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The Effectiveness of Jump Rope and Plyometrics on Improving Freestyle Swimming Speed

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The Effectiveness of Jump Rope and Plyometrics on Improving Freestyle Swimming Speed

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Abstract

The low freestyle swimming speed in elementary school students is influenced by less than optimal leg muscle strength, explosive power, and leg movement coordination. In addition, the training methods used are still less varied so that the most effective method in increasing freestyle swimming speed is not yet known. This study aims to determine the effectiveness of Jump Rope and plyometric training on increasing freestyle swimming speed. This study uses a quantitative approach with a quasi-experimental design. The research sample consisted of 15 students who were divided into a Jump Rope group, a plyometric group, and a control group. The data collection technique used a freestyle swimming speed test through a pretest and posttest. Data analysis was carried out using normality tests, homogeneity tests, and hypothesis testing using One Way ANOVA. The results showed that all groups experienced an increase in freestyle swimming speed. The Jump Rope and plyometric groups showed a greater increase than the control group, with a higher average increase. However, the results of the ANOVA test showed no significant difference between the treatment groups. In conclusion, both Jump Rope and plyometric training are equally effective in increasing freestyle swimming speed, but there is no significant difference in effectiveness between the two.

Keywords: Speed; Jump rope; Plyometrics; Freestyle Swimming.

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A. Introduction

The author encountered several problems during training and competition in swimming events. Elementary school swimmers must increase their speed and strength to perform leg kicks and explosive power in freestyle swimming. However, it was evident during training sessions that elementary school swimmers were physically fatigued and their training was substandard. They appeared to be less than maximal when performing leg muscle strength training. This was evident when the kick became weaker and when leg muscle training was insufficient to increase explosive power during the kick, resulting in kicks performed below their full potential (Dermawan et al., 2022). In addition to swimming technique, an athlete's physical condition, particularly leg muscle strength, motor coordination, and explosive power, influences speed in freestyle swimming. Creating an appropriate physical training program is an essential part of efforts to improve athlete performance (Supriyanto, 2021).

Many elementary school swimmers struggle with leg muscle strength and explosive power, resulting in subpar kicks in the water. Research by Putri & Sari (2021) defines explosive power as the muscle's capacity to perform physical tasks quickly while simultaneously applying force. A person's ability to use their leg muscles for maximum force with a rapid contraction is known as their "explosive power" (Rahman et al., 2022). Plyometric training, or plyometric exercises, involves rapidly stretching muscles before contracting to deliver maximum force. An athlete must consider other factors during the kick besides the strength that produces the speed of their own explosive muscle power. In fact, elementary school swimmers' kicks are still too slow or not at their maximum speed (Nugroho & Sulaiman, 2020).

Freestyle swimming is a goal-directed activity, therefore, it requires excellent physical fitness. Physical conditioning training is a key component that plays a crucial role in the development process (Heryadi et al., 2025). One such training is Jump Rope, often known as skipping, which is a jumping exercise that strengthens and accelerates the arms and legs (Pratama & Lestari, 2021). Jump Rope optimizes the jump and also helps align the swing, allowing the rope to pass between the head and feet, building leg strength and balance. Good physical training habits are significantly related to freestyle swimming speed, confirming that physical activity on land is inseparable from performance in the water (Maulana et al., 2026).

The authors were interested in studying speed development because competitive swimming focuses on time and speed gains. Previous studies on leg muscle growth, explosive power, and hand-foot coordination have focused on strength. Kick speed is often substandard in many school-age swimmers, such that even when basic technique is sound, speed performance is far from full strength. The researchers wanted to offer a variety of activities, including plyometrics and jump rope, to determine which treatment was superior.

Previous research by Pratama & Wijaya (2022) found that plyometric training significantly increased freestyle swimming speed in novice swimmers. A crucial element of the flutter kick method is leg muscle strength, which is enhanced through plyometric training. In aquatic sports, jumping rope can increase body movement speed, especially in the leg area (Sari, 2022). Therefore, implementing land-based training such as plyometrics and jumping rope in a swimming training program can be an effective approach to improving freestyle swimming speed performance, especially in novice swimmers.

