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INTEGRATING GAME-BASED WARM-UP AND DEEP LEARNING FOR MOTOR, COGNITIVE, AND CHARACTER DEVELOPMENT IN ELEMENTARY PHYSICAL EDUCATION

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ABSTRACT

Developing motor, cognitive, and character skills in elementary physical education remains a critical challenge, as conventional warm-up activities often emphasise physical readiness alone while neglecting deeper learning opportunities. Addressing this gap, the present study examines the effectiveness of a game-based warm-up model integrated with deep learning principles in fostering holistic student outcomes. This research employed a quantitative approach using a quasi-experimental design with a pretest–posttest control group. The population consisted of Grade V elementary students in Batang Hari District, Jambi Province, from which 70 students were randomly selected and assigned into experimental (n = 35) and control (n = 35) groups. Instruments included a motor skills test, a 25-item cognitive test, and a 30-item character scale. Data were validated for reliability (Cronbach's α = 0.79–0.87) and analysed using normality, homogeneity, and hypothesis testing (independent samples t-test). Results revealed a significant improvement in the experimental group's outcomes (M = 76.48) compared to the control group (M = 61.25), with t(68) = 10.245, p < 0.001. The effect size was huge (Cohen's d = 3.70), and the normalised gain reached a moderate level (n-Gain = 0.48). These findings confirm that integrating game-based warm-up with deep learning enhances physical readiness and promotes higher-order thinking and value internalisation. The novelty of this study lies in positioning warm-up as a pedagogical platform that bridges motor competence, cognitive engagement, and character development. The implications extend to teachers, schools, and policymakers in advancing holistic physical education aligned with 21st-century educational goals.

Keywords: game-based warm-up, deep learning, motor skills, cognitive development, character education, elementary physical education

INTRODUCTION

The Indonesian education landscape is undergoing fundamental changes due to technological acceleration, changes in student characteristics, and ongoing curriculum reforms. Digital technology has become an integral part of children's lives, but at the same time, it has significantly impacted their physical activity and holistic development. Indonesia ranks at the top in global internet usage, with over 229 million active users, equivalent to 80.6% of the population (Backlinko, 2025). Children are now exposed to digital media from an early age, a trend that, although occasionally strengthening cognitive aspects, is often associated with a decline in physical activity and social interaction (Purwijayanti & Munir, 2021). These changes seriously affect child development, particularly concerning motor skills, concentration, and emotional regulation (Rusmianto & Putra, 2020). This phenomenon also aligns with a WHO report (2020), which notes that more than 80% of school-age children worldwide do not meet the minimum recommendations for daily physical activity.

In response to these challenges, the Ministry of Education, Culture, Research, and Technology initiated the Merdeka Curriculum as a transformative reform emphasising learning independence, contextual learning, and a deep learning approach. The core of this policy is the Pancasila Student Profile, a competency framework that aims to develop students into faithful, critical thinkers, creative, independent, cooperative, and globally diverse (Kemendikbudristek, 2022). Within this framework, Physical Education, Sports, and Health (PJOK) subjects occupy a strategic position, especially at the elementary education level. In addition to improving physical fitness, PJOK also functions as a vehicle for character building, collaboration development, and students' social and emotional maturity (Bailey et al., 2009; Opstoel et al., 2020; UNESCO, 2015). However, in practice, implementing PJOK at the elementary school level still faces significant challenges, especially in the early stages of learning, namely the warm-up session.

In many schools, warm-up sessions are still monotonous and instructional without regard to pedagogical value or student cognitive engagement. Field observations at three public elementary schools in Batang Hari Regency show that conventional warm-up routines, such as static stretching and mechanical movements, cannot maintain student motivation. More than 80% of teachers stated that students showed low enthusiasm and minimal cognitive engagement during warm-up sessions, while only 60% remained focused after the first five minutes. Similar studies in various countries also indicate that warm-up sessions are often overlooked in meaningful learning design (Fernandez-Rio & Mendez-Gimenez, 2020). These findings reveal a discrepancy between the ideal objectives of PJOK and its actual practice, indicating an urgent need for an instructional model that can make warm-up sessions the foundation of effective learning.

