IJPESS
Indonesian Journal of Physical Education and Sport Science
p-ISSN 2775-765X | e-ISSN 2776-0200
Volume 6, No. 3, September 2026. Page. 711-722
http://journal.unucirebon.ac.id/index.php ijpess

The Effectiveness of a Volleyball Teaching Model in Enhancing Underhand Service Skills Among Junior Secondary School Students

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Received: 22 May 2026, Approved: 19 July 2026, Published: 30 September 2026

Abstract

Study purpose. This study aimed to examine the effectiveness of a structured volleyball teaching model in improving underhand service skills among Grade VII students at an Islamic junior secondary school.

Materials and methods. This study employed a quantitative experimental approach using a one-group pretest–posttest design. The research was conducted at MTs Islamiyah Bumi Agung, Ogan Komering Ilir, South Sumatra, during the first semester of the 2025/2026 academic year. The population comprised 198 Grade VII students, of whom 66 were selected through random sampling using the Slovin formula with a 10% margin of error. Students' underhand service skills were assessed before and after the intervention using a volleyball underhand service technique test. The pretest and posttest scores were analyzed using a paired-samples t-test at a significance level of 0.05.

Results. The results showed that students' underhand service scores increased from a pretest mean of M = 62.45, SD = 7.82 to a posttest mean of M = 74.18, SD = 6.91. The paired-samples t-test indicated that the improvement was statistically significant, $t(65) = 9.87$, $p < 0.001$. The mean gain was 11.73 points, indicating a meaningful improvement. These findings demonstrate that students achieved significantly better underhand service performance after participating in the structured volleyball teaching model.

Conclusions. The structured volleyball teaching model significantly improved the underhand service skills of Grade VII students. Therefore, this model can be recommended as an effective instructional strategy for teaching basic volleyball skills in school physical education.

Keywords: Volleyball Teaching Model, Underhand Service, Physical Education, Junior Secondary Students, Motor Skill Learning.

DOI: https://doi.org/10.52188/ijpess.v6i3.2202
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Introduction

Volleyball is an important component of school physical education because its learning activities involve object-control skills, body coordination, communication, teamwork, and decision-making (Amiri et al., 2025; Hartanto et al., 2025; Qu et al., 2025). The acquisition of basic volleyball techniques is particularly important for beginning learners because insufficient technical competence may restrict students' participation and confidence during game-based activities (Bachtiar et al., 2024; Samsudin et al., 2023; Tao et al., 2024). Among the fundamental techniques introduced at the junior secondary level, the underhand service is commonly taught as an initial serving technique because it allows students to learn how to initiate play while developing ball control, movement timing, arm-swing coordination, and directional accuracy.

Despite its relatively simple movement pattern, the underhand service requires students to coordinate several movement components (Feng et al., 2025; Kuswoyo & Shareef, 2025; Piotrowski et al., 2025). These include establishing a balanced initial stance, positioning and releasing the ball correctly, swinging the striking arm in a controlled manner, contacting the lower-back portion of the ball, transferring body weight forward, and directing the follow-through toward the intended target. Beginning learners frequently perform these components inconsistently. Common errors include an unstable stance, an excessively high or inaccurate ball release, insufficient arm swing, incorrect contact with the ball, and limited control over service direction. Such difficulties indicate that merely repeating the complete movement may not be sufficient, particularly for students whose foundational object-control skills are still developing. Previous evidence has shown that students' initial motor competence can influence their ability to acquire more complex volleyball serving skills, highlighting the importance of appropriately scaffolded practice for novice learners (Costa et al., 2021).

The structured volleyball teaching model used in this study was developed as a phase-based instructional approach grounded in principles of observational learning, progressive motor-skill practice, and corrective feedback. The model consisted of six interrelated components: (1) communicating learning objectives and identifying students' initial performance difficulties; (2) providing teacher demonstrations accompanied by concise verbal cues; (3) decomposing the underhand service into the stance, ball positioning, arm swing, ball contact, weight transfer, and follow-through phases; (4) organizing progressive practice from simplified movements without a net to short-distance and target-oriented serving tasks; (5) providing immediate corrective feedback and opportunities for students to repeat the movement after correction; and (6) applying the complete skill in modified serving activities followed by performance evaluation. Demonstration enables students to observe and mentally represent the required movement pattern, whereas feedback helps them identify errors and adjust subsequent performance. Systematic reviews have demonstrated that observational learning and appropriately delivered feedback can support motor-skill acquisition in physical education (Han et al., 2022a; Zhou et al., 2021).

