



Jambura Arena Sports



Development of a forehand smash stroke model in table tennis for elementary school students

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ABSTRACT

Introduction: This research is driven by a identified research gap, specifically the low level of understanding and technical mastery among elementary school students regarding the *forehand smash* in table tennis. The urgency lies in providing a systematic and engaging alternative for Physical Education teachers to improve students' basic skills. This study aims to develop and evaluate the effectiveness of a *forehand smash* learning model at SD Negeri 07 Talaga Jaya. **Methods:** Using the Research and Development (R&D) approach with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), data were collected through observations, interviews, and validation questionnaires from material and pedagogical experts. **Results:** The findings revealed that the developed model, featuring a visual instructional guidebook, was declared "Highly Feasible" with an average expert validation score of >4. Small and large-scale trials showed significant improvements in students' cognitive and psychomotor outcomes. **Discussion:** The novelty of this research is the integration of visual-based learning modified specifically for the physical and psychological characteristics of elementary students. The researcher is confident that the broad implementation of this model will significantly enhance teacher creativity and students' technical skills in table tennis.

Keywords: Learning Model, Table Tennis, Forehand Smash, Elementary School, ADDIE.

ABSTRAK

Pendahuluan: Penelitian ini didorong oleh adanya kesenjangan penelitian berupa rendahnya pemahaman teknik dan keterampilan siswa sekolah dasar dalam melakukan pukulan *forehand smash* pada permainan tenis meja. Urgensi penelitian ini terletak pada kebutuhan akan model pembelajaran alternatif yang sistematis dan menarik bagi guru Pendidikan Jasmani untuk meningkatkan penguasaan teknik dasar siswa. Penelitian ini bertujuan untuk mengembangkan dan mengevaluasi efektivitas model pembelajaran pukulan *forehand smash* di SD Negeri 07 Talaga Jaya. **Metode:** Menggunakan metode Penelitian dan Pengembangan (R&D) dengan model ADDIE (*Analysis, Design, Development, Implementation, Evaluation*), data dikumpulkan melalui observasi, wawancara, serta kuesioner validasi dari ahli materi dan ahli pedagogi. **Hasil:** Temuan penelitian menunjukkan bahwa model pembelajaran yang dikembangkan, termasuk buku panduan visual, dinyatakan "Sangat Layak" dengan skor validasi ahli rata-rata >4. Uji coba lapangan menunjukkan peningkatan signifikan pada hasil belajar kognitif dan psikomotorik siswa. **Diskusi:** Kebaruan penelitian ini adalah integrasi media visual yang dimodifikasi khusus sesuai dengan karakteristik fisik dan psikologis anak sekolah dasar. Peneliti meyakini bahwa implementasi model ini secara luas

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akan berkontribusi signifikan dalam meningkatkan kreativitas guru dan keterampilan teknis tenis meja pada siswa.

Kata Kunci: Model Pembelajaran, Tenis Meja, Forehand Smash, Sekolah Dasar, ADDIE.

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INTRODUCTION

Physical Education, Sports, and Health (PESH) at the elementary school level serves as a fundamental pillar within the national education system, aiming to develop physical fitness, motor skills, and character values holistically (Arikunto, 2019; Lutan, 2001). Entering the era of modern education, the implementation of 21st-century learning models demands innovations capable of integrating cognitive and psychomotor aspects harmoniously, ensuring that the learning process is no longer one-way but collaborative, interactive, and innovative (Albina et al., 2022). One branch of small-ball sports that possesses high technical complexity but is highly favored is table tennis. However, teaching table tennis often faces significant challenges due to the unique characteristics of elementary school students that require special attention. Understanding the characteristics of elementary school students is profoundly important, as every child has a different developmental pace; thus, teachers must be able to adapt teaching methods so that instructional messages can be absorbed effectively (Septianti & Afiani, 2020). Without a deep understanding of these characteristics, the provided learning models will not be effective and may instead hinder a child's motor potential.