This study identifies a critical pedagogical gap, namely the lack of a systematic, enjoyable warm-up model capable of integrating the dimensions of movement, cognition, and character building in an integrated manner. This integration is essential in 21st-century learning, which is increasingly oriented towards deep learning. In educational theory, deep learning refers to a process in which learners connect cross-disciplinary knowledge, apply concepts in real-life situations, and internalise values through active and reflective engagement (Biggs & Tang, 2007). This approach emphasises meaningful learning processes, fostering self-identity, and forming long-term competencies oriented towards real life. This principle is highly relevant for application in elementary school PJOK, primarily through physical activities designed to create deep mental and affective engagement (Casey & MacPhail, 2018).

The play-based learning approach, rooted in Piaget's constructivist theory and Vygotsky's sociocultural approach, offers an ideal solution to these problems. Play allows children to build knowledge through exploration, social interaction, and meaningful physical experiences. In the context of PJOK, games not only support the mastery of motor skills but also facilitate the development of problem-solving, decision-making, and emotional regulation skills (Dyson et al., 2016; Shapiro, 2019). The theory of embodied cognition even reinforces the assumption that cognitive development cannot be separated from movement activities and the involvement of the body with the surrounding environment (Shapiro, 2019). Thus, game-based warm-up sessions have the potential to become a space for cognitive stimulation and value formation, not just physical preparation for core activities.

Furthermore, the affective and moral dimensions of learning, which are at the core of the Pancasila Student Profile, can be effectively developed through pedagogically designed physical games. Games in warm-up sessions require students to work together, be honest, patient, and care for others. Wijayanti, Sari, and Suparno (2022) show that schools implementing character-based games in PJOK experience significant improvements in student discipline, responsibility, and cooperation. These findings reinforce the view that PJOK can be an effective character education vehicle if designed intentionally, contextually, and value-based (Hellison, 2011; Shields & Bredemeier, 2009). Research by Pesce et al. (2021) found that systematically designed play activities stimulate children's executive functions, including attention, working memory, and self-control. In terms of character, Hellison (2011), through the Teaching Personal and Social Responsibility (TPSR) model, emphasised that physical activities can effectively instill personal and social responsibility values. Furthermore, Bailey et al. (2018) identified that integrating physical activities and cognitive learning can produce a more meaningful learning experience. However, most of these studies focus on only one dimension, motor, mental, or character, without integrating all three simultaneously.

A gap analysis of the existing literature shows that, to date, there has been little research integrating the three main dimensions—motor, cognitive, and character—into the PJOK warm-up model in elementary schools. Existing studies are still partial: some focus on improving motor skills through play activities, while others highlight cognitive aspects or character values, but do not combine them into a single conceptual framework. In addition, previously developed game-based warm-up designs often did not adopt the principle of deep learning, which is learning that encourages deep understanding, reflection, and cross-context knowledge transfer. This creates both opportunities and challenges for this study to bring innovation.

The novelty of this research lies in its attempt to comprehensively integrate game-based warm-ups with deep learning principles in elementary school physical education. The warm-up model developed focuses on physical readiness and is designed to stimulate critical thinking and problem-solving and instill character values through structured game dynamics. Thus, this study provides a strong justification for the importance of further exploration in the field of physical education: first, theoretically expanding the horizons of PE research by connecting the concepts of game-based learning and deep learning; second, it practically offers innovative solutions for physical education teachers to make more meaningful use of warm-up time; third, it supports national and international education agendas in preparing students to be healthy, intelligent, and have good character. These contributions are expected to make this research relevant in the local context and at the global level.