This model differs from routine conventional instruction in the degree to which learning activities are sequenced, monitored, and adjusted. Conventional volleyball instruction frequently emphasizes teacher explanation, demonstration of the complete skill, and uniform repetition by the entire class. Although this approach provides students with opportunities to practise, it may not systematically separate difficult movement components, establish achievement criteria for each stage, or provide specific corrections based on individual performance errors. In contrast, the structured model organizes learning from simple to complex tasks, requires students to achieve control at one stage before progressing to the next, and integrates demonstrations, technical cues, target-based exercises, and

feedback throughout the learning process. Therefore, the model does not merely increase the number of repetitions but seeks to improve the quality and purpose of each practice attempt.

Previous volleyball teaching studies have demonstrated the potential benefits of innovative instructional approaches, but their findings do not fully address the acquisition of underhand service technique among beginning junior secondary students. (Batez et al., 2021a), for example, reported that a Teaching Games for Understanding program improved several volleyball skills and students' enjoyment. However, although service accuracy improved over time, both the experimental and control groups demonstrated improvement, and no clear intervention-specific advantage was established for serving performance. The study also examined volleyball skills collectively rather than focusing on the movement components of the underhand service. Thus, it remains unclear whether a more technically sequenced and service-specific teaching approach would produce meaningful improvement among beginning learners.

(Ferriz-Valero et al., 2022a) found that flipped-classroom instruction in a secondary-school volleyball unit supported students' conceptual learning and autonomous motivation compared with traditional instruction. Nevertheless, the intervention covered several volleyball contents, including passing, serving, rotation, and game knowledge, while its main outcomes focused on cognitive learning and motivation rather than an objective assessment of underhand service performance. Similarly, game-centered volleyball interventions have commonly focused on tactical understanding, enjoyment, physical fitness, or overall game performance. Although these outcomes are educationally valuable, game-centered or technology-supported models may provide insufficient information about how teachers can systematically correct the specific movement errors experienced by novice students when learning an underhand service.

Research on motor learning further suggests that demonstrations, practice organization, and feedback can influence skill acquisition. Observational learning provides learners with a visual representation of the desired movement, while corrective feedback directs their attention to discrepancies between actual and expected performance (Han et al., 2022b; Zhou et al., 2021). (Costa et al., 2021) also demonstrated that children with lower foundational motor competence experienced greater difficulty learning a volleyball serve, even when different practice schedules were provided. These findings support the need for instructional programs that simplify the movement, provide explicit technical guidance, and progressively increase task difficulty. However, previous studies have rarely integrated these elements into a practical, low-cost, teacher-led model specifically designed for teaching the underhand service to Grade VII students in an Indonesian Islamic junior secondary-school context.

Preliminary observations at MTs Islamiyah Bumi Agung indicated that many students experienced difficulties in maintaining the correct initial stance, coordinating the ball release with the arm swing, making consistent ball contact, and directing the service toward the intended area. Previous instruction provided opportunities for repetition, but the learning tasks had not been systematically organized according to the individual phases of the underhand service. Consequently, students often repeated the complete skill without clearly understanding which movement component needed correction. This instructional condition demonstrated the need for a more systematic approach that could guide students progressively from movement understanding to controlled execution and functional application.

Accordingly, the research gap addressed in this study concerns the limited evidence on a phase-based, service-specific teaching model that integrates demonstration, movement decomposition, progressive task difficulty, immediate corrective feedback, and target-oriented practice for beginning volleyball learners. The novelty of this study lies in applying these components as an integrated and practical instructional sequence that can be implemented

without specialized digital technology or expensive equipment. Therefore, this study aimed to examine whether students' underhand service skills significantly improved after participating in a structured volleyball teaching model. It was hypothesized that students would demonstrate significantly higher underhand service performance in the posttest than in the pretest.

Materials and methods

Study participants

This study employed a quantitative pre-experimental approach with a one-group pretest–posttest design to examine changes in students' underhand service skills following participation in a structured volleyball teaching program. The study was conducted at MTs Islamiyah Bumi Agung, Ogan Komering Ilir, South Sumatra, Indonesia, during the first semester of the 2025/2026 academic year.

