Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6, 8117-8125
2024
Publisher: Learning Gate
DOI: 10.55214/25768484.v8i6.3756

Game-based physical education learning to improve basic manipulative movement skills in primary school children

M. Haris Satria[1*], Hilmy Aliriad[2], Dian Nuzulia[3], Ince Abdul Muhaemin Mangngassai[4], Ilham Arvan Junaidi[5], Moh. Zainuddin[6]
[1]Department Posgraduate, Master Physical Education, Universitas Bina Darma, Palembang, Indonesia; haris@binadarma.ac.id (M.H.S.).
[2]Department Physical Education, Faculty of Teacher Training and Education, Universitas Nahdlatul Ulama Sunan Giri, Indonesia; hilmy@unugiri.ac.id (H.A.).
[3,5]Department Indonesian education, Faculty of Teacher Training and Education, Universitas PGRI Palembang, Indonesia; ilhamarvanjunaidi@univpgri-palembang.ac.id (I.A.J.).
[4]Department of Physical Education, Sport, Health and Recreation, Faculty of Teacher Training and Education Universitas Cenderawasih, Indonesia; incemuhaemin86@gmail.com (I.A.M.M.).
[6]Department English Education, Faculty of Teacher Training and Education, Universitas Nahdlatul Ulama Sunan Giri, Indonesia; zainuddin@unugiri.ac.id (M.Z.).

Abstract: Physical education plays an important role in the development of children's motor skills, especially at primary school age. Basic manipulative movement exercises that focus on object manipulation, ball games and other games can accelerate the development of hand-eye coordination and gross motor skills. This study aims to develop and implement an effective game-based physical education learning model to improve the basic manipulative movement skills of primary school children. The type of research used is pre-experimental research, one group pre-test post-test design. The study population consisted of students aged 9-10 years of grade 4 in Palembang City, with a sample of grade 4A total 25 students who participated in game-based learning for 8 sessions. The results of this study indicate that the use of the game model in learning has a significant effect on the improvement of learners' manipulative movement skills. Educators and coaches are advised to use the game model as the main tool in children's motor development, with adaptations based on learners' initial abilities.

Keywords: *Game-based learning, Manipulative motion, Physical education, Primary school students.*

1. Introduction

Physical education plays an important role in the development of children's motor skills, especially at primary school age [1]–[3]. Game-based learning in physical education is one of the most effective methods of learning in primary school, as games allow students to learn in a fun and contextualised way [4]–[6]. Basic movement skills, including basic manipulative movements, are important skills that need to be developed in school-age children.

Basic manipulative movements include activities such as throwing, catching, kicking and hitting, which contribute to gross and fine motor development [7]–[9]. This development not only supports physical health, but also lays the foundation for the child's future participation in sport and physical activity.

However, the reality on the ground shows that there are still many primary school children who have not achieved optimal basic manipulative movement skills. This is due to a number of factors, including a lack of interesting learning media, a lack of variety in teaching methods and a lack of time for physical activity at school. Therefore, effective learning methods are needed to improve the basic manipulative movement skills of primary school children, one of which is a game-based learning approach.

* Correspondence: haris@binadarma.ac.id

Previous studies on physical education learning have emphasised the importance of a game-based approach in increasing student motivation and participation [10]–[12]. Some studies suggest that a game-based approach can facilitate motor learning more effectively than conventional methods [13]–[15]. Through gaming, students are better able to improve motor skills than those who learn through traditional instruction. The social interactions that occur in games help students to develop motor and cognitive skills simultaneously.

Basic manipulative movement exercises that focus on object manipulation with a ball and other tools can accelerate the development of hand-eye coordination and gross motor skills [16]–[19]. Variations in the types of games and levels of difficulty can stimulate the development of motor skills. Based on the literature of motor learning and constructivist learning, the game model can be applied to physical education learning [20]–[22].

Motor learning explains that motor skills, including manipulative movement, are easier to learn when taught in the context of an engaging and challenging game. Constructivist learning can build students' knowledge through direct experience and interaction with the environment [23], [24]. Previous research has shown that games can create an interactive learning environment and support holistic motor development. However, the application of this approach in different educational contexts still requires adaptation to meet the needs and characteristics of students in each region.

