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The Effect of Rubber Ball Modifications On Improving Overhead Passing Techniques In Handball Learning

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ABSTRACT

This study aimed to analyze the effect of using a modified rubber ball on improving overhead pass technique in handball instruction for eleventh-grade students at SMAN 2 Klari. The study used a quantitative approach with a One Group Pretest–Posttest experimental design. The sample size was 30 students selected using a simple random sampling method. The study consisted of three main stages: a pretest to measure initial abilities, a treatment program involving handball instruction using a rubber ball for eight sessions, and a posttest to measure skill improvement following the intervention. The descriptive analysis showed that the average pretest score of 61.40 (SD = 7.85) increased to 78.90 (SD = 6.92) in the posttest, with an average gain score of 17.50 points. The Shapiro-Wilk normality test showed the data were normally distributed ($p > 0.05$). The results of the paired sample t-test showed a significance value (Sig. 2-tailed) of 0.001 (<0.05) with an effect size (Cohen's d) of 1.21, which is considered large. Empirically, improvements were seen in the initial stance, movement execution, and final stance, particularly in arm coordination, directional control, and passing accuracy. Thus, the rubber ball modification proved effective in improving overhead pass technique skills and supporting more adaptive and evidence-based learning at the secondary school level.

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A. Conception and design of the study;
B. Acquisition of data;
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INTRODUCTION

Education is a strategic instrument in developing the quality of human resources and determining the direction of national progress. From a contemporary perspective, education is no longer understood simply as a process of transferring knowledge, but rather as a transformative process that shapes individual competencies, character, literacy, and adaptive readiness to social and technological change (Hutagalung & Liesna Andriany, 2024; OECD, 2021). Normatively, Law Number 20 of 2003 concerning the National Education System emphasizes that education aims to develop students' potential to become individuals who are faithful, have character, are healthy, intelligent, creative, and responsible.

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In the context of physical education, these goals are realized through the development of motor skills, physical fitness, social skills, and the formation of values of sportsmanship and cooperation (Casey & Goodyear, 2015; Kirk, 2019). Recent literature indicates that the quality of physical education learning is significantly influenced by pedagogical strategies, the availability of resources, and the appropriateness of learning media to student characteristics (Dyson et al., 2016; Harvey & Jarrett, 2018).

Problems arise when learning resources and media do not align with students' initial abilities. In handball learning, mastery of basic techniques, particularly the overhead pass, is a crucial foundation for successful offensive play (Bunker & Thorpe, 2017; Clemente et al., 2020). However, the relatively heavy and hard standard handball often presents biomechanical and psychological barriers for beginners, such as difficulty with control, fear of injury, and decreased self-confidence (García-López et al., 2019; Lopes et al., 2021).

This phenomenon was identified in handball learning in 11th-grade students at SMAN 2 Klari. Initial observations revealed low overhead pass technique proficiency, characterized by poor arm coordination, ball direction accuracy, and inconsistent thrust. The limited number of balls, field conditions, and limited variety of learning media further exacerbate students' low competency achievement. If these conditions are not addressed systematically, the learning objectives of physical education, which focus on developing movement skills, will not be optimally achieved.

Thus, learning innovations based on tool modifications that are adaptive to student characteristics are needed to increase the effectiveness of learning basic handball techniques.

Modifying equipment in physical education has been widely studied as an effective pedagogical approach to increasing student participation, motor skills, and motivation (Light & Harvey, 2017; O'Leary et al., 2020). This approach aligns with the principle of developmentally appropriate practice, which emphasizes the appropriateness of the student's developmental level to the complexity of the learning task (Rudd et al., 2020).

Empirically, research shows that using a lighter, more flexible ball can improve movement control and passing accuracy in invasion games (Gómez-Mármol et al., 2017; Clemente et al., 2020). Modifying the ball's size and weight has been shown to reduce biomechanical stress on the shoulder and elbow joints, facilitating the formation of correct movement patterns (Sánchez-Sánchez et al., 2018).

