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Improving the Flexibility of Students Through Stick-Based Calisthenics

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Abstrac: This study aims to analyze the improvement in flexibility among students at SMP Negeri 3 Gambut after participating in flexibility training using sticks. The study employed a quantitative approach using an experimental method and a one-group pretest-posttest design. The study population consisted of all 226 students at SMP Negeri 3 Gambut. The sample comprised 25 eighth-grade students selected through purposive sampling**.** The data collection instrument used the V-Sit and Reach Test to measure flexibility before and after the intervention. The data were analysed using descriptive statistics, the Shapiro-Wilk normality test, and the Wilcoxon Signed-Rank Test. The results of the study showed that the mean score of 16.84 cm increased to 30.28 cm in the posttest, with a significance value of 0.000 < 0.05. These results indicate that body-shaping exercises using a stick had a significant effect on improving the flexibility of the pupils.

Keyword: Calisthenics, Flexibility, Students, Stick, Training

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INTRODUCTION

Physical fitness is an important aspect that must be considered in Physical Education, Sports, and Health (PJOK) instruction. Physical fitness is not only related to students' ability to perform physical activities, but also plays a role in supporting their health, readiness to learn, and quality of movement. One important component of physical fitness that needs to be developed is flexibility. Flexibility is an important component of physical fitness because it supports movement efficiency and helps students perform physical activities more comfortably (Wicaksono et al., 2022). In physical education, flexibility also supports students' functional movement abilities during learning activities (Hazar & Saçlı, 2025).

Flexibility is the ability of muscles and joints to move optimally within their full range of motion without causing pain or tension. Good flexibility can help students move more effectively, maintain proper posture, and reduce the risk of injury during physical activities and sports. During the school-age years, flexibility needs to be developed through targeted and systematic exercises because students are in a stage of physical growth and development. Low levels of physical activity can lead to a decline in physical fitness, including flexibility. This is in line with Palma et al. (2024), who stated that junior high school students need appropriate physical fitness programs to support the development of health-related fitness components. Therefore, flexibility exercises need to be included in physical education learning as part of efforts to improve students' physical fitness. This is consistent with Guthold et al. (2020), who state that physical activity among children and adolescents has declined due to changes in modern lifestyles. In the implementation of physical education classes sat school, limited class time and a lack of exercise variety pose obstacles to optimally developing students' physical fitness components.

Based on the results of initial observations of physical education classes at SMP Negeri 3 Gambut, it was found that the students' flexibility had not yet reached optimal levels. Some students appeared to have difficulty performing movements that require body flexibility, such as bending forward, stretching their backs, and maintaining maximum range of motion. Initial measurements using the V-Sit and Reach Test on 25 students showed an average flexibility score of 16.84 cm, which falls into the "very poor" category. The V-Sit and Reach Test is suitable for measuring flexibility because it assesses the flexibility of the lower back and hamstring muscles (Wicaksono et al., 2022). In addition, sit and reach-based instruments are commonly used in physical education settings because they are practical, efficient, and easy to administer (Wibowo et al., 2023). These conditions indicate that students need exercises that are well-planned, easy to implement, and aligned with the characteristics of Physical Education (PJOK) to improve their flexibility. One exercise alternative that can be implemented to improve flexibility is flexibility training using a stick. Postural gymnastics is a series of movement exercises systematically arranged to improve posture, refine movement quality, and develop physical fitness components. Using a stick as an aid in calisthenics can help students perform stretching movements with greater control, maintain proper body posture, increase their range of motion, and create more engaging exercise variations in the classroom. Stretching programs implemented in physical education settings can help improve students' flexibility when they are carried out regularly and systematically (Perera Zurita, 2020). Game-based and varied flexibility exercises can make physical education activities more interesting while supporting improvements in students' flexibility (Riza et al., 2026)