Although several studies have shown the effectiveness of play-based learning in developing students' motor skills, there are gaps in its implementation in primary schools in Indonesia, especially in the context of increasing manipulative basic movements. Many studies have been conducted abroad or in different contexts, so there is no approach specifically designed and implemented in the physical learning conditions of Indonesian primary schools. In addition, most studies have only focused on aspects of improving motor skills in general, without paying special attention to manipulative basic motor skills, which are so important in the developmental stage of children of primary school age.

Therefore, this study makes a novel contribution by developing a game-based physical education learning model specifically designed to improve the basic manipulative motor skills of primary school children in Indonesia. The approach used will be adapted to local conditions and student characteristics, which is expected to provide more optimal results.

This study aims to develop and implement an effective game-based physical education learning model to improve the basic manipulative movement skills of primary school students. Through this study, it is hoped that learning models can be created that not only improve students' motor skills, but also increase their motivation and participation in physical education activities, making learning more effective and enjoyable.

2. Method

The type of research used is a pre-experimental research with a one group pre-test post-test design [25], [26]. The study population consisted of students aged 9-10 years in grade 4 primary school in Palembang city, with a sample of grade 4 A of 25 students who participated in game-based learning for 8 sessions. Measurements were conducted using the Lingkert scale assessment with pre-test and post-test to measure changes in basic manipulative skills of throwing, catching, and dribbling. Data analysis used descriptive statistics and t-tests to identify significant differences between pre-test and post-test. The research procedure involves the preparation of modules, coordination with schools, implementation of interventions, and collection and analysis of data to determine the effectiveness of game-based learning methods in improving pupils' basic movement skills.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 8117-8125, 2024
DOI: 10.55214/25768484.v8i6.3756

Table 1.
Manipulative motion game Model in Physical Education Learning.

No	Game name	Game description	Aim
1	Throw catch the ball	Pupils form pairs and pass the ball to each other to practise throwing and catching skills.	Improves hand-eye coordination and accuracy in throwing and catching the ball.
2	Mini football	A game of football on a small scale (3 vs 3 or 5 vs 5) in which students dribble and kick the ball into the opponent's goal.	Develops dribbling, shooting and teamwork skills.
3	Handball	A game in which pupils try to throw the ball into the opponent's goal with their hands, avoiding defenders.	Improves throwing, catching, tactical and strategic skills.
4	Ball rounders	A traditional game in which a ball is hit with a stick and then run around a base or pole, dodging balls thrown by the opposing team.	Develops eye and hand coordination when hitting the ball, as well as throwing and catching skills.
5	Kick the ball to the target	Pupils try to kick the ball into a specific target, such as a cone or small pole.	Develop strength and accuracy in kicking the ball to a predetermined target.

Table 2.
Assessment of basic manipulative motion with lingkert scale.

No	Explanation	Score 1-5
1	The student is able to throw the ball accurately to a predetermined target.	
2	The student can catch the ball well and without difficulty when the ball is thrown from a medium distance.	
3	The student has good dribbling ability with stable control.	
4	The student can kick the ball to the target with appropriate power and direction.	
5	Pupils can pass the ball appropriately to a friend in a group game.	
6	Pupils show good coordination between hands and eyes when catching a moving ball.	
7	Pupils can maintain control of the ball while dribbling at different speeds.	
8	Pupils can control the direction and distance of a shot when playing with the ball.	
9	Pupils can repeat manipulative movements (throwing, catching, kicking) without losing concentration.	
10	Pupils are able to adapt to changes in the speed and direction of the ball during games.	

Description:
Score 1: Less Than Once
Score 2: Less
Score 3: Enough
Score 4: Good
Score 5: Very Good
Total Score multiplied by 2

3. Result and Discussion

This study aims to determine the effectiveness of game-based physical education in improving basic manipulative movement skills in primary school children. After the intervention for 8 weeks, the results of the pre-test and post-test were analysed to see the difference in the improvement of manipulative

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 8117-8125, 2024
DOI: 10.55214/25768484.v8i6.3756

movement skills. The data obtained showed a significant improvement in manipulative movement skills, especially throwing, catching and kicking skills, in game-based learning.

Table 3.
Basic manipulative motion assessment results.