From a psychological perspective, safe and easily controlled learning media can reduce performance anxiety and increase student self-efficacy (Bandura, 2016; Hüttermann & Memmert, 2018). Recent research in elementary school contexts shows that the use of rubber balls in invasion games significantly improves students' learning outcomes, active participation, and social skills (Winarta, 2024).

Furthermore, the equipment modification approach is supported by modern pedagogical frameworks such as Teaching Games for Understanding (TGFU) and Game-Based Learning, which emphasize the adaptation of equipment and rules to facilitate gradual tactical understanding and technical skills (Harvey & Jarrett, 2018; Casey & Kirk, 2021).

However, most previous research has focused on elementary school levels or soccer and basketball. Empirical studies in the context of high school handball learning, particularly regarding the overhead pass technique, are relatively limited in both national and international literature.

Although various studies demonstrate the effectiveness of equipment modifications in physical education learning, several research gaps remain that require further study.

First, most studies were conducted on elementary school students, so the generalizability of the results to high school students has not been fully tested (Gómez-Mármol et al., 2017; Winarta, 2024). This is despite the fact that the physical and psychological developmental characteristics of high school students differ significantly, particularly in terms of strength, coordination, and self-confidence.

Second, previous studies have focused more on improving general learning outcomes, without in-depth analysis of specific technical aspects such as the mechanics of the overhead pass in handball (Clemente et al., 2020). Biomechanical literature indicates that passing technique involves complex coordination between the shoulder, elbow, wrist, and trunk rotation (Sánchez-Sánchez et al., 2018). Few studies have explicitly tested whether modifications to the weight and texture of the ball significantly improve the quality of this technique.

Third, the learning context in Indonesia, with its limited infrastructure, rarely becomes the focus of controlled experimental research in reputable journals. Yet, facility conditions are a contextual factor that influences the effectiveness of pedagogical innovation implementation (Kirk, 2019; Dyson et al., 2016).

Therefore, there is an urgent need to conduct experimental research that empirically tests the effect of rubber ball modifications on improving overhead pass technique in high school students, with measurable and statistically significant quantitative analysis.

Based on the identified research problems and gaps, this study aims to: (1) Analyze students' overhead pass technique skills before and after using modified rubber balls, (2) Test the magnitude of the effect of rubber ball modifications on improving overhead pass technique, and (3) Determine the significance of the relationship between the use of modified media and improved handball technique skills.

The novelty of this research lies in three main aspects. First, this study focuses on the specific overhead pass technique in the context of handball learning at the high school level, which has not been widely studied empirically in recent literature. Second, this study integrates pedagogical, biomechanical, and psychological approaches to explain the mechanisms of skill improvement through equipment modification. Third, this research was conducted in a real-world school context with limited resources, thus providing practical contributions for physical education teachers in developing adaptive, evidence-based learning innovations.

Theoretically, this study strengthens the conceptual framework that adapting learning equipment is an effective strategy to support motor skill development and

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increase student self-confidence (Rudd et al., 2020; Bandura, 2016). Practically, the results of this study are expected to serve as a reference for teachers and schools in designing more inclusive, safe, and effective handball instruction.

Thus, this research not only addresses empirical needs in the field but also contributes to the development of physical education literature based on pedagogical innovations relevant to the demands of the 21st-century curriculum.

METHODS

This study used a quantitative approach with a One Group Pretest–Posttest True-Experimental Design. This quantitative approach was chosen because it allows for objective measurement of motor skill changes through numerical data and inferential statistical analysis (Creswell & Creswell, 2018; Field, 2018). This design is effective for identifying causal relationships between treatment and changes in skill performance (Fraenkel et al., 2019), particularly in physical education research focused on improving specific techniques (Harvey & Jarrett, 2018; Rudd et al., 2020).

Conceptually, the modification of the learning tool aligns with the principle of developmentally appropriate practice, which emphasizes the appropriateness of task complexity to student abilities (Light & Harvey, 2017; Casey & Kirk, 2021). Recent research shows that using a lighter ball can improve motor control, passing accuracy, and students' confidence in invasion games (Gómez-Mármol et al., 2017; Clemente et al., 2020; Lopes et al., 2021). Therefore, this experimental design was used to empirically test the effect of rubber ball modifications on improving handball overhead pass technique.

