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Improving Table Tennis Service Skills Through Cooperative Learning: An Experimental Study in Senior High School

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Abstrac: This study analyzes the effectiveness of cooperative learning in optimizing basic table tennis service techniques for class X students at MA MISBAHUNNUR, Cimahi City. Using a quasi-experimental pretest-posttest control group design, 80 students aged 15–16 years participated (40 experimental, 40 control). The experimental group received STAD-type cooperative learning for 16 sessions, while the control group used conventional methods. A forehand and backhand service skill test (reliability 0.89) served as the instrument. Independent sample t-test analysis revealed significant differences ($p < 0.05$) between the experimental group ($M = 78.45$, $SD = 6.32$) and control group ($M = 68.20$, $SD = 7.15$), with effect size $d = 1.52$ (large). The experimental group showed 34.2% improvement versus 18.6% in the control group. The cooperative learning model effectively optimized table tennis service techniques and positively impacted students' cognitive, affective, and psychomotor development.

Keyword: Cooperative Learning, Table Tennis Serve, Basic Techniques, Physical Education.

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INTRODUCTION

Table tennis is a sport that requires good hand-eye coordination, reaction time, and mastery of basic techniques. The serve, a fundamental technique in table tennis, plays a strategic role because it is the first shot that determines the course of the match (Hodges & Franks, 2002). Mastering optimal serving techniques not only affects the ability to score points but also builds a player's confidence when facing an opponent (Zhang et al., 2018). In Indonesia, teaching table tennis within the context of physical education still faces various challenges, particularly in the learning methodology, which tends to be monotonous and lacks social interaction among students (Maksum, 2012). Initial observations at MA MISBAHUNNUR in Cimahi City indicate that table tennis instruction is still dominated by a teacher-centered approach with repetitive drill methods, resulting in students being passive and unmotivated to develop their serving skills.

Cooperative learning models have proven effective in improving student learning outcomes in various fields, including physical education. Suggests that cooperative learning creates a learning environment that encourages students to help each other, share knowledge, and develop social skills while achieving learning objectives (Slavin, 2015). In the context of motor skills learning, this model facilitates peer teaching and observational learning, which can accelerate the process of mastering techniques (Dyson & Casey, A., 2012). social learning theory emphasizes that individuals learn not only through direct experience but also through observation and imitation of models (Bandura, 2017). In cooperative learning, students have the opportunity to observe techniques performed by their peers, provide feedback, and receive correction, all of which contribute to motor skill improvement (Wulf & Lewthwaite, 2016).

Serving techniques in table tennis encompass various components such as stance, grip, toss, swing, and follow-through, which must be mastered in an integrated (Tang et al., 2018). Effective learning requires an approach that focuses not only on technical aspects but also considers students' psychological and social aspects (Pill, 2014). The cooperative learning model offers a holistic solution by integrating technical learning with the development of communication skills, responsibility, and teamwork. Previous research has shown that cooperative learning models have a positive impact on sports skills learning. found that students learning using a cooperative model showed greater improvement in technical skill mastery compared to those learning using conventional learning (Casey & Goodyear, V. A., 2015). Similarly reported that cooperative learning increases students' intrinsic motivation and enjoyment in physical education learning (Fernandez-Rio et al., 2020).