No.	Research sample	Pretest learning outcomes	Pretest learning outcomes	Difference pretest-postest
1	Sample 1	70	92	22
2	Sample 2	68	88	20
3	Sample 3	62	86	24
4	Sample 4	66	92	26
5	Sample 5	64	92	28
6	Sample 6	70	90	20
7	Sample 7	74	98	24
8	Sample 8	62	88	26
9	Sample 9	66	88	22
10	Sample 10	68	96	28
11	Sample 11	64	84	20
12	Sample 12	70	94	24
13	Sample 13	68	90	22
14	Sample 14	74	94	20
15	Sample 15	66	92	26
16	Sample 16	40	60	20
17	Sample 17	64	88	24
18	Sample 18	70	92	22
19	Sample 19	62	90	28
20	Sample 20	66	92	26
21	Sample 21	68	92	24
22	Sample 22	74	94	20
23	Sample 23	42	62	22
24	Sample 24	62	86	24
25	Sample 25	70	92	22
Minimum		40.00	60.00	20.00
Maximum		74.00	98.00	28.00
Average		65.2000	88.4800	23.3600
Std. deviation		8.16497	8.87468	2.69072
Pretest-posttest cor.		0.951		
Sig.		0.000		

Table 4.
Categories manipulative basic motion assessment results.

No	Category learning outcomes	Pre-test (Frequency)	Pre-test (Percentage)	Post-test (Frequency)	Post-test (Percentage)
1	Less than once	0	0%	0	0%
2	Less	2	8%	0	0%
3	Enough	17	68%	2	8%
4	Good	6	24%	12	48%
5	Very good	0	0%	11	44%

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 8117-8125, 2024
DOI: 10.55214/25768484.v8i6.3756

Table 5.
Basic manipulative motion assessment results.

Conditions	T value	Average difference	Confidence interval 95%	Significance
Pretest	39.927	65.20	61.82 - 68.57	0.000
Posttest	49.850	88.48	84.81 - 92.14	

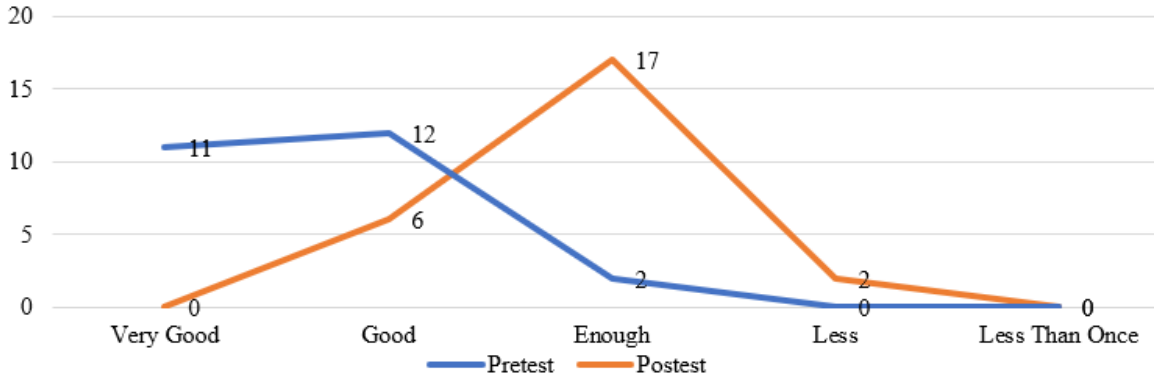

Figure 1.
Basic manipulative motion assessment results.

The results in Table 5 show a significant difference between the pretest and posttest scores of the 25 samples studied. The average pretest score of 65.20, with a range of 40 to 74, increased to an average posttest score of 88.48, with a range of 60 to 98, giving an average difference of 23.36 points. This difference is consistent, as shown by the standard deviation of 8.16 on the pretest, 8.87 on the posttest and 2.69 for the difference between the two. A very strong correlation between the pretest and posttest scores of 0.951 indicates a positive relationship between the two variables, with participants who had higher initial scores tending to also have high final scores. With a significance value of 0.000, this increase in learning outcomes was considered to be statistically significant, indicating that the intervention or treatment provided was effective in improving learners' learning outcomes.