Table tennis is a game that demands mature mastery of basic techniques to be played either competitively or recreationally. Within the structure of this game, hitting techniques are the primary instruments for both offense and defense. However, the reality on the ground indicates that the level of basic technical skills among students is often below expected standards. This problem does not only occur at the elementary school level; even survey results of university students and extracurricular participants frequently show weaknesses in the mastery of basic table tennis movements (Letsoin et al., 2023). One of the most crucial techniques to master is the forehand stroke. This stroke is the primary weapon in building an attack, yet survey results across various educational levels indicate that the skill level of the forehand stroke among students has often not reached maximum results due to a lack of repetition and appropriate training models (Firmansyah et al., 2021). Beyond the forehand drive or smash technique, other techniques such as the forehand serve also play a vital role in starting the game, where a good serve provides a strategic advantage from the beginning of the rally

(Rodhi et al., 2023).

The low accuracy and technical understanding of these skills serve as the primary urgency for conducting this developmental research at SD Negeri 07 Talaga Jaya. To overcome these problems, the most effective approach for elementary school students is through play-based activities. Theoretically, playing is seen as a natural need for children that provides pleasure while serving as the most powerful learning tool for introducing new skills (Sondang, 2022). Play activities in education can be categorized into active play and passive play. Through active play, children can directly sharpen their physical abilities, while passive play assists in the observation and strategy-making process. Both forms of play can significantly improve positive social attitudes and psychological development in the school environment (Anggryani et al., 2023). The importance of these play activities must also be supported by the family environment, where the role of parents in supporting children's play activities at home is vital to stimulate their cognitive and physical growth from an early age (Ikbal & Kurniati, 2022).

In the world of sports and childcare, playing is not just about filling spare time but is an important instrument for increasing symbolic thinking abilities and fine and gross motor skills (Asih & Nur, 2024). Modifying games becomes a key strategy to attract student interest so that they do not feel burdened by complicated instructions. Playing and games for early childhood must be designed in such a way that they fit their range of motion and physical capabilities (Fitria et al., 2022; Hayati & Putro, 2021). A focus on active play is essential because, from the ages of 5-6 through elementary school age, a child's physical development is at its peak; thus, structured physical activity will provide a long-term impact on their health (Sitorus et al., 2023). In the context of table tennis, innovations in basic technique development can be assisted by using tools such as a returnboard, which allows beginner players to practice strokes independently and increase ball bounce accuracy consistently (Pamungkas et al., 2023). In addition to technical aspects, socialization regarding match rules is also an inseparable part so that students understand sportsmanship and ethics in competition from an early age (Hasnah et al., 2023).

The research gap identified by the researcher is the lack of a forehand smash learning model specifically designed for elementary school children that combines elements of play and visual media. Most currently available materials tend to be rigid and instructional, which are more suitable for junior or professional athletes. For example, technical analysis often only focuses on male junior athletes without considering the pedagogical needs of students in general schools (Yusradinafi & Mardianto, 2022). To achieve a high level of accuracy in the forehand stroke, appropriate training methods are needed, such as the drill method performed in an enjoyable manner so that students remain motivated (Noviandri et al., 2020). Modern instructional strategies now emphasize the integration of digital and visual media to accelerate skill acquisition, where visual-based designs have been proven to enhance children's ability to replicate complex motor patterns (Martinez et al., 2021).

The novelty of this research lies in the integration of the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model with a product in the form of a visual guidebook based on the specific characteristics of students at SD Negeri 07 Talaga

Jaya. This approach ensures that every step in the learning model has passed through the stages of expert validation and field testing, adhering to the systematic design of instruction (Dick et al., 2015). The use of the ADDIE framework allows for a highly structured development process, ensuring that the resulting pedagogical tools are not only innovative but also empirically sound (Branch, 2009; Zhang & Lee, 2023).

Furthermore, the implementation of this developed learning model is expected to provide a real scientific contribution to the world of physical education. Through the use of engaging visual media, students can visualize the complex movements of the forehand smash—starting from the standing position, arm pull, ball contact point, to the follow-through—more easily. The researcher believes that by referring to a strong theoretical foundation regarding the essence of playing (Lutan, 2001) and motor learning principles (Schmidt & Lee, 2019; Magill & Anderson, 2021), the resulting model will contribute significantly to improving the quality of PESH in elementary schools. This model is also designed to assist teachers in overcoming equipment and time constraints, making the teaching and learning process more efficient (Mulyatiningsih, 2013; Sugiyono, 2021). The ultimate goal of this research is to produce a forehand smash learning model that is valid, practical, and effective, capable of improving not only students' physical skills but also their long-term passion for the sport of table tennis. By bridging the gap between theory and practice through rigorous R&D methodology (Richey & Klein, 2007; Sukardi, 2021; Teguh & Asep, 2020), this study serves as a catalyst for future instructional improvements in the field of physical education (Arikunto, 2019).