Table tennis lessons in schools tend to be monotonous and focus only on technical approaches, causing students to quickly become bored and less motivated to practice seriously (Hasmarita et al., 2020). This condition is exacerbated by the fact that more than 60% of students are unable to perform basic table tennis techniques well, and conventional learning methods have proven ineffective in improving students' motor skills. Therefore, a more innovative learning model is needed that involves active interaction between students, such as a cooperative learning model, to optimize mastery of basic serving techniques in table tennis. The forehand serve is one of the basic techniques that must be mastered in table tennis, considering that the serve is the attempt to serve the ball first to start the game. However, the reality in the field shows that before being given innovative learning activities, the majority of students have not demonstrated learning outcomes that meet the Minimum Completion Criteria (KKM), namely 63.9% of students were declared not to have passed with an average score of only 62.78 (M Rizal et al., 2020). This condition emphasizes the need for a more varied and innovative learning approach one of which is the cooperative learning model to optimally improve students' mastery of basic table tennis serving techniques. One of the obstacles faced in learning table tennis in schools is limited facilities and infrastructure and a lack of innovative learning media, resulting in students lacking interest and motivation in participating in the learning process (Solihin, 2020). This condition is exacerbated by the fact that many students are still passive during the learning process because they have to wait their turn, so that students' effective learning time is very limited. Therefore, a learning model is needed that can encourage the active involvement of all students simultaneously, such as a cooperative learning model, which allows each student to be directly involved in the process of mastering the basic techniques of table tennis serving optimally.

Table tennis is a popular sport and has been included in the physical education curriculum in Indonesia, but its implementation in schools still faces serious challenges, particularly in terms of the pedagogical approach used. Current table tennis learning methods still tend to be teacher-centered, where the instructor explains while students listen, relying on a conventional textbook-based approach that lacks personalized instruction and places students in a passive learning environment. PLoS On the other hand, although table tennis is recognized for improving skill acquisition and health, its application in the physical education curriculum is still very limited, and there is a significant lack of research focusing on its effective implementation in schools. PubMed Central Recent meta-analyses have shown that cooperative learning models including the STAD type have proven effective not only in cognitive achievement, but also in developing 21st-century social-emotional skills and ethical reasoning, with. In the context of physical education, cooperative learning structures operationalize ZPD principles by providing real opportunities for students to engage in collaborative interaction, share strategies, and build knowledge together particularly visible in group-based activities in PE settings (Zach et al., 2023). Recent empirical evidence further confirms this, as a meta-analysis of cooperative learning in physical education explicitly identified Vygotsky's ZPD as the theoretical mechanism through which skilled peers facilitate motor skill transfer among students (Frontiers, 2025). Despite these promising findings, research on cooperative learning models in physical education remains considerably less developed than in general education. In particular, experimental research examining their effectiveness on basic table tennis technical skills specifically forehand and backhand serves at the Madrasah Aliyah level in Indonesia is still very rare, highlighting a significant gap that this study aims to addres. This empirical gap is the urgency of conducting this research: to fill the gap in scientific evidence on the effectiveness of the STAD cooperative learning model in the context of table tennis instruction in high schools, so that physical education teachers have an alternative, validated learning model to improve students' mastery of basic serving techniques comprehensively cognitive, affective, and psychomotor.

Based on this background, this study aims to: (1) analyze the differences in effectiveness between cooperative learning models and conventional methods in improving basic table tennis serving techniques; (2) identify the effect size of cooperative learning models on improving serving skills; and (3) describe student responses to the implementation of cooperative learning models in table tennis instruction.

METHOD

Research Design

This study used a quasi-experimental design with a pretest-posttest control group design. This design was chosen because full randomization of the study subjects was not possible due to limitations in the school setting (Creswell & Creswell, 2018). The experimental group received treatment using the STAD cooperative learning model, while the control group used conventional learning methods (direct instruction).

Population and Sample

The study population was all 80 tenth-grade students at MA MISBAHUNNUR, Cimahi City, in the 2025/2026 academic year. The sampling technique used cluster random sampling, with two classes randomly selected as the experimental group (n=40) and the control group (n=40). Inclusion criteria included: (1) students aged 15-16; (2) no formal experience in table tennis lessons; (3) in good health for physical activity; and (4) willing to participate in the entire study. The demographic characteristics of the sample are presented in

Research Instrument

The instrument used was a table tennis serving skills test developed based on a modification of the Sports Skills Test Manual (American Alliance for Health Recreation and Dance & AAHPERD, 2010). The test consisted of two components: (1) a forehand serve test and (2) a backhand serve test. Each student performed 10 attempts for each type of serve to a predetermined target area. Scoring was performed on a 1-5 scale based on serve accuracy and consistency, with a maximum score of 100. The instrument's validity was tested using the expert

judgment of three table tennis experts (two nationally licensed coaches and one physical education lecturer), resulting in a Content Validity Ratio (CVR) of 0.85. The instrument's reliability was tested using test-retest reliability with one-week intervals on 20 students outside the study sample, resulting in a Cronbach's Alpha coefficient of 0.89, indicating high reliability (Fraenkel et al., 2019).