The results of this study indicate that the use of the game model in learning has a significant impact on the improvement of learners' manipulative movement skills [27]–[29]. The findings are consistent with many previous studies that have shown that a game-based approach can improve motor skills, including manipulative movement. Active learning models can facilitate the exploration of movement through play as a means of developing fine and gross motor skills [13], [30], [31]. This research also supports the theory of motor learning, which states that active and varied involvement in motor tasks can improve the ability to master movement, especially in developmental age [32]–[34]. This research reinforces the view that physical activity-based learning, such as play, not only improves the physical aspects of learners, but also affects their cognitive abilities and motivation. Several previous studies, [35]–[37] have also shown a positive correlation between physical activity and improved motor skills and cognitive understanding. An important aspect of this study is the strong correlation between baseline ability (pre-test) and improvement after intervention (post-test), showing that the game model can be optimised for learners with different movement abilities.

The implementation of game models that have been shown to be effective in improving manipulative movement skills can be used as a reference for teachers to design learning strategies that are more interactive and result-oriented. The study also opens space for further exploration of the impact of different games, such as traditional and digital games, on the development of motor skills [38]–[40]. Furthermore, the findings highlight the importance of a holistic approach to learning, where physical, cognitive and socio-emotional aspects can be developed simultaneously through a structured gaming model.

This study emphasises the influence of the play model in increasing the ability to perform manipulative movements, which is one of the basic types of movement in children's motor development.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 8117-8125, 2024
DOI: 10.55214/25768484.v8i6.3756

Basic movements are of three main types: locomotor movements, non-locomotor movements and manipulative movements. Locomotor movements involve moving from one place to another, such as walking, running and jumping, while non-locomotor movements involve movements that do not involve moving from one place to another, such as bending, turning and pushing. Manipulative movement, the focus of this study, includes skills related to controlling external objects, such as catching, throwing, hitting and kicking [36], [41]–[44].

The results of this study confirmed that the play model significantly improved learners' manipulative movement skills, which are closely related to fine and gross motor skills. Mastering manipulative movements through play is not only important for the motor skills themselves, but also contributes to the development of other more complex and specific movements, such as those found in certain sports or physical activities [28], [45], [46].

In addition, the study supports the finding that manipulative movement is essential for the development of eye-hand coordination and dynamic balance. As described in the Fundamental Movement Skills (FMS) theory, the development of manipulative skills often contributes to progress in other motor skills, including locomotor and non-locomotor movements[47]–[49] . Children who are skilled at throwing and catching the ball not only develop object control, but also refine locomotor skills such as running or jumping to catch the ball in play. This research suggests that well-designed games can help children combine these different forms of basic movement to improve overall coordination and balance.

This study makes a new contribution by emphasising how the game model not only improves the ability to perform specific manipulative movements, but also helps to build integration between basic movements [50], [51]. This means that the game model used in this study allows learners not only to focus on one type of movement, but also to practise other basic movements indirectly. For example, in a game that involves throwing a ball, children can also run, jump or spin to avoid obstacles, which simultaneously develops learners' locomotor and non-locomotor skills. Integrating games that target basic movement into the school curriculum can accelerate children's overall motor development. By ensuring that learners have a balanced opportunity to develop manipulative, locomotor and non-locomotor movements, educators can help improve motor skills that are essential for participation in a wider range of physical activities later in life, including sports and fitness activities.

Overall, the study reinforces existing theories about the importance of physical activity in the development of motor skills, but also makes new contributions by emphasising the importance of play in the context of manipulative learning. In the future, further research with variations in game design and larger sample sizes is expected to deepen our understanding of the effects of play-based interventions on children's motor skills.

3. Conclusion

This study aims to investigate the influence of game models on the development of learners' manipulative movement skills, focusing on how games can improve overall motor skills. The results showed that the use of the game model significantly contributed to the improvement of manipulative movement skills, which are closely related to the development of other basic movements, such as locomotor and non-locomotor movements. In addition, the study shows that the game model is not only effective in improving manipulative skills, but can also be adapted to the needs and abilities of individual learners. The main contribution of this study is to strengthen the theory that a game-based learning approach plays an important role in the development of motor skills, and to open up space for a more individualised approach to physical education. This study also provides new insights into how different types of basic movement can be integrated into an interactive learning model. Based on these findings, it is suggested that educators and coaches use the game model as the main tool in children's motor development, with adaptations based on learners' initial abilities. Further research with larger sample sizes and long-term testing is also recommended to deepen the understanding of the effects of games on motor development.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 8117-8125, 2024
DOI: 10.55214/25768484.v8i6.3756

References
[1] H. Jeon and S. Jun, "Outdoor Playground Design Criteria Development for Early Childhood Development: A Delphi Study from the Perspective of Fundamental Movement Skills and Perceptual-Motor Skills," *Int. J. Environ. Res. Public Health*, vol. 18, no. 8, p. 4159, Mar. 2021, doi: 10.3390/ijerph18084159.