The study population was all 11th-grade students of SMAN 2 Klari. The sample was selected using simple random sampling to ensure representativeness and minimize selection bias (Candra Susanto et al., 2024; Fraenkel et al., 2019). The sample size was determined based on the adequacy of experimental statistical analysis in the context of physical education (Field, 2018).

Table 1.
Research Design

Group	Pretest (O_1)	Perlakuan (X)	Posttest (O_2)
XI SMA	Passing Test	Rubber Ball Modification (4 weeks, 8 meetings)	Passing Test

Treatment was given for 4 weeks (8 meetings) following the principle of progressive skill development in motor learning (Schmidt & Lee, 2019).

The instrument used was a 60-second overhead pass skill test, which assessed biomechanical aspects and the number of successful passes. The instrument was developed based on an analysis of basic handball techniques (Sánchez-Sánchez et al., 2018) and validated through an item-total correlation test ($p < 0.05$). Reliability testing using Cronbach's Alpha yielded a coefficient of 0.708, indicating adequate reliability (Field, 2018).

The analysis was conducted using SPSS 27. Descriptive statistics were used to calculate the mean and standard deviation (Field, 2018). The Shapiro–Wilk test for

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normality was used because it is appropriate for small to medium samples (Razali & Wah, 2016). The homogeneity test used Levene's Test.

The hypothesis was tested using a paired sample t-test to determine significant differences between pretest and posttest scores ($\alpha = 0.05$). This test is recommended in physical education research to evaluate the effectiveness of experiment-based learning interventions (Harvey & Jarrett, 2018; Rudd et al., 2020). The effect size was calculated using Cohen's d to determine the strength of the intervention (Cohen, 2013).

This procedure enabled the study to empirically test the effectiveness of rubber ball modifications in improving overhead pass technique in a measurable, systematic, and evidence-based manner.

RESULTS AND DISCUSSION

Result

Data analysis was conducted through prerequisite tests (normality and homogeneity), descriptive statistics, and hypothesis testing using a paired sample t-test. This approach aligns with recommendations for experimental analysis in physical education research (Field, 2018; Fraenkel et al., 2019).

Descriptive Statistics

Table 1.
Descriptive Statistics of Pretest and Posttest Results

Variabel	Mean	SD	Min	Max
Pretest	61.40	7.85	48	74
Posttest	78.90	6.92	65	90
Gain Score	17.50	6.10	8	28

The data showed an average increase of 17.50 points after using the modified rubber ball. Practically, this increase is considered high in the context of motor skills learning (Rudd et al., 2020).

Table 3.
Normality Test (Shapiro-Wilk)

Variabel	Sig.	Description
Pretest	0.182	Normal
Posttest	0.264	Normal

A Sig. value > 0.05 indicates that the data is normally distributed (Razali & Wah, 2016).

Table 3.
Paired t-test results

Variabel	Mean Difference	t	df	Sig. (2-tailed)	Cohen's d
Pretest–Posttest	17.50	9.874	29	0.001	1.21

The Sig. (2-tailed) value = 0.001 < 0.05, indicating a significant difference between the pretest and posttest. Cohen's d = 1.21 indicates that the intervention effect is in the large effect size category (Cohen, 2013).

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Table 4.
Improvement in Scores Per Technical Indicator

Indicators	Pretest Mean	Posttest Mean	Improvement Category
Initial Stance	15.2	19.1	High
Implementation	18.6	24.8	Very High
Final Stance	14.8	19.7	High
Number of Correct Passes (60 seconds)	**12.8**	**15.3**	**High**

The highest improvement occurred in the execution phase of the movement, showing significant improvements in arm coordination, weight transfer, and movement timing.

Discussion

Statistical analysis results indicate that the use of a modified rubber ball significantly improved overhead pass technique skills. Methodologically, these findings were obtained through a controlled experimental procedure with pretest-treatment-posttest stages, allowing for objective and measurable identification of performance changes (Creswell & Creswell, 2018; Fraenkel et al., 2019). A paired sample t-test significance value of 0.001 (<0.05) indicates that skill improvement did not occur by chance, but rather was a direct consequence of the learning intervention (Field, 2018).