METODOLOGY

This study uses a quantitative method with a quasi-experimental design approach. This design was chosen because the study aims to test the effectiveness of a game-based warm-up model integrated with deep learning principles in improving students' motor skills, cognitive abilities, and character values. The quasi-experimental design was chosen because field conditions did not allow complete control of external variables, such as the school's classroom settings and learning schedules. Nevertheless, this design still provides causal analysis by comparing the experimental group that received treatment with the control group that did not. The research design used was a pretest-posttest control Group Design, in which both groups were given a pretest to determine their initial conditions. The experimental group then received treatment in the form of a game-based warm-up model, while the control group followed PJOK lessons with a conventional warm-up pattern. At the end of the learning period, both groups were given a posttest. This design allows researchers to measure the difference in scores before and after treatment while comparing the effectiveness between groups.

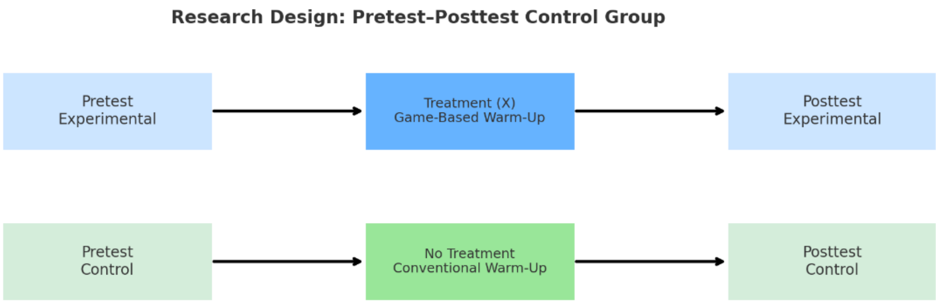

Figure 1. Research Design: Pretest–Posttest Control Group

The research population comprised all fifth-grade students in Batang Hari Regency, Jambi Province, public elementary schools, totalling 240 students across eight schools. From this population, a sample of 70 students was selected and divided into two classes. The sampling technique used was random sampling, the random selection of samples from a homogeneous population. Random sampling was chosen to give every student in the population an equal chance of being included in the sample, thereby minimizing selection bias. Based on the draw results, two classes from two schools with similar characteristics (relatively equal number of students, PJOK teachers with equivalent educational backgrounds, and almost identical sports facilities) were selected. The first class (35 students) was designated the experimental group, while the second (35 students) was designated the control group. Thus, the sample representation was sufficient to generalize the research results in the context of elementary schools in Batang Hari Regency.

The research instruments used in this study were specifically designed to measure three main aspects in accordance with the research objectives, namely motor skills, cognitive abilities, and character values of elementary school students. Motor skills were measured through basic movement tests adapted from the Test of Gross Motor Development (TGMD-2), which included components of running, jumping, and manipulative skills such as throwing and catching. This instrument was chosen because it could comprehensively describe students' motor development in the context of physical education learning. Cognitive abilities were measured using a 25-question multiple-choice test to assess understanding of movement concepts, game strategies, and basic rules in physical activities. The questions were compiled based on cognitive indicators of PJOK learning, covering factual, conceptual, and applicative knowledge. Meanwhile, character values were measured using a four-point Likert scale questionnaire consisting of 30 statements, focusing on four leading indicators: discipline, cooperation, sportsmanship, and responsibility. This character instrument allows researchers to identify how students internalise positive values during game-based learning. Character Score =

$(\Sigma Ri / (K \times 4)) \times 100$, Where: Ri = score of item i (1–4), K = number of items (e.g., 30), 4 = maximum possible score per item

All research instruments have undergone content validation by three experts in physical education and educational psychology, then empirically tested through item validity testing with Product-Moment Pearson correlation and reliability with Cronbach's Alpha coefficient. The validity criterion is when the calculated r value exceeds the table r value (at $\alpha = 0.05$). The reliability test used Cronbach's Alpha coefficient, with the reliability criterion being $\alpha > 0.70$. The validity test results show that the instruments used in this study meet the eligibility criteria. Of the 25 items in the cognitive test, 22 items were declared valid because they had a correlation value greater than the r table at a significance level of 5%. In contrast, the other three were declared invalid. Similarly, in the character questionnaire consisting of 30 statements, 27 statements were declared valid with a correlation coefficient range of 0.36 to 0.75. In comparison, the other three statements were eliminated because they did not meet the criteria. The motor skills instrument, adapted from TGMD-2, showed adequate validity based on expert testing and item analysis results. Furthermore, the instrument's reliability was tested using Cronbach's Alpha coefficient. The analysis results showed that the cognitive test had an α value of 0.812, the character scale had a value of 0.874, and the motor skills test had a value of 0.791. These values were above the threshold of 0.70, so they could be declared reliable.

