Lonsdale, C., & Reece, L. J. (2022). Sport Participation and Academic Performance in Children and Adolescents: A Systematic Review and Meta-analysis. *Medicine & Science in Sports & Exercise*, *54*(2), 299–306. https://doi.org/10.1249/MSS.0000000000002786

Pesce, C., Lakes, K. D., Stodden, D. F., & Marchetti, R. (2021). Fostering self-control development with a designed intervention in physical education: A two-year class-randomized trial. *Child Development*. https://doi.org/10.1111/cdev.13445

Qiu, P., Zhou, T., Wu, J., Liu, Y., Guo, X., & Wang, H. (2026). Effects of physical activity on executive function components and academic performance in children aged 6–12 years: a systematic review and meta-analysis of randomized controlled trials. *BMC Public Health*. https://doi.org/10.1186/s12889-026-29845-1

Reyes-Amigo, T. (2025). Effectiveness of school-based active breaks on classroom behavior, executive functions and physical fitness in children and adolescent: a systematic review. *Frontiers in Public Health*, *13*, 1469998. https://doi.org/10.3389/fpubh.2025.1469998

Sember, V., Jurak, G., Kovač, M., Morrison, S. A., & Starc, G. (2020). Children's Physical Activity, Academic Performance, and Cognitive Functioning: A Systematic Review and Meta-Analysis. *Frontiers in Public Health*, *8*, 307. https://doi.org/10.3389/fpubh.2020.00307

Shi, P., Tang, Y., Zhang, Z., Feng, X., & Li, C. (2022). Effect of Physical Exercise in Real-World Settings on Executive Function of Typical Children and Adolescents: A Systematic Review. *Brain Sciences*, *12*(12), 1734. https://doi.org/10.3390/brainsci12121734

Silva, W. P. (2026). Effects of a school physical education program combined with cognitive games on executive function: A randomized clinical trial. *Pediatric Exercise Science*. https://doi.org/10.1123/pes.2025-0148

Teng, G., Xia, H., Li, Q., & Chen, A. (2025). Improving Executive Function in Children and Adolescents with Cognitive-Engaging Physical Activity: A Systematic Review and Multilevel Meta-Analysis. *Journal of Developmental & Behavioral Pediatrics*, *46*(1), e76–e82. https://doi.org/10.1097/DBP.0000000000001330

Vorkapic, C. F., Alves, H., Araujo, L., Borba-Pinheiro, C. J., Coelho, R., Fonseca, E., Oliveira, A., & Dantas, E. H. M. (2021). Does Physical Activity Improve Cognition and Academic Performance in Children? A Systematic Review of Randomized Controlled Trials. *Neuropsychobiology*, *80*(6), 454–482. https://doi.org/10.1159/000514682

Wang, J., Yang, Y., Li, L., Yang, X., Guo, X., Yuan, X., Xie, T., Yang, K., & Zhuang, J. (2024). Comparative efficacy of physical activity types on executive functions in children and adolescents: A network meta-analysis of randomized controlled trials. *Journal of Science and Medicine in Sport*, *27*(3), 187–196. https://doi.org/10.1016/j.jsams.2023.11.006

Whittemore, R., & Knafl, K. (2005). The integrative review: updated methodology. *Journal of Advanced Nursing*, *52*(5), 546–553. https://doi.org/10.1111/j.1365-2648.2005.03621.x

Widodo. (2017). Pengembangan model pembelajaran tematik integratif penjasorkes berbasis permainan siswa sekolah dasar. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v13i1.21606

This work is licensed under a Creative Commons Attribution 4.0 International License.

al mubin
ISLAMIC SCIENTIFIC JOURNAL

P-ISSN: 2746-8240 E-ISSN: 2746-5535
DOI: https://doi.org/10.51192/almubin.v9i2.3066

Wijaya, & Fitri. (2023). Traditional Game Based on E-Learning Method to Improve the Basic Locomotor Movements. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v19i1.73698

Xu, Y. (2026). Effects of cognitively engaging physical activity on executive function, mental health, and physical fitness in school-age children: A cluster-randomized controlled trial. *BMC Psychology*. https://doi.org/10.1186/s40359-026-04339-2

Xu, Y., Qi, K., Białas, M., Xu, Q., Guo, X., & Chen, A. (2025). Time-course effects of cognitively engaging physical activity on executive function and self-control in younger school-aged children: A randomized controlled trial. *Frontiers in Psychology*. https://doi.org/10.3389/fpsyg.2025.1628814

Yuliandra, Fahrizqi, & Mahfud. (2020). Peningkatan gerak dasar guling belakang bagi siswa Sekolah Dasar. *Jurnal Pendidikan Jasmani Indonesia*. https://doi.org/10.21831/jpji.v16i2.34110

Zang, W., Zhu, J., Xiao, N., Fang, M., Li, D., Li, H., Yan, J., Jing, H., & Wang, S. (2024). Effects of aerobic exercise on children's executive function and academic performance: A systematic review and meta-analysis. *Heliyon*, *10*(7), e28633. https://doi.org/10.1016/j.heliyon.2024.e28633

Zhang. (2023). Effect of 11 Weeks of Physical Exercise on Physical Fitness and Executive Functions in Children. *Children*. https://doi.org/10.3390/children10030485

This work is licensed under a Creative Commons Attribution 4.0 International License.