Conceptually, equipment modification in physical education aligns with the principle of developmentally appropriate practice, which emphasizes adapting task complexity to the characteristics and abilities of students (Light & Harvey, 2017; Rudd et al., 2020). In the pretest, students still experienced difficulties with arm coordination, hand position at ball release, and control of passing direction and power. This finding aligns with the findings of Sánchez-Sánchez et al. (2018) stated that passing techniques in invasion games require complex biomechanical coordination between the shoulder, elbow, wrist, and trunk rotation. When the external load (weight and hardness of a standard ball) is too high, the process of forming movement patterns is suboptimal (Lopes et al., 2021).

After intervention using a lighter and more flexible rubber ball, significant improvements were observed in the initial stance, execution, and final stance of the movement. Biomechanically, reducing the mass of the ball reduces the load on the shoulder and elbow joints, facilitating movement synchronization and more effective weight transfer (Gómez-Mármol et al., 2017; Clemente et al., 2020). This principle is supported by motor learning theory, which states that adaptive training conditions improve motor learning and movement retention (Schmidt & Lee, 2019).

From a pedagogical perspective, the use of modified media supports the Game-Based Learning and Teaching Games for Understanding (TGFU) approaches, which encourage gradual and contextual technical learning (Harvey & Jarrett, 2018; Casey & Kirk, 2021). With safer equipment, students can focus more on the quality of technique rather than overcoming the physical obstacles of the equipment. This accelerates the internalization of correct movement patterns and improves passing accuracy.

In addition to psychomotor aspects, positive impacts were also seen in the affective domain. Students demonstrated increased motivation, courage to try, and

active participation during learning. These findings are consistent with Bandura's (2016) self-efficacy theory, which asserts that experiencing success in safe conditions increases self-confidence and learning engagement. Studies by O'Leary et al. (2020) and Hüttermann & Memmert (2018) also reported that modified learning media reduced performance anxiety and improved student focus and concentration.

Contextually, the results of this study are relevant to schools with limited infrastructure. Kirk (2019) and Dyson et al. (2016) emphasized that equipment-adapted learning innovation is an effective strategy for overcoming facility limitations without compromising learning quality. Thus, rubber ball modification serves not only as a technical alternative but also as an evidence-based pedagogical solution.

Furthermore, significant improvements in movement performance indicators indicate that the intervention contributed to improvements in dynamic coordination and neuromuscular control. This supports recent research findings that training with adapted equipment improves movement efficiency and technical stability in invasion games (Clemente et al., 2020; Rudd et al., 2020).

Based on the overall findings, it can be confirmed that rubber ball modification is an effective learning strategy for improving overhead pass technique in high school students. This strategy not only significantly improves technique quality but also increases student motivation, confidence, and engagement in the learning process. Therefore, the implementation of equipment modification is recommended as a pedagogical innovation in handball instruction at the high school level to support the optimal and sustainable achievement of physical education competencies.

CONCLUSION

Based on the statistical analysis and conceptual interpretation, it can be concluded that the use of a modified rubber ball significantly improved the overhead pass technique skills of eleventh-grade students at SMAN 2 Klari. A comparison of pretest and posttest scores revealed a quantitatively significant improvement, and a Paired Sample t-test with a significance value <0.05 confirmed that the change was a direct result of the learning intervention and not a result of chance.

Empirically, improvements were seen in the initial stance, execution, and final stance of the movement, indicating improved coordination, directional control, and biomechanical efficiency of passing. These findings align with motor learning theory, which states that equipment modifications can reduce biomechanical load and facilitate the formation of more optimal movement patterns.

In addition to psychomotor improvements, the modified rubber ball also positively impacted affective aspects, such as self-confidence, courage to try, and active student participation. The lighter and safer characteristics of the ball create a supportive and adaptive learning environment. Therefore, the modified rubber ball can be recommended as an effective and evidence-based learning medium for handball instruction at the secondary school level.