Although the effects of plyometrics and Jump Rope have been investigated in previous research, no study has directly assessed how well each method improves freestyle swimming speed. Which land

training is better as a complementary technique in a swimming training program depends on this comparison. The researcher will conduct an experiment by dividing the participants into three groups: a plyometric group, a Jump Rope group, and a control group that does not receive therapy. These three groups will be used in the experiment to address the study's problem. It is hoped that this design will provide empirical answers about the best exercises to improve freestyle swimming speed and serve as a guide for coaches designing more optimal training programs.

B. Methods

This study employed a quantitative approach with a quasi-experimental design aimed at determining and comparing the effects of jump rope and plyometric training on improving freestyle swimming speed in elementary school students. This method was chosen because the research focused on measuring the effect of treatment on observable outcomes using statistical analysis. The design used consisted of two experimental groups and one control group, allowing researchers to compare changes in results before and after treatment. The first experimental group received jump rope training, while the second group received plyometric training. The division of groups was carried out purposively based on the participants' similar age, swimming ability, and training background to ensure balanced group characteristics.

The participants were 15 students or athletes involved in swimming activities at the Okeanos Aquatic Club. The characteristics of the subjects included elementary school-aged students who actively participated in regular swimming training and were physically healthy. The study was conducted with the support of parents and coaches at the club as the research site. The research lasted for 15 sessions, conducted three times per week over approximately one month and one week. Each session included structured warm-up, core training, and cooldown activities. The intensity and duration of the exercises were adjusted to the participants' physical abilities and training needs. Jump rope training emphasized coordination, rhythm, and muscular endurance, while plyometric training focused on explosive power and lower-body strength.

The treatment procedure began with a pretest to measure the participants' initial freestyle swimming speed. Afterward, each experimental group received its respective training program during the intervention period, while the control group continued regular swimming practice without additional land-based exercises. At the end of the program, a posttest was conducted to measure changes in freestyle swimming speed.

The research instrument used was a freestyle swimming speed test in the form of a time trial test. This test measured the swimmer's speed by recording the time required to complete a specified distance using freestyle stroke technique. The test was conducted individually with an official start, and the timekeeper stopped the stopwatch when the swimmer touched the finish wall. The equipment used in this study included: (1) a 25-meter standard swimming pool, (2) stopwatch, (3) whistle, (4) observation sheet, (5) mobile phone camera, and (6) writing instruments. This instrument was considered relevant because it provided objective, measurable, and comparable data before and after the treatment.

Data analysis was carried out through several stages. Before hypothesis testing, prerequisite tests were conducted, including normality and homogeneity tests, to ensure that the data met the assumptions required for parametric statistical analysis. After the assumptions were fulfilled, hypothesis testing was conducted using the t-test to determine the significance of differences between the pretest and posttest results in each group as well as between groups. The entire research procedure and program implementation were designed

systematically and supported by relevant scientific references to ensure the validity and reliability of the findings.

C. Result and Discussion

Results

Analysis of Pretest Results

Table 1. Normality Test Results

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	kelompok	Statistic	df	Sig.	Statistic	df	Sig.
hasil	kelompok Jump Rope	.312	5	.126	.794	5	.073
	kelompok pliometrik	.164	5	.200*	.978	5	.923
	kelompok kontrol	.208	5	.200*	.916	5	.505

Based on the results of the Normality Test using Kolmogorov-Smirnov and Shapiro Wilk in Table 4, it can be concluded that the pretest data tested has a significance value > 0.05, so it can be concluded that the data is normally distributed

Table 2. Homogeneity Test Results

		Levene Statistic	df1	df2	Sig.
Hasil	Based on Mean	12.477	2	12	.001
	Based on Median	1.583	2	12	.245
	Based on Median and with adjusted df	1.583	2	5.374	.288
	Based on trimmed mean	11.817	2	12	.001

Based on observations of the significance value of the homogeneity test based on the mean, a significant value was obtained, which indicates that the data variance for the pretest of the three groups was not homogeneous.