The study population comprised 198 seventh-grade students enrolled at the school. The required sample size was calculated using the Slovin formula with a 10% margin of error, resulting in a sample of 66 students. Participants were selected through simple random sampling, which provided each eligible student with an equal opportunity to be included in the study. Students were included in the final analysis when they completed the pretest, attended all intervention sessions, and completed the posttest.

Before data collection, permission to conduct the study was obtained from the school administration. The students and their parents or guardians were informed about the objectives, procedures, and voluntary nature of participation. The confidentiality and anonymity of participants' information were maintained throughout data collection, analysis, and reporting.

Study Organization

The intervention consisted of a structured volleyball teaching program conducted over eight consecutive weeks. Two instructional sessions were delivered each week, resulting in a total of 16 sessions. Each session lasted approximately 60 minutes and was conducted by the same physical education teacher to maintain consistency in the delivery of instructional content, demonstrations, practice activities, and feedback.

The program was designed to develop students' underhand service skills through a progressive and systematically organized learning sequence. It consisted of six instructional stages. The first stage introduced the learning objectives and identified common technical errors in students' initial performances. The second stage involved a demonstration of the complete underhand service technique, accompanied by explanations of the key movement components. During the third stage, students practised individual components of the technique separately, including the initial stance, ball position, arm swing, ball contact, and follow-through.

In the fourth stage, students completed progressive drills that moved from simplified movements to short-distance practice and target-oriented serving activities. The fifth stage involved immediate corrective feedback followed by repeated practice, allowing students to apply the corrections to subsequent attempts. In the final stage, students performed the complete underhand service technique in modified game situations. The learning activities were therefore organized from simple to more complex tasks to help students develop movement control before applying the complete skill in game-related settings.

Each instructional session consisted of an introductory activity, a core learning activity, and a closing activity. The introductory activity included attendance, an explanation of the session objectives, and a volleyball-specific warm-up. The core activity consisted of teacher demonstrations, guided practice, progressive drills, repeated skill execution, and

corrective feedback. Each session concluded with a cool-down, reflection on students' learning difficulties, and a review of the principal technical cues covered during the lesson.

Research Instrument

Students' underhand service skills were measured using a performance-based assessment rubric. The instrument assessed five technical components: (1) initial body position, (2) ball position and control, (3) arm-swing coordination, (4) hand contact with the ball, and (5) follow-through and service direction.

Each component was rated on a four-point scale. A score of 4 indicated that the movement was performed correctly and consistently; a score of 3 indicated generally correct performance with a minor technical error; a score of 2 indicated partially correct performance with several technical errors; and a score of 1 indicated incorrect execution or an inability to perform the required movement. The total raw score ranged from 5 to 20 and was subsequently converted to a scale of 0–100 using the following formula:

$$\text{Final Score} = \left(\frac{\text{Obtained Score}}{\text{Maximum Possible Score}} \right) \times 100$$

The content validity of the assessment instrument was evaluated by three experts with expertise in volleyball coaching, physical education, and motor learning. The experts assessed the relevance, clarity, and appropriateness of the indicators used to measure underhand service performance. The content-validity analysis produced an Aiken's (V) coefficient of 0.89, indicating high content validity.

Inter-rater reliability was examined by asking two assessors to independently evaluate the same student performances using the established scoring rubric. The analysis produced an intraclass correlation coefficient of (ICC=0.91), indicating excellent agreement between the assessors. Before the assessments were conducted, both assessors reviewed the performance indicators and discussed the scoring criteria to establish a consistent interpretation of each rubric category.

Data Collection Procedure

Data collection was conducted in three stages: pretest, intervention, and posttest. The pretest was administered before the first instructional session to determine students' initial underhand service performance. All participants received the same instructions and were assessed using the same performance rubric.

Following the pretest, students participated in the 16-session structured volleyball teaching program. The instructional activities were delivered according to the predetermined learning sequence, and students' attendance was recorded at each session.

The posttest was administered one day after the final instructional session. The same assessment instrument, court, equipment, instructions, assessors, procedures, and scoring criteria were used for the pretest and posttest. Maintaining identical testing conditions was intended to reduce measurement variation unrelated to the intervention.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 27. Descriptive statistics, including the mean, standard deviation, minimum score, and maximum score, were calculated to summarize students' pretest and posttest underhand service scores.