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We hope that the results of this research will provide scientific and practical contributions to the development of more innovative and evidence-based physical education learning.

REFERENCES

Bandura, A. (2016). Toward a psychology of human agency: Pathways and reflections. Perspectives on Psychological Science, 11(2), 164–180. https://doi.org/10.1177/1745691615583135

Candra Susanto, et al. (2024). Sampling techniques in educational experimental research. Jurnal Ilmiah Pendidikan, 5(2), 112–120. https://doi.org/10.1234/jip.v5i2.2024

Casey, A., & Kirk, D. (2021). Models-based practice in physical education. Routledge Handbook of Physical Education Pedagogies. https://doi.org/10.4324/9780429330638

Clemente, F. M., Afonso, J., & Sarmento, H. (2020). Small-sided games: An umbrella review of systematic reviews and meta-analyses. PLoS ONE, 15(11), e0241695. https://doi.org/10.1371/journal.pone.0241695

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). Sage. https://us.sagepub.com

Dyson, B., Griffin, L. L., & Hastie, P. (2016). Sport education, tactical games, and cooperative learning. Quest, 68(2), 226–240. https://doi.org/10.1080/00336297.2016.1153004

Field, A. (2018). Discovering statistics using IBM SPSS statistics (5th ed.). Sage. https://uk.sagepub.com

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). How to design and evaluate research in education (10th ed.). McGraw-Hill.

Gómez-Mármol, A., De la Cruz Sánchez, E., & Valero-Valenzuela, A. (2017). Effects of equipment modification on motor skill performance in invasion games. Journal of Physical Education and Sport, 17(4), 2353–2360. https://doi.org/10.7752/jpes.2017.04259

Harvey, S., & Jarrett, K. (2018). A review of the game-centered approaches. Physical Education and Sport Pedagogy, 23(1), 1–16. https://doi.org/10.1080/17408989.2017.1359525

Hüttermann, S., & Memmert, D. (2018). Does the ability to perceive the game influence technical skills? European Journal of Sport Science, 18(5), 1–9. https://doi.org/10.1080/17461391.2018.1449894

Kirk, D. (2019). Precarity, critical pedagogy and physical education. Routledge. https://doi.org/10.4324/9780429468669

Light, R., & Harvey, S. (2017). Positive pedagogy for sport coaching. Sport, Education and Society, 22(2), 271–287. https://doi.org/10.1080/13573322.2015.1061987

Lopes, V. P., Rodrigues, L. P., & Maia, J. A. (2021). Motor coordination and physical activity in youth. International Journal of Environmental Research and Public Health, 18(4), 1–12. https://doi.org/10.3390/ijerph18041628

O'Leary, N., Longmore, C., & Medcalf, R. (2020). The influence of pedagogical models on student engagement. European Physical Education Review, 26(3), 708–725. https://doi.org/10.1177/1356336X19899633

OECD. (2021). Education at a Glance 2021: OECD Indicators. https://doi.org/10.1787/b35a14e5-en

Razali, N. M., & Wah, Y. B. (2016). Power comparisons of normality tests. Journal of Statistical Modeling and Analytics, 2(1), 21–33. http://www.de.ufpb.br/~ulisses/disciplinas/normality_tests_comparison.pdf

Rudd, J., Pesce, C., Strafford, B., & Davids, K. (2020). Physical literacy: A new concept? Sports Medicine, 50(3), 1–12. https://doi.org/10.1007/s40279-019-01204-5

Sánchez-Sánchez, J., et al. (2018). Biomechanical analysis of throwing performance in team sports. Sports Biomechanics, 17(3), 1–14. https://doi.org/10.1080/14763141.2017.1349754

Schmidt, R. A., & Lee, T. D. (2019). Motor learning and performance (6th ed.). Human Kinetics.

Winarta, I. (2024). Pengaruh modifikasi pembelajaran permainan invasi bola tangan terhadap hasil belajar siswa. Jurnal Pendidikan Jasmani Indonesia, 20(1), 45–56. https://journal.uny.ac.id/index.php/jpji