



The Effect of Peer-Based Learning On The Knowledge And Skills of Swimming In University Students

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ABSTRACT

This study aims to determine the effect of peer-based learning on the knowledge and skills of freestyle swimming in university students. This research uses an experimental method with a matching-only posttest-only control group design. The research sample consisted of 60 first-semester students from the 2025/2026 academic year, selected through quota-purposive sampling technique and divided into an experimental group and a control group. The experimental group received swimming instruction through a combination of lecturer-led learning and peer-based learning, while the control group used a part and whole practice approach. The research instruments included a freestyle swimming knowledge test and a 25-meter freestyle swimming skill test. Data analysis was conducted descriptively and inferentially using the MANOVA test with a Pillai's Trace interpretation. The results showed a significant effect of peer tutoring on improving knowledge and skills in freestyle swimming ($V = 0.54$, $F = 32.873$, $p < 0.001$). Univariate analysis showed an increase in knowledge with a moderate effect ($\eta^2 = 0.104$) and an increase in swimming skills with a large effect ($\eta^2 = 0.459$). Thus, it can be concluded that the peer tutoring learning model is effective in improving university students' knowledge and skills in freestyle swimming.

ARTICLE HISTORY

Received: 2026/02/08

Accepted: 2026/02/23

Published: 2026/02/25

KEYWORDS

Freestyle
Swimming skills
Peer-tutoring
Physical education
Knowledge.

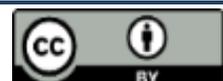
AUTHORS' CONTRIBUTION

- A. Conception and design of the study;
- B. Acquisition of data;
- C. Analysis and interpretation of data;
- D. Manuscript preparation;
- E. Obtaining funding

Cites this Article : Fahreza, N.A.; Prakoso, B.B.; Hartoto, S.; Khory, F.D. (2026). The Effect Of Peer-Based Learning On The Knowledge And Skills Of Swimming In University Students. **Competitor: Jurnal Pendidikan Kepeleatihan Olahraga**. 18 (1), p.1349-1361

INTRODUCTION

Physical education plays a crucial role in developing physical abilities, motor skills, knowledge, and a positive attitude toward sports activities. Swimming is a crucial component of physical education, as it not only promotes physical fitness but also provides a fundamental skill that supports water safety. Among the various swimming styles, freestyle is the most frequently taught technique to students because it is relatively easy to master, efficient in movement, and serves as a foundation for learning other swimming strokes. However, in practice, many students still struggle to understand the technique and correctly execute the freestyle strokes (Sulfiandi, 2024). These difficulties can be caused by various factors, such as the lack of theoretical understanding of basic techniques, low learning motivation, limited practice time (Arhesa et al., 2020), uninteresting learning



methods, and inadequate training programs (Hermawan et al., 2022). Therefore, learning strategies that can increase students' active participation and help them understand and practice swimming technique effectively and easily are needed (Signorini et al., 2025).

Students' understanding of swimming skills needs to be improved to support the subsequent stroke learning process. According to Fitts and Posner's (1967) motor learning theory, learning movement begins with the cognitive stage, followed by the associative stage, and finally the automation stage (Weaver, 2015). In the context of learning how to swim, knowledge encompasses understanding basic techniques such as streamlined body position, rhythmic breathing, arm and leg coordination, and the ability to float and glide to reduce water resistance (Yamakawa et al., 2025). The next sociative stage, which involves students applying the acquired knowledge to advanced skills such as movement efficiency, energy management, and speed regulation, is also crucial for improving performance. At this stage, students repeatedly practice skills until they achieve automation. Unfortunately, these stages are sequential, meaning that failure to achieve these skills in the initial stages prevents them from progressing to the next stage. Therefore, to efficiently implement the theoretical stage of motor learning, students' knowledge needs to be improved. Furthermore, students are given ample opportunity to practice applying this knowledge through appropriate learning strategies.

One of the strategies that can help address this issue is peer-based learning, also known as peer-tutoring, a learning method that uses peers as tutors. This approach allows students to learn through simpler communication, closer interaction, and more practice opportunities (Mubarok et al., 2024). Peer-teaching is a learning process in which a student with more knowledge teaches other students (Prasetya, 2016). The peer-tutoring model essentially involves selecting a student to act as a teacher, also known as a "tutor." This tutor then assists other students (learners) in learning the subject matter or performing movement tasks within the learning process (Kurniawati & Prasetyo, 2021).

Peer tutoring is one of the learning pillars in university because it offers numerous benefits. Students who act as tutors possess higher skills than their peers (tutees), will benefit from the learning process. Meanwhile, as tutees, they receive specific skills training from peers who are at least somewhat compatible with the learning environment. According to the learning pyramid, peer tutoring can impact up to 90% of students' learning outcomes (teaching others) (Sa'diyah & Sabariman, 2020). The implementation of peer tutoring strongly supports the formation of a collaborative learning environment among students. Peer tutoring can be implemented in the form of microteaching. The application of peer tutoring in the microteaching concept makes it possible for tutors, who are also students, to learn teaching skills, while tutees can hone basic skills as learning materials (Lailatul Munawaroh, Yuni Pantiwati, 2015).