[2] R. Navarro-Patón, J. Brito-Ballester, S. P. Villa, V. Anaya, and M. Mecías-Calvo, "Changes in Motor Competence after a Brief Physical Education Intervention Program in 4 and 5-Year-Old Preschool Children," *Int. J. Environ. Res. Public Health*, vol. 18, no. 9, p. 4988, Mar. 2021, doi: 10.3390/ijerph18094988.

[3] S.-Y. Wu and J. L. Jensen, "Association Between Motor Competence and Percentage of Body Fat in Late Childhood: Comparing Proficiency in Fundamental Motor Skills and Advanced Movement Skills," *Child. Obes.*, vol. 19, no. 7, pp. 452–460, Mar. 2022, doi: 10.1089/chi.2022.0040.

[4] I. B. Endrawan and H. Aliriad, "Problem-Based Collaborative Learning Model Improves Physical Education Learning Outcomes for Elementary School Students," 2023.

[5] H. Aliriad, S. Adi, J. G. Manullang, I. B. Endrawan, and M. H. Satria, "Improvement of Motor Skills and Motivation to Learn Physical Education Through the Use of Traditional Games," *Phys. Educ. Theory Methodol.*, vol. 24, no. 1, pp. 32–40, 2024, doi: https://doi.org/10.17309/tmfv.2024.1.04.

[6] H. Aliriad, "Level Of Motor Educability In Floor Gymnastics Courses To Motion Skills," *JUARA J. Olahraga*, vol. 8, no. 1, pp. 530–537, Mar. 2023, doi: 10.33222/juara.v8i1.2807.

[7] J. Chen, X. Wang, and W. Chen, "Impact of Bilateral Coordinated Movement on Manipulative Skill Competency in Elementary School Students," *Children*, vol. 8, no. 6. MDPI AG, p. 517, 2021. doi: 10.3390/children8060517.

[8] Kowiyah and A. Margiaty, "Development of Two-Dimensional Figure Jenga Media to Improve Students' Learning Outcome in Elementary School," *JIP Jurnal Ilmiah PGMI*, vol. 10, no. 1. State Islamic University of Raden Fatah Palembang, pp. 89–101, 2024. doi: 10.19109/jip.v10i1.23940.

[9] H. J. Bang, "Evaluation of a Personalized Game-Based Program Designed to Improve Early Elementary School Students' Math Performance," *Proceedings of the 2021 AERA Annual Meeting*. AERA, 2021. doi: 10.3102/1688980.

[10] M. H. Satria, N. Ramadhan, H. Aliriad, and M. Da'i, "Circuit-based basic motor activity games: An innovative solution to improve the movement skills of children with dyspraxia in the context of physical education," *Edu Sport. Indones. J. Phys. Educ.*, vol. 4, no. 3, pp. 256–269, Mar. 2023, doi: 10.25299/esijope.2023.vol4(3).14293.

[11] N. Ihwanto and M. Mashud, "Game Based Learning in Physical Education Sport and Health Subject," *TEGAR: Journal of Teaching Physical Education in Elementary School*, vol. 5, no. 1. Universitas Pendidikan Indonesia (UPI), pp. 10–18, 2021. doi: 10.17509/tegar.v5i1.34905.

[12] E. Y. Pratama, "MODIFIKASI PERMAINAN KECIL PADA PEMBELAJARAN PENDIDIKAN JASMANI OLAHRAGA DAN KESEHATAN," *Pendek. J. Pendidik. Berkarakter*, vol. 5, no. 3, pp. 194–197, Mar. 2022, doi: 10.31764/pendekar.v5i3.10997.

[13] Riskyka, R. R. Lubis, and N. C. Yusnita, "Development of Media Puzzle Using Game Based Learning Approach to Improve Learning Outcomes Student Mathematics in Elementary School," *Journal of Elementary School Education*. PT. Berlian Pustaka Indonesia, pp. 188–194, 2023. doi: 10.62966/joese.v1i3.338.