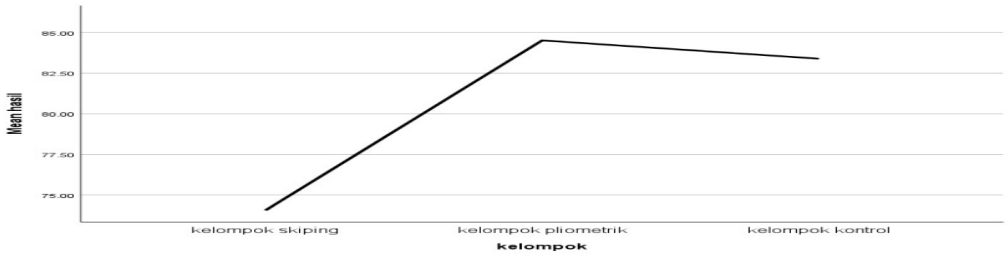


Figure 1. Test Diagram

Based on the diagram showing the average (mean) results of the three groups, namely the skipping group, the plyometric group, and the control group. It can be seen that the skipping group has the lowest average score, which is around 74. Then there was a very significant increase in the plyometric group, with an average score of around 84–85 which is the highest score among the three groups. Furthermore, the control group experienced a slight decrease compared to the plyometric group, with an average score of around 83, but still higher than the skipping group.

Analysis of Posttest Results

Table 3. Normality Test Results

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	kelompok	Statistic	df	Sig.	Statistic	df	Sig.
hasil	kelompok Jump Rope	.317	5	.113	.784	5	.060
	kelompok pliometrik	.189	5	.200*	.966	5	.846
	kelompok kontrol	.200	5	.200*	.909	5	.463

Based on the results of the Normality Test using Kolmogorov-Smirnova and Shapiro Wilk in Table 3, it can be concluded that the posttest data tested has a significance value > 0.05, so it can be concluded that the data is normally distributed so that parametric statistical tests can be carried out.

Table 4. Homogeneity Test Results

		Levene Statistic	df1	df2	Sig.
hasil	Based on Mean	15.044	2	12	.001
	Based on Median	1.642	2	12	.234
	Based on Median and with adjusted df	1.642	2	5.345	.278
	Based on trimmed mean	13.987	2	12	.001

Based on observations of the significance value of the homogeneity test based on the mean, a significant value was obtained, which indicates that the data variance for the posttest of the three groups was not homogeneous.

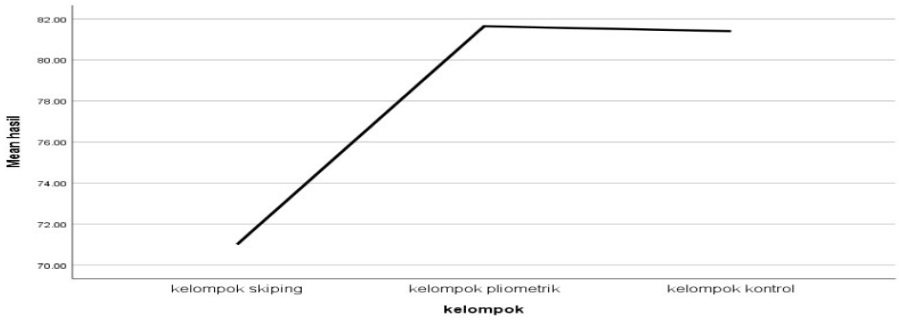


Figure 2. Posttest Diagram

Based on the diagram showing the average (mean) results of the three treatment groups, namely the skipping group, the plyometric group, and the control group. It can be seen that the skipping group has the lowest average value, which is around 71. Furthermore, there was a fairly sharp increase in the plyometric group, with an average value of around 82, which is the highest value among the three groups. Meanwhile, the control group had an average value slightly lower than the plyometric group, which is around 81, but still higher than the skipping group.

Analysis of Profit Results

Table 5. Normality Test Results

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	kelompok	Statistic	df	Sig.	Statistic	df	Sig.
hasil	kelompok Jump Rope	.273	5	.200*	.897	5	.394
	kelompok pliometrik	.228	5	.200*	.903	5	.428
	kelompok kontrol	.252	5	.200*	.854	5	.209

Based on the results of the data normality test, it can be concluded that the tested gain data has a significance value of 0.394> 0.05, so it can be concluded that the data is normally distributed.