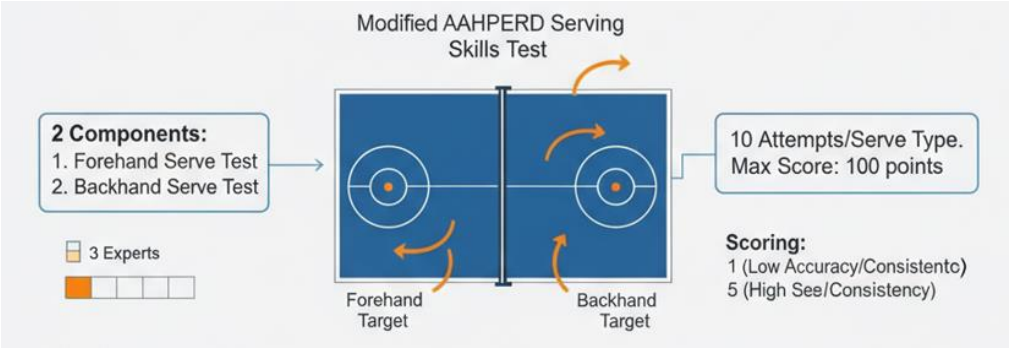

Figure 1. Table tennis test instrument of serveing skills

Procedur of treatment programs

Pemberian perlakuan untuk masing-masing kelompok terdiri dari 16 kali pertemua dengan durasi sekitar 90 menit untuk setiap pertemuannya. Karena fokus penelitian tertuju pada kelompok eksperimen, maka berikut merupakan program perlakuan secara rinci yang diberikan pada kelompok eksperimen.

Table 1. Treatment Program Table: Experimental Group (STAD Cooperative Learning Model)

Meeting	Phase	Activity / Treatment	Technical Focus	STAD Component
1	Introduction	Pre-test, introduction to STAD model, group formation (5 students/group), discussion of goals and rules	Forehand & Backhand Serve overview	Group formation
2	Foundation	Demonstration of serving technique by teacher, video analysis, group discussion on stance, grip, and ball toss	Stance, grip, ball toss	Present material
3	Forehand Serve 1	Cooperative peer-practice: stance and grip for forehand serve; peer observation checklist, group feedback	Stance & grip (forehand)	Team study & peer teaching
4	Forehand Serve 2	Cooperative practice: ball toss and backswing; partners provide corrective feedback using observation sheets	Ball toss & backswing	Team study & individual accountability
5	Forehand Serve 3	Cooperative practice: swing and ball contact; target accuracy drill (10 attempts/student); group score recording	Swing & ball contact	Team study & group recognition
6	Forehand Serve 4	Follow-through and serve consistency; peer-teaching rotation; inter-group mini quiz on technique theory	Follow-through & consistency	Team quiz & peer teaching
7	Forehand Serve 5	Integrated forehand serve: full movement sequence practice; group performance evaluation; individual progress check	Full forehand serve sequence	Individual quiz & group recognition