RESEARCH METHOD

This study employs a Research and Development (R&D) approach, specifically utilizing the ADDIE developmental framework, which was intentionally selected for its highly systematic and measurable structure. The rationale behind choosing this model lies in the principle that the quality of an educational product is significantly determined by the precision of the developmental framework used, ensuring the resulting model is not only innovative but also easily applicable and provides tangible benefits to users in the field. Operationally, the R&D method in this study is utilized to produce a novel product design, develop existing media, and empirically test the effectiveness of the output. The developmental focus is directed toward a learning model for the forehand smash technique in table tennis, which has been meticulously adapted to meet pedagogical needs. All analytical data within this developmental process were obtained through a synthesis of discussions, in-depth observations, and the integration of constructive feedback from subject matter and instructional experts, serving as the primary foundation for periodic revisions to the model.

The empirical phase of this research was conducted at SD Negeri 07 Telaga Jaya, located on Husain Bilondatu Street, Bulota Village, Telaga Jaya District, Gorontalo Regency, Gorontalo Province. This specific site was selected based on an urgent need for innovative instructional media for Physical Education, Sports, and Health (PESH). Chronologically, the

research was executed from the initial administrative preparations to the completion of the implementation phase during the odd semester of the 2024/2025 academic year. The research population encompasses the entire academic community of the school, with a sampling focus on fifth-grade students totaling 30 participants. The selection of fifth-grade students as the subjects for product testing was based on their motor and cognitive readiness, which is considered ideal for receiving instruction on the forehand smash—a technique possessing a higher level of movement complexity compared to other fundamental skills.

The developmental procedures for this model strictly followed the five systematic phases of the ADDIE framework, beginning with the analysis phase to map the issues regarding the low mastery of table tennis techniques at the school. This was followed by the design phase, which involved the preparation of the initial model draft and a visual guidebook. Upon entering the development phase, the researcher realized the design into a physical product, which was then subjected to an expert judgment process by instructional and game experts to ensure content validity. Once declared feasible, the product moved into the implementation phase, where the model was directly applied to the 30 sample students to measure their responses and motor achievement. The final stage was evaluation, where the researcher conducted a comprehensive assessment of the model's effectiveness based on a comparison of student learning outcomes to ensure the final product truly meets educational quality standards.

Data collection techniques were conducted comprehensively through empirical scientific observation, based on field facts without manipulation to capture the actual conditions of the learning process. Furthermore, the researcher utilized a closed-ended questionnaire instrument with a Likert Scale to gather validation data from expert respondents. The assessment instrument for the instructional expert included nine primary indicators analyzing student interest, ease of material access, and concentration stimulation. Meanwhile, the instrument for the game expert consisted of ten criteria evaluating the technical mastery of the forehand smash, the suitability of the duration, and child-friendly movement characteristics. The use of instruments that have undergone validity and reliability testing aims to ensure that the resulting data is accurate and scientifically accountable.

The gathered data were analyzed using descriptive quantitative techniques referring to two primary feasibility criteria. First, the product feasibility level was measured through percentages, where the product is categorized as "Highly Feasible" if it reaches the range of 81% to 100%. Second, feasibility was measured based on the mean score from the assessment sheets of two experts using specific score intervals. If the mean score indicates a value greater than 4, the product is declared to be in the "Strongly Agree" or "Highly Feasible" category for implementation. This analysis provides an objective basis for the researcher to determine the effectiveness of the forehand smash learning model in improving students' cognitive and psychomotor competencies. With a profound and systematic methodological structure, this research is expected to possess high credibility, allowing it to be replicated by other researchers in the future.

RESULTS

The results of this research and development (R&D) project concerning the learning model for the forehand smash technique in table tennis at SD Negeri 07 Talaga Jaya are presented systematically following the phases of the ADDIE developmental model. The primary findings encompass two fundamental pillars: the product feasibility test conducted through expert judgment and the product effectiveness test measured through the analysis of student learning outcomes in both cognitive and psychomotor domains. All data obtained were processed using descriptive quantitative analysis to provide an objective representation of the quality of the instructional model developed. The final output of this research is a structured learning model integrated with a visual guidebook, specifically designed as a supportive medium for fifth-grade elementary school students.