Table 6. Homogeneity Test Results

		Levene Statistic	df1	df2	Sig.
hasil	Based on Mean	.456	2	12	.645
	Based on Median	.286	2	12	.756
	Based on Median and with adjusted df	.286	2	11.564	.757
	Based on trimmed mean	.471	2	12	.636

Based on observations of the significance value of the homogeneity test based on the mean, a significant value was obtained, which indicates that the data variance for the posttest for the three groups was homogeneous. Because the requirements for normality and homogeneity were met, the difference in freestyle swimming speed results for the three groups was tested using ANOVA.

Table 7. ANOVA Test Results

Hasil	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.236	2	1.618	11.632	.002
Within Groups	1.669	12	.139		
Total	4.906	14			

The hypotheses used are:

Ho1: There is no difference in students' freestyle swimming speed after being treated in three different groups.

Ha1: There is a difference in students' freestyle swimming speed after being treated in three different groups.

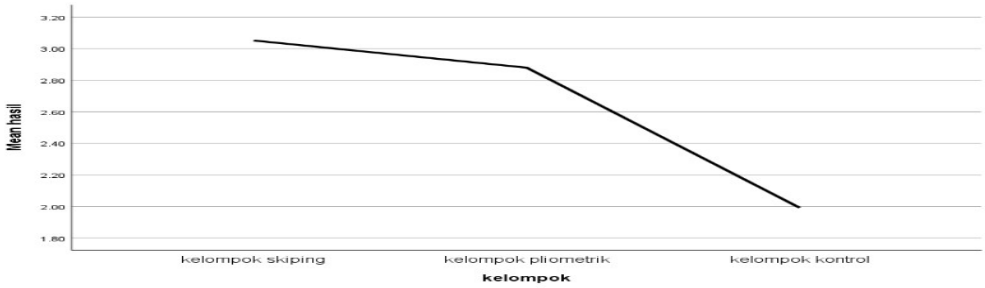
H1 is therefore accepted. Because the significance value is 0.002 < 0.05, it can be concluded that there are at least two different groups for freestyle swimming speed results. Since there are at least two different groups, the analysis continued using a Post Hoc Test.

Table 8. Post Hoc Test Results

					95% Confidence Interval	
(I) kelompok	(J) kelompok	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
kelompok x1	kelompok x2	.17200	.23589	1.000	-.4837	0.8277
	kelompok y	1.06000*	.23589	.002	.4043	1.7157

kelompok x2	kelompok x1	-.17200	.23589	1.000	-.8277	0.4837
	kelompok y	.88800*	.23589	.008	.2323	1.5437
kelompok y	kelompok x1	-1.06000*	.23589	.002	-1.7157	-.4043
	kelompok x2	-.88800*	.23589	.008	-1.5437	-.2323

Figure 3. Gain Diagram



Based on the results above, it can be concluded that the comparison of the significance value between group x1 - group x2 = 1.000 > 0.05, it can be concluded that there is no significant difference, while the comparison value of group x1 - group Y = 0.002 < 0.05, so there is a significant difference. Likewise, group x2 with group y = 0.008 < 0.05, which means there is a significant difference. Thus, it can be concluded that groups x1 and x2 (skipping and plyometric groups) both provide a significant effect compared to the control group, but there is no significant difference in effectiveness between skipping and plyometric training in increasing freestyle swimming speed results.

Discussion

The effectiveness of Jump Rope exercises on increasing freestyle swimming speed

The results of this study indicate that Jump Rope training significantly improves freestyle swimming speed in elementary school swimmers. The increase in performance, reflected by the reduction in swimming time after the intervention, demonstrates that Jump Rope training not only affects general physical fitness but also supports specific motor abilities required in freestyle swimming. Scientifically, this improvement can be explained through physiological adaptations in the neuromuscular system, particularly increased coordination, muscle endurance, and lower-limb movement efficiency. Repetitive jumping movements stimulate faster muscle contractions and improve synchronization between the nervous system and muscle performance, which contributes to more effective flutter kick movements in freestyle swimming.