8	Backhand Serve 1	Introduction to backhand serve: stance and grip; teacher demonstration and video modeling; group discussion	Stance & grip (backhand)	Present material & team study
9	Backhand Serve 2	Cooperative practice: ball toss and body rotation for backhand serve; observation checklist by peers	Ball toss & body rotation	Peer teaching & team study
10	Backhand Serve 3	Swing mechanics for backhand; accuracy drill (10 attempts/student); cooperative feedback and scoring	Swing & accuracy	Individual accountability
11	Backhand Serve 4	Follow-through and serve direction control; peer-teaching rotation; inter-group comparison and discussion	Follow-through & direction	Team study & peer teaching
12	Backhand Serve 5	Integrated backhand serve: full movement practice; group performance evaluation; individual quiz on serve components	Full backhand serve sequence	Individual quiz & group recognition
13	Integration 1	Combined forehand and backhand serve practice in game-like scenarios; group strategy discussion; peer feedback sessions	Forehand & backhand integration	Team study & peer teaching
14	Integration 2	Serve accuracy competition between groups (10 serves each type); group score tallying; recognition of top-performing groups	Serve accuracy & consistency	Group competition & recognition
15	Consolidation	Remedial and enrichment: peer-teaching for students still struggling; advanced serve variation for high achievers; reflection	Remedial & enrichment	Peer teaching & differentiated learning
16	Post-test	Post-test: forehand and backhand serve skill test (10 attempts each); group reflection; feedback and closing	Forehand & backhand serve assessment	Individual accountability & group recognition

Note: Each meeting is 90 minutes in duration and consists of: (1) Warm-up (10 min), (2) Main Activity / Treatment (65 min), and (3) Cool-down & Reflection (15 min). STAD components applied throughout: Present Material,Team Study,Individual Quiz/Assessment,Group Recognition.

RESULT

Description of Research Data

The research sample consisted of 80 Grade X students from MA MISBAHUNNUR, Cimahi City, divided equally into an experimental group (n=40) and a control group (n=40). As presented in Table 1, the two groups demonstrated comparable baseline characteristics across all measured variables. In terms of age, the experimental group had a mean of 15.4 ± 0.5 years, while the control group recorded a slightly higher mean of 15.5 ± 0.6 years, yielding an overall sample mean of 15.45 ± 0.55 years. Regarding gender distribution, the experimental group comprised 22 male and 18 female students, and the control group consisted of 21 male and 19 female students, resulting in a total of 43 male and 37 female participants across the entire sample. With respect to Body Mass Index (BMI), the experimental group averaged 20.8 ± 2.3 kg/m^2, compared to 21.1 ± 2.5 kg/m^2 in the control group, with an overall mean of 20.95 ± 2.4 kg/m^2 — values that fall within the normal weight range according to WHO adolescent BMI standards. The homogeneity

of these characteristics between groups suggests that both groups were well-matched at baseline, thereby minimizing potential confounding variables and strengthening the internal validity of the experimental design.

Table 2. Characteristics of the Research Sample

Characteristics	Experimental Group (n=40)	Control Group (n=40)	Total (N=80)
Age (years)	15.4 ± 0.5	15.5 ± 0.6	15.45 ± 0.55
Gender M/F	22/18	21/19	43/37
BMI (kg/m^2)	20.8 ± 2.3	21.1 ± 2.5	20.95 ± 2.4

This study The results of the table tennis serving skill measurements in the pretest and posttest for both groups showed significant differences. Table 2 presents the frequency distribution of pretest scores for the experimental group, while Table 3 presents the frequency distribution of posttest scores for the experimental group.

Table 3. Frequency Distribution of Pretest Scores for the Experimental and Control Groups

Score Range	Category	Experimental Group (n=40)		Control Group (n=40)	
		Frequency	Percentage (%)	Frequency	Percentage (%)
81–100	Very Good	0	0.0	0	0.0
61–80	Good	5	12.5	4	10.0
41–60	Fair	18	45.0	19	47.5
21–40	Poor	15	37.5	15	37.5
0–20	Very Poor	2	5.0	2	5.0
Total		**40**	**100.0**	**40**	**100.0**

Based on Table 3, the frequency distribution of pretest scores shows that both the experimental and control groups had relatively similar and comparable baseline conditions prior to the treatment. In the experimental group (n=40), the majority of students fell into the Fair category (score range 41–60) with 18 students (45.0%), followed by the Poor category (21–40) with 15 students (37.5%), Good (61–80) with 5 students (12.5%), Very Poor (0–20) with 2 students (5.0%), and none in the Very Good category (81–100). Similarly, the control group (n=40) showed a comparable distribution, with 19 students (47.5%) in the Fair category, 15 students (37.5%) in the Poor category, 4 students (10.0%) in the Good category, 2 students (5.0%) in the Very Poor category, and none in the Very Good category. These findings indicate that prior to the intervention, both groups demonstrated predominantly low to moderate table tennis service skill levels, confirming the homogeneity of the two groups as a prerequisite for a valid experimental comparison.