The data obtained from this study were analysed in several stages to ensure the interpretation was accurate and aligned with the study's objectives. The first stage was a normality test to determine whether the pretest and posttest data in the experimental and control groups were normally distributed. The normality test was conducted using the Kolmogorov–Smirnov and Shapiro–Wilk tests, with the criterion that the data was considered normal if the significance value (p) was greater than 0.05. The second stage was a homogeneity test conducted to test the similarity of variance between groups. This test uses Levene's Test with the criterion that the data is declared homogeneous if the significance value (p) is greater than 0.05. These two prerequisite tests are essential to determine the most appropriate type of hypothesis test.

Suppose the research data meet the assumptions of normality and homogeneity. In that case, a parametric test in the form of an independent t-test is used to determine the difference in posttest scores between the experimental and control groups. The t-test was chosen because it has a higher statistical power in identifying differences in the means of two independent groups. Conversely, suppose the prerequisite test results show that the data are not normally distributed or homogeneous. In that case, the non-parametric Mann–Whitney U Test is used, which does not require a normal distribution and is more appropriate for data with these characteristics. This analysis procedure was selected to maintain the validity of the research results, so that the conclusions obtained truly reflect the effectiveness of the deep learning-based game-based warm-up model in improving the motor skills, cognitive abilities, and character values of elementary school students.

RESULT AND DISCUSSION

This section presents the research results obtained from data collection and analysis based on instruments tested for validity and reliability. This study aims to examine the effectiveness of a deep learning-based game-based warm-up model on the development of elementary school students' motor skills, cognitive abilities, and character values. The research results were analysed in stages, starting with the presentation of descriptive data in the form of pretest and posttest scores, followed by inferential statistical analysis. These results form the basis for interpreting the changes after the treatment.

Table 1. Descriptive Results of Pretest and Posttest in Experimental and Control Groups

Group	Test	N	Mean	Median	SD	Score Range
Experimental	Pretest	35	54.21	54.00	6.12	42 – 66
Experimental	Posttest	35	76.48	77.00	5.89	65 – 88
Control	Pretest	35	53.97	54.00	5.84	43 – 65
Control	Posttest	35	61.25	61.00	6.04	49 – 73

The results in Table 1 show that the experimental and control groups had almost identical average scores on the pretest (54.21 vs. 53.97), indicating that the initial conditions of the two groups were relatively balanced. After the treatment, there was a significant increase in the average score in the experimental group, from 54.21 to 76.48, with the median rising from 54.00 to 77.00. This shows that most students in the experimental group consistently improved learning outcomes. In contrast, the control group also experienced an increase, but it was much lower, from an average of 53.97 to 61.25, with a median of 61.00. The difference in standard deviation between the pretest and posttest in both groups was relatively stable, indicating that the variation in student scores did not change dramatically. These findings show that applying a deep learning-based game-based warm-up model is more effective in improving student learning outcomes, both in terms of motor skills, cognitive skills, and character values, compared to the conventional warm-up applied to the control group. The significant difference in posttest scores between the two groups indicates a real contribution from the treatment given, which was further tested through inferential analysis.

Table 2. Normality Test Results (Shapiro–Wilk)

Group	Test	N	Statistic (W)	Sig. (p)	Interpretation
Experimental	Pretest	35	0.972	0.412	Normal
Experimental	Posttest	35	0.968	0.355	Normal
Control	Pretest	35	0.975	0.498	Normal
Control	Posttest	35	0.962	0.281	Normal

The Shapiro–Wilk test results indicate that all data sets have $p > 0.05$, which means that both pretest and posttest scores in the experimental and control groups are normally distributed. This fulfils the assumption required for parametric analysis.