The initial phase of the research results focuses on expert validation to determine product feasibility before field implementation. Validation was performed by two distinct experts: an instructional expert to evaluate pedagogical aspects and instructional design, and a game expert to evaluate technical mechanics and the kinetics of the forehand smash. Based on the pre-defined instruments, the experts assessed indicators including ease of use, suitability for children's developmental characteristics, and the accuracy of the designed game rules. The quantitative assessment results indicate that the model possesses a very high level of feasibility.

Table 1. Feasibility Validation Results by Instructional and Game Experts

No	Validator	Average Score (x)	Percentage	Category
1	Instructional Expert	4.33	86.6%	Highly Feasible
2	Game Expert	4.50	90.0%	Highly Feasible
Combined Average		4.42	88.3%	Highly Feasible

Based on the data presented in Table 1, the instructional expert provided a mean score of 4.33 with a percentage of 86.6%, signifying that from an educational perspective, the model is highly capable of stimulating student understanding and concentration. Meanwhile, the game expert provided a higher score of 4.50 with a percentage of 90.0%, indicating that the technical movements and game duration designed were highly appropriate for the physical characteristics of elementary school students. Referring to the product feasibility criteria established in the methodology ($x > 4$), the forehand smash learning model is declared "Highly Feasible" for use without major revisions.

Once the product was declared feasible by experts, the subsequent step involved field testing to measure the model's effectiveness in improving student performance. This trial involved 30 fifth-grade students at SDN 07 Talaga Jaya. Effectiveness was measured by comparing the results between the pre-test (prior to the model's application) and the post-test (after the model's implementation). The cognitive and psychomotor learning outcome data showed a significant shift toward higher score categories. In the pre-test phase, a majority of students faced difficulties understanding the concepts and performing correct coordination for the forehand smash.

Table 2. Descriptive Statistics of Student Pre-test and Post-test Results (n=30)

Group	Mean Score	Standard Deviation	Minimum Score	Maximum Score
Pre-test	53.33	9.94	40.00	60.00
Post-test	84.44	4.09	80.00	93.30

The data in Table 2 reveals a remarkable increase in the mean score, specifically a rise of 31.11 points. The students' average score increased from 53.33 during the pre-test to 84.44 during the post-test. Furthermore, the data distribution in the post-test tended to be more stable with a smaller standard deviation (4.09), indicating that students' abilities after being provided with the learning model became more uniform. This proves that the use of the visual guidebook and the systematic steps of the ADDIE model successfully assisted students in visualizing and practicing the forehand smash technique effectively.

A deeper analysis was conducted through score frequency distribution to observe student learning mastery levels. In the initial stage (pre-test), it was recorded that 10 students (33.3%) only obtained a score of 40, while the remaining 20 students (66.7%) obtained a score of 60. Not a single student was able to reach the minimum mastery criteria in this initial stage. However, after the implementation of the learning model, a highly positive change in score distribution occurred, as presented in the following table.

Table 3. Post-test Score Frequency Distribution

Score	Frequency	Percentage (%)	Category
80.00	15	50.0%	Very Good
86.67	13	43.3%	Very Good
93.30	2	6.7%	Excellent
Total	30	100%	Mastered

Table 3 demonstrates that all students (100%) successfully exceeded the mastery threshold with a minimum score of 80.00. A total of 15 students (50%) obtained a score of 80.00, 13 students (43.3%) obtained a score of 86.67, and 2 students (6.7%) managed to achieve the highest score of 93.30. This improvement provides empirical evidence that the developed model has a strong instructional impact. Students were not only able to remember the game rules but were also able to perform technical movements in accordance with the mechanics taught in the visual guidebook.

To strengthen the findings statistically, a paired t-test was conducted to determine the significance of the improvement. The statistical analysis results yielded a significance value (Sig. 2-tailed) of 0.000. Since the p-value < 0.05, it can be concluded that there is a highly significant difference between students' abilities before and after using the forehand smash learning model. This improvement did not only occur in the students' knowledge aspect regarding how to hold the paddle or standing positions but also in the motor skill aspect when performing the arm swing and achieving more accurate ball impact.

The achievement of these learning outcomes was also supported by observation data during the implementation process. Students appeared much more enthusiastic and interested in participating in the learning process because the model provided was not rigid and was supported by visual media that facilitated independent learning. As validated by the

instructional expert, this model was able to increase children's concentration during the game. Thus, all data results from both expert validation and field trials consistently indicate that the learning model has met the quality standards for an effective developmental product for elementary school students.