Table 4. Frequency Distribution of Posttest Scores for the Experimental and Control Groups

Score Range	Category	Experimental Group (n=40)		Control Group (n=40)	
		Frequency	Percentage (%)	Frequency	Percentage (%)
81–100	Very Good	8	20.0	2	5.0
61–80	Good	24	60.0	22	55.0
41–60	Fair	7	17.5	14	35.0
21–40	Poor	1	2.5	2	5.0
0–20	Very Poor	0	0.0	0	0.0
Total		**40**	**100.0**	**40**	**100.0**

Based on Table 4, the frequency distribution of posttest scores reveals a notable improvement in both groups after the treatment, with the experimental group demonstrating considerably greater gains compared to the control group. In the experimental group (n=40), the majority of students shifted to the Good category (score range 61–80) with 24 students (60.0%), followed by the Very Good category (81–100) with 8 students (20.0%), Fair (41–60) with 7 students (17.5%), and Poor (21–40) with only 1 student (2.5%), with no students remaining in the Very Poor category (0–20). In contrast, the control group (n=40) showed more modest

improvement, with 22 students (55.0%) in the Good category, 14 students (35.0%) in the Fair category, 2 students (5.0%) in the Very Good category, 2 students (5.0%) in the Poor category, and none in the Very Poor category. These results suggest that the application of the STAD cooperative learning model in the experimental group was more effective in enhancing students' table tennis service skills, as evidenced by the higher proportion of students achieving Good and Very Good scores compared to the control group.

A normality test using the Shapiro Wilk test showed that the gain score data (posttest-pretest difference) in both groups was normally distributed ($p > 0.05$). The results of the normality test for the experimental group showed a W value of 0.974, $p = 0.482$, while the control group showed a W value of 0.968, $p = 0.328$. A homogeneity test for variance using Levene's test showed that the variances of both groups were homogeneous ($F = 1.823$, $p = 0.181$). With the assumptions of normality and homogeneity met, the analysis could proceed using an independent sample t-test.

Hypothesis Testing and Effect Size

The results of the descriptive and inferential statistical analyses are presented in Table 5 below:

Table 5. Comparison of Pretest, Posttest, and Gain Score Results Between Groups

Group	Pretest M ± SD	Posttest M ± SD	Gain Score M ± SD	Improvement (%)	t-value	p-value
Experiment	58.45 ± 10.12	78.45 ± 6.32	20.00 ± 5.84	34.2	7.82	< 0.001
Control	57.50 ± 9.85	68.20 ± 7.15	10.70 ± 4.92	18.6		

The results of the independent sample t-test showed a significant difference between the gain scores of the experimental and control groups ($t(78) = 7.82$, $p < 0.001$). The experimental group showed an average increase of 20.00 points (SD = 5.84), while the control group only increased by 10.70 points (SD = 4.92). In terms of percentage improvement, the experimental group experienced a 34.2% increase compared to the control group's 18.6%. The effect size calculation using Cohen's d yielded a value of $d = 1.52$, which, according to Cohen (1988), falls into the large effect category ($d > 0.8$). This indicates that the cooperative learning model has a significant impact on improving students' table tennis serving skills.