Table 3. Homogeneity Test Results (Levene's Test)

Variable	F	Sig. (p)	Interpretation
Pretest	0.214	0.645	Homogeneous
Posttest	0.327	0.571	Homogeneous

Based on the results of Levene's Test, the significance values for pretest ($p = 0.645$) and posttest ($p = 0.571$) are greater than 0.05. This indicates that the data from the experimental and control groups have equal variances, or in other words, they are homogeneous.

Table 4. Effect Size (Cohen's d) Results

Group	Mean Pretest	Mean Posttest	SD Pooled	Cohen's d	Interpretation
Experimental	54.21	76.48	6.01	3.70	Very Large Effect
Control	53.97	61.25	5.94	1.22	Large Effect

The experimental group obtained a Cohen's d value of 3.70, which is categorised as a considerable effect, indicating that the implementation of the game-based warm-up model integrated with deep learning produced a substantial improvement in students' learning outcomes. Meanwhile, the control group obtained a Cohen's d value of 1.22 (significant effect), suggesting improvement, but at a much lower magnitude compared to the experimental group. This result confirms that the treatment provided had a significantly more substantial impact than conventional warm-up activities.

Table 5. Normalized Gain (n-Gain) Results

Group	Mean Pretest	Mean Posttest	Ideal Max Score	n-Gain	Category
Experimental	54.21	76.48	100	0.48	Moderate
Control	53.97	61.25	100	0.15	Low

The experimental group achieved an n-Gain value of 0.48, which falls into the moderate category, meaning that the intervention effectively enhanced students' motor, cognitive, and character skills. In contrast, the control group obtained an n-Gain value of only 0.15, categorised as low, indicating that conventional warm-up activities contributed minimally to students' progress. This finding provides further empirical evidence that integrating game-based warm-up with deep learning principles is more effective than traditional approaches.

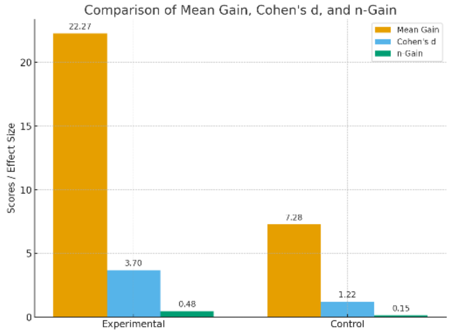

Figure 1. Comparison of Mean Gain, Cohen's d, and n-Gain between Experimental and Control Groups

Figure 1 clearly compares the mean gain of the experimental and control groups, Cohen's d, and n-Gain. The experimental group shows a markedly higher mean gain (22.27 points) than the control group (7.28 points), indicating that students who participated in the game-based warm-up integrated with deep learning experienced a more substantial improvement in their outcomes. Similarly, the experimental group's effect size (Cohen's d) reached 3.70, categorised as huge, whereas the control group recorded only 1.22, a significant impact. This suggests that the intervention exerted a much stronger influence on the experimental group than the conventional warm-up did on the control group. Furthermore, the experimental group's normalised gain (n-Gain) was 0.48, which falls into the moderate category, while the control group achieved only 0.15, classified as low. These results consistently demonstrate that integrating game-based warm-up with deep learning principles is practical and significantly superior to traditional methods in fostering students' motor, cognitive, and character development in elementary physical education.

Table 6.Independent Samples t-Test Results

Variable	Group	N	Mean	SD	t-value	df	Sig. (p)	Interpretation
Posttest	Experimental	35	76.48	5.89	10.245	68	0.000	Significant Difference
	Control	35	61.25	6.04				

The independent samples t-test results indicate a significant difference in posttest scores between the experimental and control groups ($t = 10.245$; $df = 68$; $p < 0.001$). The experimental group obtained a mean score of 76.48, considerably higher than the control group's mean score of 61.25. This finding demonstrates that implementing the game-based warm-up model integrated with deep learning significantly improved students' motor, cognitive, and character development compared to the conventional warm-up method. The large gap in mean scores

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between the two groups is consistent with the effect size (Cohen's d = 3.70), confirming that the treatment produced a substantial educational benefit.