Before hypothesis testing, the normality of the difference scores between the pretest and posttest measurements was examined using the Shapiro–Wilk test. As the difference

scores met the assumption of normality, a paired-samples (t)-test was used to determine whether students' underhand service performance differed significantly between the pretest and posttest. The analysis included the mean difference, (t) value, degrees of freedom, (p)-value, and 95% confidence interval. Statistical significance was established at ($p<0.05$).

In addition to statistical significance, the magnitude of the intervention effect was calculated using Cohen's (d_z), which is appropriate for paired measurements. The effect size was calculated using the following formula:

$$d_z = \frac{t}{\sqrt{n}}$$

Effect-size values were interpreted as small at approximately 0.20, moderate at approximately 0.50, and large at 0.80 or higher. The inclusion of Cohen's (d_z) allowed the practical magnitude of the changes in students' underhand service performance to be evaluated alongside the results of the paired-samples (t)-test.

Results

Participants and Sampling Outcomes

The participants were seventh-grade students from MTs Islamiyah Bumi Agung, Ogan Komering Ilir, South Sumatra. The study population consisted of 198 students. Using simple random sampling, 66 students were selected as the research sample based on the Slovin formula with a 10% margin of error. This procedure was applied to ensure that each student had an equal opportunity to be included and that the sample represented the target population.

All selected participants completed the research procedures, including the pretest, the volleyball teaching model intervention, and the posttest. No participant dropout or missing data were identified; therefore, all statistical analyses were conducted using complete data from 66 participants.

Descriptive Statistics

Table 1 presents the descriptive statistics of students' underhand service skill scores before and after the intervention. The mean score increased from 62.45 ± 7.82 at pretest to 74.18 ± 6.91 at posttest. This improvement indicates that students demonstrated better underhand service performance after participating in the structured volleyball teaching model.

Table 1. Descriptive statistics of pretest and posttest scores (n = 66)

Measurement	Mean	SD
Pretest	62.45	7.82
Posttest	74.18	6.91

Pretest–Posttest Comparison

A paired-samples t-test was conducted to examine whether the improvement in underhand service skill scores was statistically significant. The results showed a significant difference between pretest and posttest scores, $t(65) = 9.87$, $p < 0.001$. The mean gain was 11.73 points, indicating a meaningful improvement after the intervention.

Overall, the results demonstrate that the structured volleyball teaching model had a significant positive effect on students' underhand service skills.

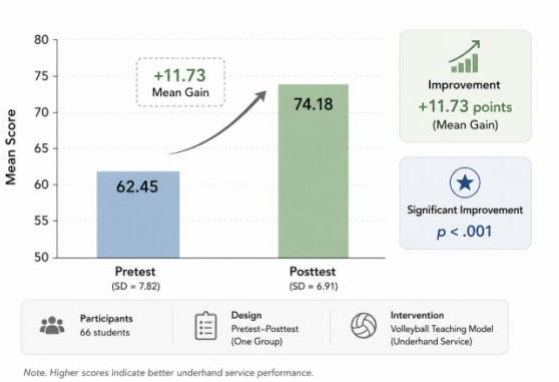


Figure 1. Comparison of Pretest and Posttest Mean Scores for Underhand Service Skills

Discussion

The present study found a statistically significant improvement in students' underhand service performance following the structured volleyball teaching program. The mean score increased from 62.45 in the pretest to 74.18 in the posttest, representing a mean gain of 11.73 points. This result indicates that the students performed the technical components of the underhand service more successfully after completing the eight-week program. However, given the one-group pretest–posttest design, the observed improvement should be interpreted as a meaningful change associated with participation in the program rather than definitive evidence of causality.

The improvement may be explained by the progressive organization of the learning activities. Students did not begin by repeatedly performing the complete service from the standard service area. Instead, they first observed the correct movement, practised individual technical components, completed drills of gradually increasing difficulty, received corrective feedback, and then applied the complete skill in target-oriented and modified-game situations. This sequence may have reduced the complexity of the task during the initial stages of learning and allowed students to concentrate on body position, ball control, arm-swing coordination, contact point, weight transfer, and follow-through.