Conceptually, the improvement in flexibility through conditioning exercises using a stick can be explained by the principle of exercise adaptation. Exercises performed repeatedly, in a planned and continuous manner, can stimulate muscles and joints, thereby increasing muscle elasticity and range of motion. Regular stretching can be used as a simple exercise strategy to maintain and improve range of motion, particularly when physical activity levels are limited (Warneke et al., 2022). Stretching exercises performed systematically can improve flexibility and range of motion because they provide repeated stimuli to the muscles and joints (TinThan et al., 2025). Based on this, flexibility exercises using a stick can serve as a relevant form of training to improve students' flexibility, particularly in the hamstring and lower back muscles, as measured by the V-Sit and Reach Test. A relevant study conducted by Hidayatullah et al. (2022) showed that regular stretching exercises can significantly improve students' flexibility. That study shares

similarities with the present study, as both examined improvements in flexibility and used the V-Sit and Reach Test as a measurement instrument. The difference lies in the type of intervention administered.

The previous study used stretching exercises, whereas this study employed body-shaping exercises using a stick. The use of a stick is an innovative element because it allows for more targeted movement variations, aids in body posture control, and expands students' range of motion during exercise. Based on the above discussion, this study is important because flexibility is one of the components of physical fitness that needs to be developed in physical education classes. In addition, research on the application of flexibility exercises using sticks to improve the flexibility of junior high school students remains limited. Previous studies have examined various exercise methods to improve students' flexibility. For example, Hidayatullah et al. (2022) found that stretching exercises could improve flexibility, particularly in the hamstring and lower back muscles, as measured using the V-Sit and Reach test. However, previous studies have mostly focused on general stretching exercises and have not specifically discussed the use of stick-based calisthenics as a simple learning medium in physical education classes.

Therefore, the research gap in this study lies in the limited discussion of stick-based exercises as an alternative training method to improve students' flexibility. The novelty of this study is the use of a stick as a practical, low-cost, and easy-to-apply exercise tool that can help students improve flexibility through structured body-conditioning movements. Therefore, this study aims to determine the improvement in flexibility among students at SMP Negeri 3 Gambut through flexibility exercises using sticks.

METHOD

Research Design

A research method is a scientific approach to collecting data for specific purposes and applications. This study employs a quantitative approach using an experimental method. The design used is a one-group pretest-posttest design, which involves a single group of research subjects with measurements taken before and after the intervention. In the initial stage, students were given a pretest to determine their flexibility levels before participating in the intervention. Next, students underwent an intervention consisting of flexibility exercises using sticks. After the entire intervention was completed, students were given a posttest using the same instrument. This design was used to determine changes in students' flexibility after participating in the exercise program. The research design can be described as follows.

Figure 1. One Group Pretest-Posttest Research Design

Explanation:
O_1 = pretest of students' flexibility
X = intervention consisting of flexibility exercises using sticks
O_2 = posttest of students' flexibility

The independent variable in this study was flexibility training using sticks, while the dependent variable was the students' flexibility. Improvements in flexibility were assessed by comparing the pretest and posttest results after the students participated in the intervention.

Participant

The population in this study consisted of all 226 students at SMP Negeri 3 Gambut. The study sample comprised 25 eighth-grade students at SMP Negeri 3 Gambut. The sampling technique used was purposive sampling, which involves selecting a sample based on specific criteria aligned with the research objectives. The sample selection criteria in this study included

students in the eighth grade who actively participated in physical education classes, were in good health, and were able to participate in the entire series of flexibility exercises using sticks. The selection of eighth-grade students was based on the consideration that students at this level are in a relatively stable phase of physical development and already have basic experience in performing gymnastic movements.

Data Collection and Instruments

The data collection instrument used in this study was the V-Sit and Reach Test. This test was used to measure students' flexibility, particularly lower-back and hamstring flexibility. The instrument was selected because it was relevant to the objective of this study, namely to examine changes in students' flexibility before and after the intervention. (Hasibuan et al., 2024) reported that the V Sit and Reach test showed validity, with a value of 0.314 > 0.163, while the overall reliability of the student physical fitness test instrument was 0.676. Therefore, the V-Sit and Reach Test was considered appropriate for measuring students' flexibility in this study. This test is used to measure flexibility in the hamstrings and lower back. The sit-and-reach test is commonly used as a field test to measure hamstring and lower back flexibility because it is simple and easy to administer in school settings (Hua et al., 2022). The sit and reach test is widely used to assess hamstring and lower back flexibility in physical education and health-related fitness settings (Kamaruddin et al., 2026). Test results are expressed in centimeters (cm). This test was selected because it aligns with the study's objective, which is to determine changes in students' flexibility before and after the intervention.