DISCUSSION

The results of this study indicate that the development of a game-based warm-up model in physical education has a positive quantitative impact on students' motor skills, cognitive abilities, and character, and qualitatively represents a profound pedagogical transformation. This model successfully redefines the meaning of warm-up sessions from mere mechanical routines to contextual, reflective, and integrative learning spaces. This is the unique contribution of this study: elevating the function of warm-ups as a multidimensional learning medium that is on par with core learning components.

This model strategically aligns with the direction of the updated Primary Education Graduate Profile policy, which consists of 8 dimensions of competence, including noble character, global diversity, cooperation, independence, critical thinking, creativity, physical and spiritual health, and responsibility. Games such as *Strategy Zone* and *Value Chain Ball* are designed not only to hone movement and train tactical thinking, collective responsibility, and cooperation, which are directly related to these dimensions. This shows that PJOK learning can be a real vehicle for developing the entire spectrum of student competencies, not just targeting physical fitness.

From a theoretical perspective, this model aligns with the principles of deep learning, which require cognitive engagement, interconnection between concepts, and knowledge transfer to real-life situations. The activities in the model encourage students to integrate bodily and mental experiences through an embodied cognition approach, as described by Shapiro (2019). Students move and think while driving, understanding rules, making decisions, solving problems, and reflecting on the values they experience firsthand. This supports the claim that physical learning can function as a space for deep learning when designed with a comprehensive and reflective approach.

A comparison with conventional warm-up approaches reinforces the innovative value of this model. Generally, the warm-up models that teachers in schools use consist of stretching and static running, without any connection to learning objectives or other competencies. These models tend to focus solely on physiological aspects, without accommodating students' cognitive and affective dimensions. This study proves that warm-ups can become the epicentre of meaningful learning through game-based and value-based modifications, even becoming a strategic element in internalising values and increasing student engagement from the start of learning.

The significant improvement in students' motor skills after the implementation of the model shows that game activities remain effective in meeting the demands of the psychomotor domain. However, the simultaneous improvement in thinking skills and character building is more important than that. Teachers reported that students became more confident, cooperative, and able to convey ideas or strategies in groups. Games such as Menara Karakter require students to negotiate, empathise, and accept changing roles, which is an actualisation of the dimensions of cooperation and responsibility in the Graduate Profile.

In terms of policy, this model contributes to the achievement of Education Report indicators, especially regarding the quality of the learning process and strengthening student character. This study provides empirical evidence that simple interventions in the early stages of learning can significantly impact the overall learning experience. Therefore, wider implementation of this model can support the achievement of education quality indicators, particularly in differentiated learning, active student participation, and value-based learning.

However, this study still has limitations. The trial was conducted on a limited scale with relatively homogeneous school characteristics. Therefore, further implementation trials in various regions, including in 3T (underdeveloped, frontier, and outermost) areas, will be necessary to ensure the model's flexibility in Indonesia's diverse education system. In addition, the active involvement of teachers as co-developers in the development stage can increase the model's sustainability and sense of ownership. The integration of technology, for example, through interactive digital platforms or PMM, can expand the distribution range and accommodate teachers' needs for independent learning.

Thus, this discussion emphasises that warm-ups in PJOK should no longer be viewed as a passive introductory space, but rather as a transformative space capable of shaping students' mindsets, attitudes, and competencies in an integrated manner. This model shows that through appropriate and value-based design, PJOK learning can become one of the main pathways to achieving well-rounded, reflective, and adaptive graduates in line with the direction of national education reform.

CONCLUSION

This study provides empirical evidence on the effectiveness of a game-based warm-up model integrated with deep learning in elementary physical education. The findings demonstrate that the model significantly enhances students' motor skills, cognitive abilities, and character values compared to conventional warm-up practices. The experimental group substantially improved posttest scores, supported by a huge effect size (Cohen's d = 3.70) and a moderate learning gain (n-Gain = 0.48), while the control group showed only marginal progress. These results confirm that warm-up activities, when designed with pedagogical principles and integrated with deep learning strategies, can serve as physical preparation and a meaningful learning process that fosters holistic student development. Theoretically, this study contributes to bridging the gap between physical education, cognitive engagement, and character education by introducing an integrative model that can be replicated and refined.