The demonstration stage was particularly relevant for beginning learners because it provided a visible representation of the expected movement pattern. (Han et al., 2022b) concluded that observational learning can support motor-skill development in physical education, especially when demonstrations are accompanied by appropriate verbal cues that direct students' attention to important movement components. In the present program, demonstrations were not limited to showing the complete service. They were followed by explanations of specific technical cues and practice of separate movement phases, enabling students to connect the observed movement with their own performance.

The findings also support previous evidence concerning the importance of feedback in motor-skill learning. During the intervention, students received immediate information about errors in their stance, ball position, arm swing, ball contact, and service direction. They were subsequently given opportunities to repeat the movement and apply the correction. A systematic review by (Zhou et al., 2021) found strong evidence that feedback contributes positively to students' motor-skill learning in physical education. Similarly, the meta-analysis conducted by (Han et al., 2022c) showed that feedback produced a significant positive effect on motor-skill acquisition and that corrective, teacher-regulated, visual, and combined visual-verbal feedback could be particularly beneficial. These findings help explain why the combination of specific correction and immediate repetition may have supported the improvement observed in the present study.

The results are generally consistent with recent volleyball education studies. (Batez et al., 2021b) reported that a Teaching Games for Understanding program supported the development of several volleyball skills and enjoyment among secondary-school students. However, its effects on serving were less conclusive than its effects on some other volleyball skills. The present study differs by focusing specifically on the underhand service and by organizing the technique into a phase-based instructional progression. Therefore, the current findings provide more focused evidence regarding the potential value of technical decomposition, progressive serving distances, corrective feedback, and target-oriented practice for beginning learners.

(Ferriz-Valero et al., 2022b) also demonstrated that a flipped-classroom approach could support cognitive learning and autonomous motivation during a volleyball unit for lower-secondary students. Nevertheless, their program addressed broader volleyball content, including conceptual and motivational learning outcomes. By contrast, the present intervention concentrated on the observable execution of one fundamental skill. The comparison suggests that different pedagogical models may serve complementary purposes: technology-supported or game-based approaches may strengthen knowledge, motivation, and tactical understanding, whereas structured technical instruction may be useful when novice students need direct support in developing a specific movement pattern.

This interpretation is reinforced by recent comparisons between game-based and direct instructional approaches. (Arantes et al., 2025) examined volleyball learning among students aged 13–15 years and showed that the instructional model used by the teacher shaped the learning environment and students' tactical-technical and life-skill outcomes. In addition, the meta-analysis by (Ortiz et al., 2023) found that Teaching Games for Understanding produced stronger outcomes for decision-making but did not consistently outperform technical approaches in skill execution. These results indicate that game-based instruction is valuable for tactical and decision-making development, but systematic technical teaching remains relevant when the primary objective is the acquisition of a specific skill such as the underhand service.

The duration and consistency of the program may also have contributed to the observed improvement. The intervention included 16 sessions delivered over eight weeks, allowing students to practise the same movement under progressively more challenging conditions. The value of this arrangement was not merely the quantity of repetitions but the way the repetitions were organized. Each practice stage had a clear technical focus, and students progressed from simplified movements to complete execution. (Morales-Belando et al., 2022) emphasized that the effectiveness of model-based physical education interventions depends on the alignment among objectives, lesson content, task organization, teacher implementation, and outcome assessment. In the present study, the instructional stages and assessment indicators addressed the same five components of underhand service performance, strengthening the alignment between teaching and evaluation.

Although the program primarily used direct teacher feedback, schools may also consider visual feedback when resources permit. (Mödinger et al., 2022) found that video-based visual feedback can enhance motor learning in physical education and may be more effective than verbal feedback alone under suitable conditions. However, the authors also noted practical challenges involving lesson time, class size, equipment, teacher digital competence, and data protection. The structured program examined in the present study offers a comparatively accessible alternative because it can be implemented through teacher demonstration, observation, technical cues, and repeated practice without requiring specialized digital equipment.

The findings have direct implications for physical education teachers. Underhand service instruction should not rely exclusively on asking students to repeatedly perform the

complete technique. Teachers can divide the movement into observable phases, beginning with stance and ball position, followed by arm swing, contact, and follow-through. Practice can then progress from movements without a net to short-distance serving, target-based exercises, and modified games. Feedback should identify one or two specific errors rather than provide general statements such as “good” or “incorrect.” Students should also be given an immediate opportunity to repeat the movement after receiving feedback so that they can apply the correction while the information remains relevant.