The V-Sit and Reach Test was administered by having students sit on the floor or a mat with both legs extended forward and spread apart to form a V shape. The heels were placed on the zero line, and both arms were extended forward with the palms stacked on top of each other. Students were asked to reach forward as far as possible slowly without bending their knees. The reach position was held for about two seconds, and the farthest reach was measured using a measuring tape. Each student was given two attempts, and the best score was recorded as a measure of flexibility. The equipment used in the test included a flat floor or mat, a measuring tape in centimeters, tape to mark the line, and a test result record sheet. The flexibility scores obtained by the students were then categorized based on flexibility assessment norms into five levels: excellent, good, fair, poor, and very poor. This categorization was adapted from the sit-and-reach test norms developed by (Boleng et al., 2023).

Research Procedures

The research procedure was conducted in three main stages: the preparation stage, the implementation stage, and the final stage. During the preparation stage, the researcher prepared the research equipment, identified the research subjects, developed the treatment design, and prepared the flexibility measurement instruments. The instrument used was the V-Sit and Reach Test to measure hamstring and lower back flexibility. The implementation phase began with administering a pretest to the students to determine their initial flexibility levels before the intervention. Afterward, the students participated in a conditioning exercise program using sticks. The research activities were conducted over 8 sessions, consisting of 1 pretest, 6 intervention sessions, and 1 posttest. The intervention was administered twice a week. Each training session lasted approximately 30 minutes, consisting of a 5-minute warm-up, a 20-minute core workout, and a 5-minute cool-down.

Body-shaping exercises using a stick focus on stretching the muscles of the shoulders, arms, back, waist, and legs particularly the hamstrings. The use of the stick is intended to help students maintain proper posture, expand their range of motion in a controlled manner, and enhance the effectiveness of flexibility exercises. The movements are performed repeatedly and in a targeted manner to provide optimal stimulation for improving the students' flexibility. The final stage involves administering a posttest after the entire treatment series is complete. The posttest is conducted using the same procedures and instruments as the pretest. The posttest results are then compared with the pretest results to determine the increase in the students' flexibility after participating in the flexibility training using a stick.

Data Analysis Techniques

The research data were analyzed using IBM SPSS Statistics software. The data analyzed consisted of the students' flexibility scores from the pretest and posttest. Data analysis was conducted in three stages: descriptive statistical analysis, normality tests, and hypothesis testing. Descriptive statistical analysis was used to describe the research data in general. This analysis included the mean, minimum, maximum, and standard deviation of the pretest and posttest results. The purpose of this analysis was to determine the level of flexibility among the students before and after the intervention.

A normality test was conducted to determine whether the research data were normally distributed. The Shapiro-Wilk test was used in this study because the sample size was less than 50 students. The decision criteria are based on the significance value. If the significance value is greater than 0.05, the data are considered to be normally distributed. Conversely, if the significance value is less than or equal to 0.05, the data are considered not to be normally distributed. The hypothesis test was conducted using the Wilcoxon Signed-Rank Test because the research data were not normally distributed. This test was used to determine whether there was a significant difference between the pretest and posttest flexibility scores of the students after participating in flexibility exercises using a stick. The decision criterion is that if the Asymp. Sig. (2-tailed) value is less than 0.05, then H_0 is rejected and H_1 is accepted. This means that flexibility training using a stick significantly improves students' flexibility. Conversely, if the Asymp. Sig. (2-tailed) value is greater than or equal to 0.05, then H_0 is accepted and H_1 is rejected.