From a theoretical perspective, Bompa & Buzzichelli (2019) explain that structured and progressive physical training can improve biomotor components such as coordination, endurance, and speed. In this study, the Jump Rope program was implemented systematically over 15 training sessions with gradual increases in intensity. This progressive overload principle enabled athletes to adapt physiologically, leading to improved lower-body muscle performance and movement rhythm. These findings are consistent with Hidayat (2023), who reported that Jump Rope exercises enhance leg coordination and movement speed in swimmers, resulting in better swimming performance.

The improvement in freestyle swimming speed can also be interpreted through the transfer of training effect theory, where land-based exercises

contribute to sport-specific movement performance. Jump Rope training develops rhythmic and repetitive lower-body movements that resemble the continuous kicking action in freestyle swimming. As a result, athletes become more efficient in generating propulsion while maintaining body balance and movement stability in the water. This explanation is supported by Nugraha et al. (2023), who found that Jump Rope training improved leg muscle strength and reduced freestyle swimming time in athletes.

The novelty of this study lies in its direct comparison between Jump Rope and plyometric training in elementary school swimmers, a topic that has received limited attention in previous studies. Earlier research generally examined each training method separately, whereas this study specifically analyzes and compares the effectiveness of both methods within the same experimental framework. Therefore, this research contributes new scientific evidence regarding the role of land-based exercise variations in improving freestyle swimming speed among young swimmers and provides practical references for coaches in selecting training methods appropriate to the physiological characteristics of school-age athletes.

The effectiveness of plyometric training on increasing freestyle swimming speed

Based on data analysis through training treatments and time trial measurements, it was found that plyometric training had a positive effect on increasing students' freestyle swimming speed. This was demonstrated by a decrease in the posttest time compared to the pretest, with the gain value reflecting improved performance after the treatment. These findings indicate that plyometric training is effective in improving students' physical abilities, particularly the explosive power of the leg muscles, which plays a crucial role in generating propulsion during freestyle leg movements.

The plyometric training in this study was conducted systematically, structured, and in stages over 15 sessions. The training program focused on increasing explosive power, strength, and speed of muscle contraction through various forms of exercise such as jumping, bounding, and hopping. Scientifically, plyometric training has been shown to increase muscle strength, speed, and sprinting ability by enhancing neuromuscular function and muscle force production in a short period of time (Haff & Triplett, 2016). This makes plyometrics a relevant training method for supporting swimming performance, particularly speed. The effectiveness of plyometric training is also influenced by the consistency of training and the physiological adaptation process that occurs in students. Repeated training with gradually increasing intensity can improve the efficiency of the neuromuscular system, including muscle fiber recruitment and movement coordination. Recent research has shown that plyometric training can significantly improve various components of physical fitness, such as strength, speed, and agility (Chaabene et al., 2021). This adaptation has a direct impact on the ability to move faster and more efficiently in sports activities.

In addition to its impact on physical aspects, plyometric training also contributes to increased movement efficiency in swimming. The explosive movements trained through plyometrics enable muscles to produce a stronger and faster propulsion, which can then be transferred to the flutter kick movement in freestyle swimming. Research in aquatic sports has shown that plyometric training programs can increase leg muscle strength and significantly reduce swimming time (Amaro-Gahete et al., 2022). Thus, this training not only increases strength but also improves the efficiency of movement techniques in the water.

From a biomechanical perspective, plyometric training aligns with the movement characteristics of freestyle swimming, particularly the leg push phase, which requires a combination of strength

and speed. This training utilizes the stretch-shortening cycle mechanism, a muscle stretch-shortening cycle that allows for greater force production in a short period of time. Meta-analytic studies have shown that plyometric training significantly improves athletic performance, including movement speed and power (Slimani et al., 2016). This confirms that plyometrics has a positive transfer rate to swimming performance.

The results of this study also showed that the improvement in the plyometric group was greater than that of the control group that received no special treatment. This confirms that plyometric training significantly contributes to increasing freestyle swimming speed. However, a post hoc test showed no significant difference between the plyometric and jump rope groups, suggesting that both are equally effective in increasing freestyle swimming speed.