For schools, the results highlight the importance of providing sufficient practice opportunities and suitable learning arrangements. Although the program does not require expensive technology, schools should provide an adequate number of volleyballs, safe practice areas, nets, and clearly marked targets. Organizing students into small practice groups may reduce waiting time and increase active learning. Schools may also provide professional-development activities that help physical education teachers design progressive drills, deliver performance-specific feedback, and use technical assessment rubrics consistently.

For curriculum developers, volleyball learning units should specify not only the competencies that students are expected to achieve but also the instructional sequence through which those competencies can be developed. Curriculum materials could provide examples of movement indicators, simplified exercises, progressive task levels, achievement criteria, and scoring rubrics. A combination of technical instruction and modified-game application may be especially appropriate. Technical stages can support the acquisition of stable movement patterns, while game-based stages can help students apply the skill within tactical and social contexts.

The contribution of the present study lies in its service-specific and practically applicable instructional sequence. Previous research has frequently examined complete volleyball units, game-based models, flipped classrooms, motivation, tactical knowledge, or multiple technical skills simultaneously. The present study focused on a single fundamental technique and integrated demonstration, movement decomposition, progressive task difficulty, corrective feedback, repetition, target practice, and modified-game application within one program. This approach may be particularly relevant for beginning students who require explicit guidance before they can successfully use the service in game situations.

Nevertheless, several limitations should be considered. First, the absence of a control group means that the improvement cannot be attributed exclusively to the structured teaching program. Familiarity with the assessment, regular physical education participation, natural development, or practice outside the scheduled sessions may also have influenced the results. Second, the participants were drawn from only one school, limiting the extent to which the findings can be generalized to other schools, regions, and age groups. Third, the posttest was administered immediately after the intervention, so the study did not determine whether the improvement was retained over time. Finally, the assessment focused on technical execution and did not establish whether the improved scores transferred to successful serving performance during formal volleyball games.

Future studies should compare the structured teaching program with conventional instruction or other pedagogical models using controlled or randomized designs. Research involving several schools and more diverse student populations would provide stronger evidence regarding generalizability. Retention tests, game-performance assessments, and measures of accuracy or service success should also be included to determine whether technical improvement is maintained and transferred to actual gameplay. Accordingly, the present findings should be viewed as promising preliminary evidence for the use of structured underhand service instruction in a junior secondary-school setting rather than as proof that the program is superior to all other teaching approaches.

Conclusions

Within the context of this one-group pretest–posttest study, seventh-grade students at MTs Islamiyah Bumi Agung showed improved underhand service performance after participating in the structured volleyball teaching program. The progressive sequence of demonstration, guided practice, corrective feedback, repeated skill execution, and modified-game application appears to have supported students' development of the technical components of the underhand service.

For physical education teachers, the program provides a practical framework for teaching basic volleyball skills through gradual task progression and specific feedback. Schools can support its implementation by providing sufficient instructional time, appropriate equipment, and safe practice areas. Curriculum developers may also consider including step-by-step skill progressions, observable movement indicators, and performance-based assessment rubrics in volleyball learning units.

However, the findings should be interpreted cautiously because the study was conducted in only one school and did not include a control group. Therefore, the improvement cannot be attributed exclusively to the intervention or generalized broadly to other student populations and educational settings. Further research involving comparison groups, multiple schools, and retention assessments is needed to confirm the effectiveness and wider applicability of the structured volleyball teaching program.

Acknowledgment

The authors would like to express their sincere gratitude to MTs Islamiyah Bumi Agung, Ogan Komering Ilir, South Sumatra, for providing permission and support during the implementation of this study. The authors also appreciate the participation and cooperation of all students involved in the research process. In addition, the authors thank colleagues and teachers who contributed valuable assistance during data collection and the implementation of the volleyball learning program.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this study.

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Cite this article as:
Umam, A *et al*. (2026). The Effectiveness of a Volleyball Teaching Model in Enhancing Underhand Service Skills Among Junior Secondary School Students. *Indonesian Journal of Physical Education and Sport Science (IJPESS)*, *6*(3), 711-722. https://doi.org/10.52188/ijpess.v6i3.2202