[14] W. Wei, J. Wang, J. Du, Z. Fang, Y. Ren, and C. L. P. Chen, "Differential Game-Based Deep Reinforcement Learning in Underwater Target Hunting Task," *IEEE Trans. Neural Networks Learn. Syst.*, vol. PP, no. 99, pp. 1–13, Apr. 2023, doi: 10.1109/tnnls.2023.3325580.

[15] M. N. Fadlan, D. F. Dwi, A. S. Anshor, and A. Landong, "Improving Basic Locomotor Movement Skills in Elementary School Students Through an Active Learning Approach Based on Traditional Games," *Pedagogik Journal of Islamic Elementary School*. Institut Agama Islam Negeri (IAIN) Palopo, pp. 229–238, 2023. doi: 10.24256/pijies.v6i2.4319.

[16] C. M. Capio, K. Lee, R. A. Jones, and R. S. W. Masters, "Examining the Antecedent Role of Movement Proficiency in Child Development: Study Protocol," *Front. Psychol.*, vol. 12, p. 678874, Mar. 2021, doi: 10.3389/fpsyg.2021.678874.

[17] C. Lawson, E. L. J. Eyre, J. Tallis, and M. J. Duncan, "Fundamental Movement Skill Proficiency Among British Primary School Children: Analysis at a Behavioral Component Level," *Percept. Mot. Skills*, vol. 128, no. 2, pp. 625–648, Mar. 2021, doi: 10.1177/0031512521990330.

[18] F. Borioni, V. Biino, V. Tinagli, and C. Pesce, "Effects of Baby Swimming on Motor and Cognitive Development: A Pilot Trial," *Percept. Mot. Skills*, vol. 129, no. 4, pp. 977–1000, Apr. 2022, doi: 10.1177/00315125221090203.

[19] J. Hu *et al.*, "Influence of different caregiving styles on fundamental movement skills among children," *Front. Public Heal.*, vol. 11, p. 1232551, Mar. 2023, doi: 10.3389/fpubh.2023.1232551.

[20] H. Gmamdya *et al.*, "The Positive Impact of Combining Motor Imagery, Action Observation and Coach's Feedback on Archery Accuracy of Young Athletes," *Percept. Mot. Skills*, vol. 130, no. 5, pp. 2226–2248, Mar. 2023, doi: 10.1177/00315125231193218.

[21] G. F. Friskawati, A. Ma'mun, and A. Mahendra, "Early childhood educators' beliefs on increasing fundamental motor skills by playing games in a physical education context: The contradictory belief," *Edu Sportivo: Indonesian Journal of Physical Education*, vol. 4, no. 3. UIR Press, pp. 243–255, 2023. doi: 10.25299/esijope.2023.vol4(3).14540.

[22] D. K. C. Chan, A. S. Y. Lee, and K. Hamilton, "Descriptive epidemiology and correlates of children's swimming competence.," *J. Sports Sci.*, vol. 38, no. 19, pp. 2253–2263, Oct. 2020, doi: 10.1080/02640414.2020.1776947.

[23] H.-N. Do, B. Ngoc, and M. H. Nguyen, "3How do constructivism learning environments generate better motivation and learning strategies? The Design Science Approach," *Heliyon*, vol. 9, no. 12, p. e22862, Apr. 2023, doi: 10.1016/j.heliyon.2023.e22862.

[24] A. F. Backes *et al.*, "Adaptation and Validation of the Constructivist Teaching Practices Inventory in Elementary Physical Education (CTPI-EPE) for Brazilian Physical Education Pre-Service Teachers," *Int. J. Environ. Res. Public Health*, vol. 19, no. 19, p. 12091, Apr. 2022, doi: 10.3390/ijerph191912091.

[25] H. Wijaya, "METODE-METODE PENELITIAN DALAM PENULISAN JURNAL ILMIAH ELEKTRONIK," *OSF Prepr.*, Mar. 2019, doi: 10.31219/osf.io/dw7fq.

[26] M. Sari, H. Rachman, N. Juli Astuti, M. Win Afgani, and R. Abdullah Siroj, "Explanatory Survey dalam Metode Penelitian Deskriptif Kuantitatif," *J. Pendidik. Sains dan Komput.*, vol. 3, no. 01, pp. 10–16, Mar. 2022, doi: 10.47709/jpsk.v3i01.1953.