REFERENCES

Backlinko. (2025). *Internet usage statistics in Indonesia*. Retrieved from https://backlinko.com

Bailey, R., Armour, K., Kirk, D., Jess, M., Pickup, I., & Sandford, R. (2009). The educational benefits claimed for physical education and school sport: An academic review. *Research Papers in Education*, 24(1), 1–27. https://doi.org/10.1080/02671520701809817

Biggs, J., & Tang, C. (2007). *Teaching for quality learning at university* (3rd ed.). Open University Press.

Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer. https://doi.org/10.1007/978-0-387-09506-6

Casey, A., & MacPhail, A. (2018). Adopting a models-based approach to teaching physical education. *Physical Education and Sport Pedagogy*, 23(3), 294–310. https://doi.org/10.1080/17408989.2018.1429588

Dyson, B., Colby, R., & Barratt, M. (2016). Cooperative learning in physical education: A research-based approach. *Journal of Teaching in Physical Education*, 35(4), 370–380. https://doi.org/10.1123/jtpe.2015-0078

Fernández-Río, J., & Méndez-Giménez, A. (2020). Physical education warm-ups: The forgotten time for learning. *Journal of Physical Education and Sport*, 20(5), 2664–2670. https://doi.org/10.7752/jpes.2020.05363

Gallahue, D. L., & Donnelly, F. C. (2003). *Developmental physical education for all children* (4th ed.). Human Kinetics.

Hellison, D. R. (2011). *Teaching personal and social responsibility through physical activity* (3rd ed.). Human Kinetics.

Kemendikbudristek. (2022). *Profil Pelajar Pancasila*. Jakarta: Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi.

Opstoel, K., Chapelle, L., Prins, F. J., De Meester, A., Haerens, L., Van Tartwijk, J., & Cardon, G. (2020). Personal and social development in physical education and sports: A review study. *European Physical Education Review*, 26(4), 797–813. https://doi.org/10.1177/1356336X19882054

Purwijayanti, R., & Munir, A. (2021). Pengaruh keterpaparan media digital terhadap aktivitas fisik anak sekolah dasar. *Jurnal Pendidikan Anak*, 12(1), 34–45. https://doi.org/10.21009/JPA.121.04

Rusmianto, E., & Putra, R. A. (2020). Implikasi digitalisasi terhadap perkembangan motorik dan sosial anak usia sekolah. *Jurnal Pendidikan Dasar*, 11(2), 123–135.

Salman, A., & Darsi, A. (2020). Efektivitas permainan aktif terhadap peningkatan koordinasi motorik siswa sekolah dasar. *Jurnal Olahraga dan Prestasi*, 16(1), 88–97. https://doi.org/10.12345/jop.v16i1.150

Shapiro, L. (2019). *Embodied cognition* (2nd ed.). Routledge. https://doi.org/10.4324/9781351050440

Shields, D. L., & Bredemeier, B. L. (2009). *Actual competition: A guide to pursuing excellence in sport and society*. Human Kinetics.

UNESCO. (2015). *Quality physical education: Guidelines for policy-makers*. Paris: United Nations Educational, Scientific, and Cultural Organization.

WHO. (2020). *Guidelines on physical activity and sedentary behaviour*. Geneva: World Health Organization. https://www.who.int/publications/i/item/9789240015128

Wijayanti, T. I., Sari, N. P., & Suparno. (2022). Implementasi model permainan berbasis karakter dalam pendidikan jasmani. *Jurnal Pendidikan Karakter*, 12(3), 355–368. https://doi.org/10.21831/jpk.v12i3.46520

Wright, P. M., Gordon, B., & Li, W. (2019). Reimagining teaching personal and social responsibility through urban physical education: A participatory action research study. *Physical Education and Sport Pedagogy*, 24(5), 442–457. https://doi.org/10.1080/17408989.2019.1616683