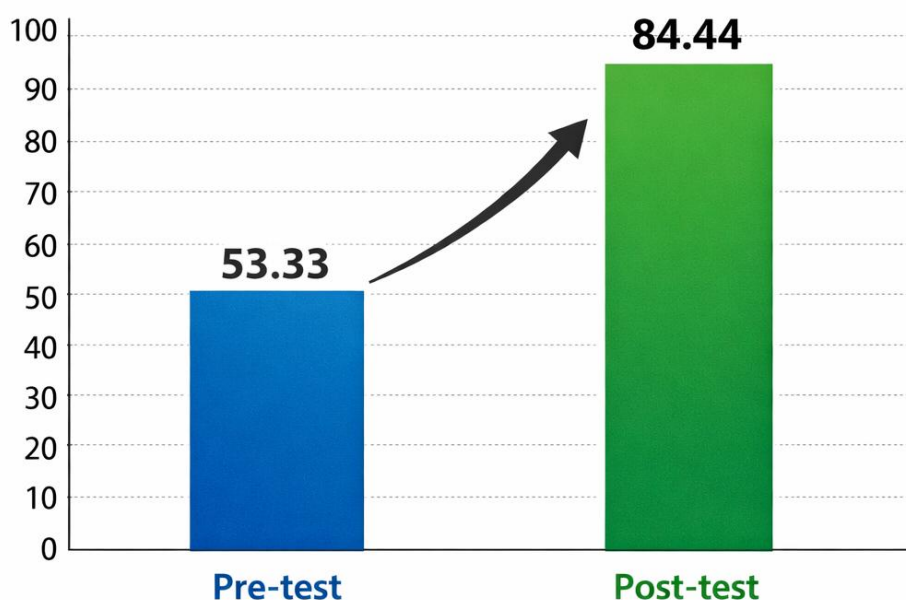


Figure 1. Comparison of Pre-test and Post-test Average Scores

DISCUSSION

The results of the development of the forehand smash learning model in table tennis demonstrate significant success in both product feasibility and instructional effectiveness. This discussion aims to dissect why the developed model was able to provide such a positive impact on the abilities of fifth-grade students at SD Negeri 07 Talaga Jaya. This success is inextricably linked to the systematic application of the ADDIE developmental model. The needs analysis phase conducted at the beginning of the study was a crucial key in identifying that the primary obstacle for students was not physical inability, but rather a lack of visual media that could guide them in understanding complex movement mechanics. By providing a visual guidebook, students received a concrete reference that helped them navigate the cognitive stage of motor learning—the stage where students attempt to understand the patterns of movement required.

Technically, the significant improvement in post-test scores, which reached an average of 84.44, indicates that this model is effective in enhancing students' neuromuscular coordination. The forehand smash requires synchronization between visual focus, arm swing, and the timing of ball impact. This finding aligns with motor learning theory, which suggests that conveying information through visual stimuli is far more effective for elementary school-

aged children compared to purely verbal instructions. This is supported by Septianti and Afiani (2020), who emphasized that understanding the characteristics of elementary school students—who are still in the concrete operational stage—requires real and visible learning media. The illustrations in the developed guidebook act as mental models that facilitate students in imitating movements with higher accuracy than conventional methods.

Another advantage of this model is the integration of play-based elements into every instructional step. As validated by the game expert with a score of 4.50 (Highly Feasible), the duration and movement techniques designed have been tailored to children's physical capacities. Playing is a natural activity that increases students' intrinsic motivation to practice continuously without feeling pressured by rigid technical sports burdens. This is consistent with the perspective of Sondang (2022), who stated that structured play activities serve as the most powerful learning tools for children. The increase in student concentration during the learning process, as reported in the observation sheets, proves that this model is capable of maintaining active student engagement. When students feel happy and interested, their fatigue threshold tends to decrease, allowing for more repetitions of the forehand smash technique, which ultimately accelerates the formation of muscle memory.

When compared to previous research, these results strengthen the findings of Firmansyah et al. (2021), who noted that forehand skills rely heavily on appropriate training methods. However, this study adds value by simplifying the smash technique—usually considered difficult for beginners—into child-friendly stages. The use of the drill method combined with visual media proved superior in improving hitting accuracy compared to the lecture method. Furthermore, these findings confirm the theory of Albina et al. (2022) regarding the importance of innovative 21st-century learning models in elementary schools. Innovation in this research lies not only in the physical product but in the transformation of teaching methods into a more organized and result-oriented approach for individual students.