Based on the statistical analysis using ANOVA on the gain data, a significant value was obtained indicating a significant difference between the treatment groups. This further confirms the significant effectiveness of plyometric training in increasing freestyle swimming speed in students. Therefore, it can be concluded that plyometric training is an effective training method for increasing freestyle swimming speed. This effectiveness is achieved through increased leg muscle explosiveness, movement coordination, technical efficiency, and consistent, well-programmed training (Schoenfeld, 2021). Therefore, plyometric training can be recommended as an effective form of land training to support improved freestyle swimming performance, particularly speed.

Comparison of the effectiveness between Jump Rope training and plyometric training in increasing freestyle swimming speed

Based on data analysis using training treatments and time trial measurements, it was found that both jump rope and plyometric training had a positive impact on increasing freestyle swimming speed in students. This was evident in the decrease in run times in both treatment groups, with gain values indicating improved performance after the intervention. Thus, both training methods have proven effective in increasing freestyle swimming speed, despite their different training characteristics.

Jump rope training emphasizes the development of coordination, rhythm, and leg muscle endurance, thus playing a role in maintaining stability and continuity of leg movements during swimming. In contrast, plyometric training focuses on increasing explosive muscle power through explosive movements such as jumping and bounding. Scientifically, plyometric training has been shown to increase strength, speed, and explosive movement ability by optimizing the stretch-shortening cycle mechanism in muscles (Ramírez, 2022). These differences in characteristics indicate that jump rope training contributes more to movement efficiency, while plyometric training plays a more important role in increasing maximum strength and speed.

In terms of effectiveness, statistical tests showed no significant difference between the jump rope and plyometric training groups in increasing freestyle swimming speed. This indicates that both types of training have relatively equal levels of effectiveness. This finding aligns with recent research showing that various strength- and explosiveness-based training methods are equally capable of significantly improving athletes' physical performance and movement speed (Wang, 2024).

However, when examined more closely from a physiological perspective, plyometric training tends to have an advantage in increasing muscle explosiveness, which plays a role in generating a stronger leg propulsion during swimming. Research shows that plyometric training can increase freestyle swimming speed by increasing leg muscle strength and

sprint performance (Chen et al., 2025). On the other hand, jump rope training is superior in improving coordination and rhythm of movement, which are crucial for maintaining efficient and continuous leg movements in the water.

From a biomechanical perspective, both types of training are related to the flutter kick movement pattern in freestyle swimming. Jump rope training promotes rhythmic and repetitive movements that facilitate synchronization, while plyometric training promotes rapid and powerful muscle contractions. The combination of these two aspects is essentially complementary in improving swimming performance. This is supported by research showing that plyometric training in aquatic sports significantly improves specific performance, including movement speed and power (Ramírez, 2022).

Thus, it can be concluded that rope skipping and plyometric training are both effective in increasing freestyle swimming speed in students, with no statistically significant differences in effectiveness. Rope skipping plays a greater role in improving coordination, rhythm, and muscular endurance, while plyometric training focuses more on increasing explosive power and muscular strength. Therefore, these two training methods can be used either separately or in combination to achieve more optimal results in improving freestyle swimming performance.

D. Conclusion

This study This study demonstrates that jump rope and plyometric training positively improve freestyle swimming speed in swimming club students. Both training methods significantly enhanced performance, as shown by decreased swim times from pretest to posttest. The improvement was supported by increased leg muscle strength, coordination, endurance, and explosiveness developed through systematic training. Jump rope training contributed more to coordination and endurance, while plyometric training emphasized explosive power. Statistical analysis showed that both methods were effective compared to the control group, although no significant difference was found between the two training methods. Practically, these findings provide implications for swimming coaches in designing varied and structured land-based training programs to improve athletes' swimming performance. Scientifically, this study contributes to the development of sports coaching knowledge, particularly regarding the effectiveness of jump rope and plyometric exercises in supporting freestyle swimming speed. Future research is recommended to involve larger and more diverse samples, longer training durations, and additional physical variables to obtain more comprehensive results.

E. Acknowledgments

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F. Conflict of Interest

There is no conflict of interest.

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