[27] P. A. Ardiana, "ANALYSIS OF PHYSICAL ACTIVITY TO IMPROVE STUDENTS BASIC MOVEMENT SKILLS PHYSICAL LITERACY BASED PRIMARY SCHOOL," *Gladi : Jurnal Ilmu Keolahragaan*, vol. 15, no. 1. Universitas Negeri Jakarta, pp. 10–23, 2024. doi: 10.21009/gjik.151.02.

[28] G. Setiawan, S. Syamsuramel, and S. Aryanti, "The Basic Motion Learning Model of Small Game Based Throwing in Elementary School," *Journal Physical Education, Health and Recreation*, vol. 5, no. 2. State University of Medan, p. 95, 2021. doi: 10.24114/pjkr.v5i2.24175.

[29] H. S. Rejeki, H. Humaedi, and A. Ardiansyah, "Developing Manipulative Basic Movement Learning Model Based on Traditional Games in Elementary Schools," *Al-Ta lim Journal*, vol. 29, no. 1. Universitas Islam Negeri Imam Bonjol Padang, pp. 78–83, 2022. doi: 10.15548/jt.v29i1.667.

[30] P. Pathuddin, S. Rochaminah, and R. Hidayatullah, "Implementation of Van Hiele Learning Model Assisted By Manipulative Media in Circle Materials to Improve the Learning Outcomes of Violent Students Inpres Palupi Elementary School," *International Journal of Research and Innovation in Social Science*, vol. 5, no. 1. International Journal of Research and Innovation in Social Science, pp. 6–14, 2021. doi: 10.47772/ijriss.2021.5101.

[31] D. A. Ritonga, S. Damanik, S. A. Damanik, S. Suprayitno, and G. Priyambada, "Development of Learning Variations to Improve Basic Jumping Skills and Play Approaches of Elementary School Students," *International Journal of Education in Mathematics, Science and Technology*, vol. 10, no. 2. ISTES Organization, pp. 360–371, 2022. doi: 10.46328/ijemst.2246.

[32] S. S. Reed, C. A. Mullen, and E. T. Boyles, "Correction to: Problem-Based Learning in Elementary School," *SpringerBriefs in Education*. Springer International Publishing, 2021. doi: 10.1007/978-3-030-70598-5_6.

[33] S. H. Pratiwi, E. Faridah, N. Bukit, and E. Surya, "Module Development Based on Communicative Approach to Indonesian Language Learning to Improve Speaking Skills of Elementary School Students," *Pedagogik Journal of Islamic Elementary School*. Institut Agama Islam Negeri (IAIN) Palopo, pp. 163–176, 2023. doi: 10.24256/pijies.v6i2.4291.

[34] M. Murniningsih, A. Widyawati, T. Trisniawati, D. M. Wijayanti, and R. Effendi, "Analysis of Department of Elementary School Students' Critical Thinking Abilities through Case Based Learning in the Classroom Action Research Courses," *International Research-Based Education Journal*, vol. 6, no. 1. State University of Malang (UM), p. 128, 2023. doi: 10.17977/um043v6i1p128-136.

[35] A. P. Veselovskyi, S. V Danylkiv, and O. M. Veselovska, "Mobile games as a means of increasing the motor activity of younger school students during physical education lessons," *Scientific Journal of National Pedagogical Dragomanov University. Series 15. Scientific and pedagogical problems of physical culture (physical culture and sports)*, no. 5. National Pedagogical Dragomanov University, pp. 30–34, 2023. doi: 10.31392/npu-nc.series15.2023.5k(165).06.

[36] E. S. Haugland *et al.*, "Effects of a staff-led multicomponent physical activity intervention on preschooler's fundamental motor skills and physical fitness: The ACTNOW cluster-randomized controlled trial," *The international journal of behavioral nutrition and physical activity*, vol. 21, no. 1. p. 69, 2024. doi: 10.1186/s12966-024-01616-4.

[37] R. J. Flynn, A. Pringle, and C. M. P. Roscoe, "Direct Parent Engagement to Improve Fundamental Movement Skills in Children: A Systematic Review," *Children*, vol. 10, no. 7, p. 1247, Mar. 2023, doi: 10.3390/children10071247.

[38] S. Supriyadi, "Mini Basketball Game Model to Improve Social Skill, Motoric Skill, and Physical Fitness of Elementary School Students," *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, vol. 6, no. 4. State University of Malang (UM), p. 559, 2021. doi: 10.17977/jptpp.v6i4.14707.