RESULT

The research data were obtained by measuring the students' flexibility using the V-Sit and Reach Test. The measurements were taken twice: before the intervention (pretest) and after the intervention (posttest). The collected data were then analyzed to determine changes in the students' flexibility after participating in flexibility training using a stick.

Descriptive Statistics Results

The results of the descriptive statistical analysis indicate an increase in students' flexibility scores following the intervention. As shown in Table 1, the mean pretest score of 16.84 cm increased to 30.28 cm on the posttest. The minimum score also increased from -8 cm on the pretest to 20 cm on the posttest. The maximum score increased from 25 cm to 35 cm. Additionally, the standard deviation decreased from 7.36 to 3.43. This indicates that after the intervention, students' flexibility scores not only improved but also became more evenly distributed.

Table 1. Descriptive Statistics for Pretest and Posttest Flexibility Scores

Measurement	N	Mean	Minimum	Maximum	Std. Deviation
Pretest	25	16.84	-8	25	7.36
Posttest	25	30.28	20	35	3.43

The increase in students' average flexibility scores can be seen in Figure 1. The pretest results showed an average score of 16.84 cm. This score indicates that the students' flexibility before the intervention was still in the low category. After the students participated in flexibility exercises using sticks, the average posttest score increased to 30.28 cm. This increase indicates that structured training can bring about positive changes in students' flexibility.

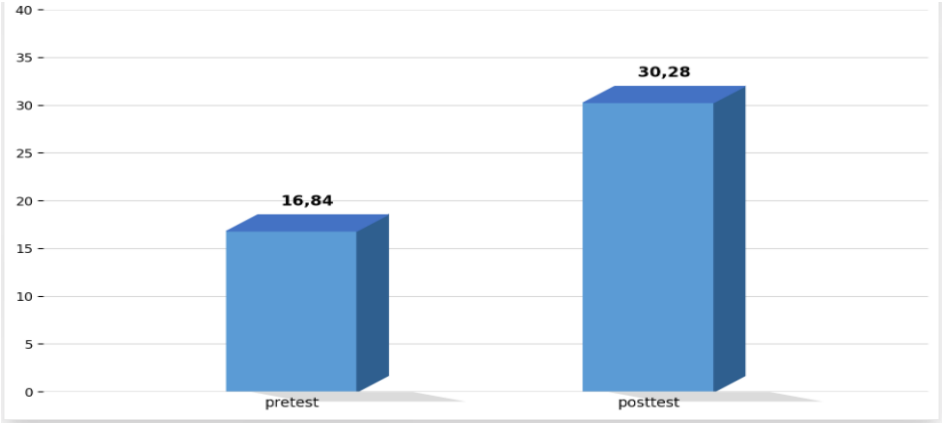

Figure 2. Comparison of average pretest and posttest flexibility scores

Distribution of Flexibility Categories

The distribution of students' flexibility categories before and after the intervention is presented in Table 2. In the pretest results, the majority of students were in the "very low" category, totaling 16 students or 64%. There were 8 students (32%) in the "low" category, while only 1 student (4%) was in the "adequate" category. In the pretest phase, no students fell into the "good" or "very good" categories.

Table 2. Distribution of flexibility categories in the pretest and posttest

Category	Pretest f	Pretest %	Posttest f	Posttest %
Excellent	0	0%	1	4%
Good	0	0%	19	76%
Fair	1	4%	4	16%
Poor	8	32%	1	4%
Very Poor	16	64%	0	0%
Total	25	100%	25	100%

After undergoing flexibility training using sticks, changes were observed in the students' flexibility categories. In the posttest results, the number of students in the "good" category increased to 19, or 76%. There were 4 students (16%) in the "fair" category, 1 student (4%) in the "very good" category, and 1 student (4%) in the "poor" category. No students were in the "very poor" category after the intervention. These results indicate that flexibility exercises using sticks were effective in improving students' flexibility levels.

Normality Test

A normality test was conducted to determine whether the pretest and posttest data were normally distributed. The Shapiro-Wilk test was used to assess normality because the sample size in this study was less than 50 students. The results of the normality test are presented in Table 3.