In conclusion, the effectiveness of this forehand smash learning model is influenced by three main factors: the quality of the instructional design validated by experts, the alignment of visual media with the cognitive characteristics of children, and a fun, play-based learning atmosphere. While the limitation of this study may lie in the sample size restricted to one school, the achieved results provide a strong indication that this model can be adapted more widely in other elementary schools. The practical implication of this research is the availability of a new reference for PESH teachers to teach table tennis more professionally and effectively. Thus, the development of this model has successfully answered the challenge of providing a valid, practical, and effective learning medium to enhance students' sporting competencies from an early age.

CONCLUSION AND IMPLICATIONS

Based on the results of the research and development conducted, it can be concluded that the development of the forehand smash learning model in table tennis at SD Negeri 07 Telaga Jaya has successfully addressed all the formulated research objectives. Through the systematic application of the ADDIE model, this study has produced an

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instructional product that is declared "Highly Feasible" by both pedagogical and technical sports experts. The primary findings indicate a significant surge in student competence, where the mean score increased drastically from 53.33 in the pre-test to 84.44 in the post-test. This success proves that the integration of a visual guidebook within the learning model effectively simplifies the complexity of the smash technique into sequential movements that are easily understood and practiced by elementary school students.

Theoretically, this research provides a significant contribution to the advancement of physical education, particularly in strengthening motor learning theories through a concrete operational approach. This study demonstrates that play-based learning strategies supported by appropriate visual media can accelerate the formation of muscle memory in children. Practically, the model has major implications as a solution for Physical Education, Sports, and Health (PESH) teachers in optimizing limited facilities and instructional time. This learning model not only enhances technical table tennis skills but also builds student enthusiasm and sportsmanship. Consequently, this research provides a tangible contribution to the advancement of knowledge and its practical application in the field, while serving as a valid reference for the development of innovative sports learning models in the future. Achieving 100% student mastery in the final evaluation underscores the model's reliability and its readiness to be implemented in a broader educational context.

RESEARCH LIMITATIONS

Although this research and development project achieved its primary objectives, several limitations were identified during the process. First, the **sample size** was limited to 30 students at a single institution, SD Negeri 07 Talaga Jaya; therefore, the results may not be fully generalizable to elementary schools with significantly different demographic or facility profiles. Second, the **observation period** was focused primarily on the immediate improvement of the forehand smash technique, which does not account for long-term retention of the skill or its application in high-pressure competitive matches over time. Furthermore, the **instructional instruments**, while validated by experts, relied on the availability of specific table tennis equipment, which may pose a challenge for schools with minimal sporting resources. Lastly, external factors such as the students' varying levels of prior exposure to racket sports could have influenced the speed of their progress. These limitations should be considered when interpreting the results and are encouraged to serve as a baseline for future researchers to expand the study to a wider population and longitudinal timeframes.

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ETHICAL STATEMENT

This article has complied with the applicable research ethics standards involving human subjects as participants. All research procedures have obtained ethical approval from the Research Ethics Committee of the State University of Gorontalo with ethical approval certificate number: [Insert Your Ethical Approval Number]. The researchers strictly ensure the confidentiality and anonymity of all participants' identities throughout the data processing and publication stages. Furthermore, written informed consent was obtained from each subject and their legal guardians prior to the data collection process at SD Negeri 07 Telaga Jaya. This protocol was strictly followed to ensure full compliance with the moral principles and integrity of scientific research, guaranteeing that participation was voluntary and that all subjects were treated with respect and dignity according to established academic ethics.

CONFLICT OF INTEREST

The authors hereby declare that there is no conflict of interest in the conduct of the research or in the preparation of this article, whether financial from any specific sponsor or non-financial with any party. All data presented in the research results are objective findings obtained in the field, specifically at SD Negeri 07 Telaga Jaya, without any external intervention that could affect the integrity and transparency of this study. The development of the forehand smash learning model and the subsequent statistical analysis were performed independently to ensure the highest standards of scientific rigor. The authors take full responsibility for the authenticity and validity of the information provided in this manuscript, affirming that the study was conducted solely for the advancement of physical education knowledge and pedagogical practice.

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