Table 6. Independent Sample T-Test Output (SPSS)

F	t	df	Mean Difference	Std. Error Difference	Cohen's d	Sig. (2-tailed)
Equal variances assumed	7.82	78	9.30	1.19	1.52	< 0.001
Equal variances not assumed	7.82	75.43				

DISCUSSION

The results of the study indicate that the STAD cooperative learning model is effective in improving table tennis serving skills in tenth-grade students at MA MISBAHUNNUR. This finding aligns with research who found that the cooperative learning model creates a learning environment that supports motor skill development through peer teaching and reciprocal learning (Dyson & Casey, A., 2012). In the context of table tennis learning, interactions between students facilitate observational learning, allowing students to observe, imitate, and receive feedback from their peers. The significant improvement in the experimental group (34.2%) can be explained by several mechanisms. First, the cooperative learning structure provides students with more opportunities for peer-assisted practice (peer-assisted learning). shows that peer teaching in a physical education context not only improves motor skills but also develops students' communication and leadership skills (Goodyear & Casey, 2015). Second, the STAD model encourages individual and group responsibility, motivating each member to achieve their best performance for the team's success (Slavin, 2015).

The social aspect of cooperative learning also contributes to increased students' intrinsic motivation. Found in their research that students learning using a cooperative learning model demonstrated higher levels of enjoyment and lower anxiety compared to those learning using conventional learning (Fernandez-Rio et al., 2020). This finding is relevant to the conditions at MA MISBAHUNNUR, where observations during the study revealed higher enthusiasm and active participation among students in the experimental group. From a cognitive theory perspective, cooperative learning facilitates knowledge construction through dialogue and discussion among students. explained that verbalizing and explaining techniques to others can deepen understanding and retention of motor skills (Schmidt & Wrisberg, 2008). In this study, students in the experimental group not only practiced serving but also explained and discussed the techniques with their teammates, contributing to deeper understanding. The findings of this study are in line with various recent studies that confirm the effectiveness of cooperative learning

in physical education. Through bibliometric analysis, it was confirmed that cooperative learning has been proven to have a positive impact simultaneously on the motor, cognitive, social, and affective development of students (Wang, 2023). Cooperative learning is effective in increasing students' enthusiasm and intrinsic motivation to participate in physical activities, creating a conducive learning atmosphere, and encouraging positive interactions between students. Through collaboration and peer correction, students' cognitive development increased significantly, in line with the increase in mastery of basic table tennis serving techniques in the experimental group in this study. In a systematic review of 44 cooperative learning studies in physical education (2000-2020), they found that the implementation of cooperative learning models showed positive results in four domains: social, physical, affective, and cognitive, with a correct classification rate reaching 68.2-81.8%. Through discriminant function analysis, they revealed that various cooperative learning strategies such as Jigsaw, Learning Team, Complex Instruction, and Cooperative Learning Model showed "partial associations between various cooperative teaching strategies and learning outcomes in the four domains". This finding strengthens the argument that cooperative learning models do not specifically applied cooperative learning with audio-visual media to fifth-grade students at SDN Cinunuk 02 Bandung (Zach & Shoval, 2023). found that their research showed a significant improvement in forehand and backhand drive skills, with the percentage of backhand drives increasing from 42.55% to 78.03%, while forehand drives increased from 45.17% to 83.90% (Faisal et al., 2018). They concluded that "the implementation of cooperative learning with audio-visual game media can improve students' forehand and backhand drive skills... and is beneficial for implementation in physical education learning in elementary schools." Similar findings were also presented, showing an increase in the mastery of basic table tennis techniques from 28% to 86.84% through an inclusive teaching style. stated that the principle of learning that "involves all students, adjusting for individual differences, providing opportunities to begin tasks at their own ability level" is relevant to the cooperative learning model applied in this study, where students learn according to their own abilities and speed while remaining actively involved in the group learning process (Rizky, 2021).