Table 3. Results of the Shapiro-Wilk Normality Test

Data	Statistic	Df	Sig.
Pretest	0.845	25	0.001
Posttest	0.881	25	0.007

Based on Table 3, the significance value for the pretest data was 0.001 and the significance value for the posttest data was 0.007. Both significance values were less than 0.05. Thus, the pretest and posttest data were determined not to be normally distributed. Therefore, the hypothesis test was conducted using a nonparametric test, namely the Wilcoxon Signed-Rank Test.

Wilcoxon Signed-Rank Test

The Wilcoxon Signed-Rank Test was used to determine differences in students' flexibility before and after the intervention. The results of the Wilcoxon test are presented in Table 4.

Table 4. Results of the Wilcoxon Signed-Rank Test

Description	N	Mean Rank	Sum of Ranks
Negative Ranks	0	0.00	0.00
Positive Ranks	25	13.00	325.00
Ties	0	-	-
Total	25	-	-

Based on Table 4, no students experienced a decrease in flexibility scores after receiving the intervention. This is indicated by a Negative Ranks value of 0. All students experienced an increase in flexibility scores, as indicated by Positive Ranks values for 25 students. Furthermore, there were no identical scores between the pretest and posttest results, resulting in a Ties score of 0. These findings indicate that all students experienced an increase in flexibility after participating in flexibility exercises using sticks.

Table 5. Results of the Wilcoxon Signed-Rank Test

Statistics	Scores
Z	-4.378
Asymp. Sig. (2-tailed)	0.000

Based on Table 5, a Z-value of -4.378 and an Asymp. Sig. (2-tailed) value of 0.000 were obtained. This significance value is less than 0.05. This means that H_0 is rejected and H_1 is accepted. These results indicate that there was a significant increase in flexibility after the students were given the treatment of flexibility exercises using sticks. Thus, flexibility exercises using sticks can be considered effective in improving the flexibility of students at SMP Negeri 3 Gambut.

DISCUSSION

The results of this study indicate that flexibility exercises using sticks can improve the flexibility of students at SMP Negeri 3 Gambut. This improvement is evident from the students' average flexibility score, which increased from 16.84 cm on the pretest to 30.28 cm on the posttest. The difference of 13.44 cm indicates that the intervention had a positive impact on the students' flexibility. The results of the Wilcoxon Signed-Rank Test also yielded a significance value of 0.000 < 0.05. This indicates that H_0 is rejected and H_1 is accepted. Thus, it can be concluded that flexibility exercises using a stick significantly improve students' flexibility. This improvement in flexibility occurs because flexibility exercises using a stick provide targeted movement stimuli to the muscles and joints. Movements performed repeatedly, in a controlled and systematic manner, can help improve muscle elasticity, reduce body stiffness, and expand the range of motion in the joints. Behm et al. (2015) state that stretching exercises can increase the range of motion in the joints. Furthermore Konrad et al. (2024) demonstrate that programmed static stretching exercises can have a positive effect on increasing range of motion. The findings of this study align with the concept of flexibility as a key component of physical fitness. Good flexibility helps students perform various physical activities more effectively, safely, and efficiently. In physical education classes, flexibility is necessary to support students' ability to perform basic movements, gymnastics activities, games, and various sports that require bodily flexibility. Sriwidaningsih et al. (2022) state that physical education through structured physical training can improve students' physical fitness. Therefore, flexibility exercises using sticks can serve as a relevant form of training to develop physical fitness, particularly in terms of flexibility.

The improvement in students' flexibility is also related to the characteristics of the body-shaping exercises using sticks. The movements applied in this study involved stretching the shoulder, back, waist, and leg muscles particularly the hamstrings, which are directly related to

measurements taken using the V-Sit and Reach Test. Merino-marban et al. (2025) showed that hamstring stretching programs implemented in physical education classes can improve students' back-saver sit-and-reach scores. Hamstring flexibility is important in physical education because it is related to students' movement quality and can be influenced by physical activity habits (De Castro-Maqueda et al., 2025). Mocanu (2021) found that incorporating stretching exercises into physical education instruction can improve lower-body flexibility. These findings support the results of this study, as calisthenics using a stick stimulate the muscles responsible for flexibility in the lower body and back. The use of sticks in this study contributed to the success of the flexibility exercises. Sticks were used as aids to guide movements, maintain body position, increase range of motion, and help students perform stretches in a more controlled manner. With the use of sticks, students were able to perform movements in a more focused manner, making the exercises easier to understand and execute.