[39] I. Wahidah, W. Nurlaela, C. Cahyana, N. Nurwahidah, and F. N. Rahman, "Permainan Tradisional: Keterampilan Motorik dan Ketepatan Strategi," *J. Educ. Hum. Soc. Sci.*, vol. 3, no. 3, pp. 1238–1245, Mar. 2021, doi: 10.34007/jehss.v3i3.530.

[40] A. Sutini, "Meningkatkan keterampilan motorik anak usia dini melalui permainan tradisional," *Cakrawala Dini J. Pendidik. Anak Usia Dini*, 2018, [Online]. Available: https://ejournal.upi.edu/index.php/cakrawaladini/article/view/10386

[41] X. Gu, P. M. Tamplain, W. Chen, T. Zhang, M. J. Keller, and J. Wang, "A Mediation Analysis of the Association between Fundamental Motor Skills and Physical Activity during Middle Childhood," *Children*, vol. 8, no. 2, p. 64, Mar. 2021, doi: 10.3390/children8020064.

[42] C. M. Capio and K. F. Eguia, "Movement skills, perception, and physical activity of young children: A mediation analysis," *Pediatr. Int.*, vol. 63, no. 4, pp. 442–447, Mar. 2021, doi: 10.1111/ped.14436.

[43] B. Ku, J. D. Stinson, M. MacDonald, and L. L. McIntyre, "Parental Behavior Influences on Motor Skill Development in Young Children with Developmental Disabilities: A Two-Year Longitudinal Study," *Child Psychiatry Hum. Dev.*, vol. 54, no. 2, pp. 460–469, Mar. 2021, doi: 10.1007/s10578-021-01263-x.

[44] C. Melinda, A. Gumilar, and N. Nuryadi, "Lower Elementary School Student Non-Locomotor Movement Profile During COVID-19 Pandemic," *TEGAR: Journal of Teaching Physical Education in Elementary School*, vol. 6, no. 2. Universitas Pendidikan Indonesia (UPI), pp. 39–46, 2023. doi: 10.17509/tegar.v6i2.56842.

[45] P. Ardanari, N. Nurhasan, and A. S. Tuasikal, "Motor Skills Increase In The Learning Model Of Circuit Games," *COMPETITOR: Jurnal Pendidikan Kepelatihan Olahraga*, vol. 15, no. 2. Universitas Negeri Makassar, p. 298, 2023. doi: 10.26858/cjpko.v15i2.46928.

[46] N. A. Rohmansyah, "Challenge-based games' impact on manipulative motor skills, direction-following, and body awareness in children with mental disabilities," *Journal of Anthropology of Sport and Physical Education*, vol. 6, no. 4. Montenegrin Sports Academy, pp. 7–9, 2022. doi: 10.26773/jaspe.221002.

[47] H. Kavanagh, J. Issartel, S. Meegan, and M. Manninen, "Exploring the motor skill proficiency barrier among children with intellectual disabilities: Analysis at a behavioural component level," *PLoS One*, vol. 18, no. 11, p. e0288413, Mar. 2023, doi: 10.1371/journal.pone.0288413.

[48] S. Moss, X. Zhang, P. Tamplain, and X. Gu, "Overweight/obesity and socio-demographic disparities in children's motor and cognitive function," *Front. Psychol.*, vol. 14, p. 1134647, Mar. 2023, doi: 10.3389/fpsyg.2023.1134647.

[49] L. S. Neto, L. Venâncio, and M. de C. Ferracioli-Gama, "Complexity in Teaching Games for Understanding Notions of Motor Behaviour," *Advances in Early Childhood and K-12 Education*. IGI Global, pp. 241–256, 2022. doi: 10.4018/978-1-7998-9621-0.ch013.

[50] M. Andriy, "INTEGRATION OF PHYSICAL AND HEALTH, PHYSICAL AND SPORTS AND ENTREPRENEURIAL ACTIVITIES," *Sport Science and Human Health*, vol. 4, no. 2. Borys Grinchenko Kyiv University, pp. 102–113, 2020. doi: 10.28925/2664-2069.2020.2.9.

[51] Z. Chen and X. Dai, "Utilizing AI and IoT technologies for identifying risk factors in sports," *Heliyon*, vol. 10, no. 11, p. e32477, 2024, doi: https://doi.org/10.1016/j.heliyon.2024.e32477.