The large effect size (d = 1.52) indicates that the difference between the two groups is not only statistically significant but also has important practical implications. According to Cohen (1988), an effect size above 0.8 indicates a substantial and meaningful difference in educational practice. These findings are consistent with a meta-analysis conducted by Johnson and Johnson (2009), which found an average effect size of 1.2 for cooperative learning in a physical education context. Comparison with similar studies demonstrates consistency in the results (Zhang Liu, W., Hu, J. J., & Liu, R. Z., 2018). in their study of table tennis instruction in Chinese secondary schools, found that a student-centered learning approach, including a cooperative model, was more effective than traditional methods, with an effect size of d = 1.38. Similarly, reported that a cooperative learning model for teaching striking games skills resulted in greater technical improvement with a higher retention rate (Casey, 2014). Analysis of the service skill components showed that the experimental group improved in all aspects of technique, including stance, grip, toss, swing, and follow-through. This aligns with the findings who stated that holistic learning that integrates technical, tactical, and social aspects is more effective in developing sports skills

than approaches that focus solely on technical drills (Pill, 2014). From the perspective of Self-Determination Theory cooperative learning fulfills three basic psychological needs: autonomy, competence, and relatedness (Deci & Ryan, 2000). The learning structure provides autonomy through opportunities for students to organize learning strategies within their groups, fulfills the need for competence through achieving improved skills, and fulfills relatedness through positive social interactions. Fulfilling these three needs contributes to high intrinsic motivation. study of table tennis learning using the Teaching Games for Understanding (TGfU) approach showed consistent results, where students who learned with the student-centered approach showed improved decision-making and tactical awareness (Harvey & Jarrett, 2014). Although the models used were different, the basic principles of the importance of active student involvement and contextual learning remained consistent. Affective aspects also showed positive developments in the experimental group. Although the models used were different, the basic principles of the importance of active student involvement and contextual learning remained consistent. Affective aspects also showed positive developments in the experimental group. Observations during the study revealed increased cooperation, communication, and sportsmanship among students. These findings align with the research of (Goodyear et al., 2014). who found that the cooperative learning model fosters not only cognitive and psychomotor gains but also affective growth, including social responsibility and interpersonal skills, which are essential components of holistic physical education.

Despite these encouraging results, this study is not without limitations. First, the sample was confined to students at MA Misbahunnur, Cimahi City, which limits the generalizability of the findings to other school settings, regions, or educational levels with different demographic and infrastructural characteristics. Second, the study spanned only one academic semester, making it difficult to determine whether the observed improvements in table tennis service skills and affective behaviors would be sustained over a longer period. Third, the absence of a follow-up or retention test means that the long-term effectiveness of the STAD cooperative learning model on skill retention remains unknown. Fourth, potential confounding variables such as students' prior sports experience, physical fitness levels, and out-of-school practice were not fully controlled, which may have influenced the results. These limitations open several potential avenues for future research, including longitudinal studies examining the sustained effects of cooperative learning models in physical education, replication of this study across more diverse school contexts, and investigations comparing STAD with other cooperative learning variants to identify the most effective approach for developing psychomotor skills in sport settings.

CONCLUSION

In conclusion, this study affirms that the STAD cooperative learning model constitutes a significantly more effective instructional approach for improving basic table tennis serving techniques compared to conventional learning methods, with the experimental group demonstrating substantially greater gains in both psychomotor performance and overall learning outcomes. Beyond technical skill acquisition, the cooperative learning framework proved instrumental in fostering students' cognitive understanding of serving mechanics and their affective development, encompassing cooperation, communication, and a sense of responsibility dimensions that are often overlooked in traditional physical education settings. The statistically significant and practically meaningful difference observed between the two groups underscores the broader pedagogical value of student centered learning models that integrate social interaction as a core element of motor skill development. Furthermore, the successful implementation of this model within the context of Islamic high school physical education demonstrates its feasibility and adaptability across diverse educational environments, even in the face of common constraints such as limited facilities and instructional time, while simultaneously nurturing 21st century competencies including collaboration and communication. On the basis of these achievements, it is recommended that physical education practitioners consider adopting cooperative learning models as a sustainable instructional alternative, and that future research extend this inquiry by examining long-term skill retention, exploring the influence of cooperative models on other dimensions of table tennis performance,

comparing the relative effectiveness of different cooperative learning types such as STAD, Jigsaw, and TGT, and conducting in-depth qualitative investigations into students' subjective learning experiences within cooperative instructional frameworks.

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