The results of this study also show a change in the students' flexibility categories after the intervention. Before the intervention, most students were in the "very poor" and "poor" categories. After participating in flexibility exercises using sticks, most students showed improvement and moved into the "good" category. This change in category indicates that the exercises not only increased the average flexibility score but also improved the students' overall flexibility. These results are consistent with those of, who found that stretching exercises can significantly improve flexibility. The findings of this study are related to the research by Hidayatullah et al. (2022), in that both discuss improving flexibility through regular exercise. Another similarity lies in the use of flexibility tests as a measurement instrument. The main difference lies in the type of intervention used. Samodra et al. (2023) showed that stretching exercises can be applied in different forms to improve flexibility. Therefore, the use of sticks in this study can be understood as a variation of flexibility training that helps students perform movements in a more controlled and directed manner. The use of the stick serves as a distinguishing factor because the students not only performed stretching movements but were also trained to maintain proper posture, control their movements, and expand their range of motion in a more targeted manner. The flexibility exercises using a stick in this study involved stretching movements performed gradually and systematically, ensuring that the students received sufficient training stimulus to improve their body flexibility. Konrad et al. (2024) also state that systematically structured flexibility training can increase range of motion. This suggests that the increase in flexibility observed in this study resulted from the systematic nature of the intervention, rather than chance.

The results of the Wilcoxon Signed-Rank Test further reinforce the study's findings. The Positive Ranks value of 25 students indicates that all students experienced an increase in flexibility after receiving the intervention. The Negative Ranks value of 0 indicates that no students experienced a decrease, while the Ties value of 0 indicates that no students had the same scores on the pretest and posttest. These results prove that flexibility exercises using sticks have a positive effect on the entire study sample. Thus, this exercise can be deemed effective in improving the flexibility of students at SMP Negeri 3 Gambut. Based on this analysis, the improvement in students' flexibility occurred because the exercises were conducted systematically, purposefully, repeatedly, and consistently. Stick-based flexibility exercises can serve as a simple, engaging, and easily implementable exercise variation in Physical Education (PJOK) classes. This is supported by Sarkar (2022), who explained that structured physical exercise can contribute to the improvement of physical fitness variables. The use of sticks helps students maintain proper body posture and perform movements with a greater range of motion.

Therefore, stick-based flexibility exercises can be used as an alternative exercise in Physical Education (PJOK) classes to improve components of physical fitness, particularly flexibility. This study has several limitations that should be considered. First, the number of participants was limited, so the findings cannot be generalized to a broader student population. Second, this study used a one-group pretest-posttest design without a control group, which means that other external factors may also have influenced the improvement in students' flexibility. Third, the instrument used in this study focused only on measuring flexibility through the V-Sit and Reach Test.

Therefore, future researchers are encouraged to involve a larger number of participants, use a control group or a more comprehensive experimental design, and include additional instruments to assess other components of physical fitness. Future studies may also compare stick-based calisthenics with other flexibility training methods to obtain more comprehensive findings.

CONCLUSION

Based on the research findings, flexibility exercises using sticks were proven to improve students' flexibility. The improvement observed after the intervention indicates that stick-based calisthenics can be used as an effective alternative exercise in physical education learning, especially to support flexibility development. These exercises are simple, easy to implement, and suitable for school settings because they do not require complex equipment. The implication of this study is that physical education teachers can incorporate stick-based calisthenics as a practical learning strategy to help students improve flexibility and participate more actively in physical fitness activities. Future researchers are encouraged to involve a larger sample size, extend the treatment period, include a control group, and compare stick-based calisthenics with other flexibility training methods to obtain more comprehensive findings.

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