Peer tutoring is considered more conducive to promoting a positive and engaging learning environment for both tutors and learners (Supardi, 2016). The peer tutoring learning model has the potential to be one that can be used to overcome several aspects that hinder the learning process. The clear impact of implementing peer tutoring is the development of cognitive, psychosocial, and motor skills. In addition, this model also helps overcome

teachers' difficulties in observing and providing feedback to each student (Arends, 2012). Peer tutoring is not a new learning method, but rather a learning method that has been around for a long time. The method often applied during the learning process for students is mostly teacher-centered. However, with the existence of this learning method (peer tutoring), it is hoped that it can produce more effective output in the learning process and outcomes (Febianti, 2018).

The peer tutoring method is a learning approach that involves students acting as tutors for their peers in the learning process (Sudjadmiko, 2020). Peer tutoring plays a role in providing explanations, demonstrations, and feedback to the peers being tutored. Through this interaction, a mutual learning process occurs that encourages increased conceptual understanding, technical skills, and self-confidence (Supardi, 2021). In the context of swimming lessons, the peer tutoring method can help students with greater abilities share their knowledge with others, making learning more effective and enjoyable (Bahari, 2025).

Regarding learning in the subject of Physical Education, Health and Recreation, it is a means to encourage physical growth, psychological development, motor skills, knowledge and reasoning, appreciation of values (attitude, mental, emotional, sportsmanship, spiritual, social), and habituation of healthy lifestyles to stimulate the growth and development of balanced physical and psychological qualities (Muchlisin Riadi, 2021). This research aims to test the effectiveness of the implementation of peer tutoring learning. This research is also expected to contribute to the development of physical education learning methods, particularly in mastering freestyle swimming knowledge and skills in students. Based on the background, the author wants to conduct research as an effort to improve freestyle swimming skills through the implementation of the peer tutoring method.

METHODS

Types & Design

The type of research used is an experiment with the Matching-Only Posttest-Only Control Group Design, as shown in the following image.

Treatment group	M	X (peer tutoring)	O (knowledge and swimming skills)
Control group	M	C (part and whole)	O (knowledge and swimming skills)

Figure 1.

Research Design (Fraenkel et al., 2012)

The Matching-Only Posttest-Only Control Group design excels because it minimizes selection bias by matching important characteristics between groups, resulting in more valid results (Fraenkel et al., 2012). Furthermore, this design is efficient because it uses only a posttest, thus avoiding pretest effects, and is more practical for the implementation (Malau et al., 2024).

Population & Sample

The population in this research was all students of the Pendidikan Jasmani Kesehatan dan Rekreasi (PJKR) Study Program, FIKK Unesa, in the first semester of the

2025/2026 academic year. This population was selected because they were in the initial phase of swimming practice lectures, thus having relatively homogeneous characteristics related to experience and basic swimming skills. The population serves as the entire potential research subject and serves as the basis for determining how representative the selected sample is. By understanding the characteristics of the population, researchers can ensure that the research results are relevant and can be generalized to the appropriate group.

The research sample was determined using a quota-purposive sampling technique, which is a combination of sampling methods based on a certain number (quota) and specific criteria (purposive). The criteria set included: (1) students who are not yet able to swim freestyle for 25 meters, thus in accordance with the focus of the intervention; and (2) active students with full attendance to ensure consistency during the treatment. The quota was used to equalize the number of participants between the control and treatment groups, so that the two groups could be compared fairly. Sample selection was carried out with the assistance of the course instructor to ensure equality of initial abilities, or matching, between the control and treatment groups. Based on these criteria, 59 students (33 males and 26 females) were selected as research participants who were divided equally into the control and treatment groups.

Instruments

This research instrument was designed to measure two main variables: theoretical knowledge and practical skills in freestyle swimming, and to describe how peer tutoring plays a role in improving both aspects. Theoretical knowledge was measured using an objective test in the form of multiple-choice and short-answer questions based on the core material of freestyle swimming, including the concepts of arm movement, leg movement, breathing techniques, body coordination, water safety, and the principles of swimming efficiency. This instrument consists of 30 questions that have undergone a content validity test by a swimming expert lecturer and a reliability test using the internal consistency technique, making it suitable for use in measuring the level of cognitive understanding of participants. The items were tested on 367 students and analyzed using CTT, with the following results.

Table 1.
 Calibration Results of Multiple Choice Questions Using CTT

Item Number	Difficulty (itemMean)	Differentiator Potency (pBis)	Decision
B_1	0.86 (easy)	0.35 (good)	Eligible
B_2	0.94 (very easy)	0.19 (weak)	Not Eligible
B_3	0.99 (very easy)	0.25 (enough)	Eligible
B_4	0.84 (easy)	0.28 (enough)	Eligible
B_5	0.76 (moderate)	0.38 (good)	Eligible
B_6	0.97 (very easy)	0.14 (weak)	Not Eligible
B_7	0.54 (moderate)	0.49 (good)	Eligible
B_8	0.96 (very easy)	0.33 (good)	Eligible
B_9	0.88 (easy)	0.23 (enough)	Eligible
B_10	0.80 (moderate)	0.51 (good)	Eligible
B_11	0.77 (moderate)	0.33 (good)	Eligible
B_12	0.64 (moderate)	0.46 (good)	Eligible

Item Number	Difficulty (itemMean)	Differentiator Potency (pBis)	Decision
B_13	0.82 (easy)	0.32 (good)	Eligible
B_14	0.98 (very easy)	0.33 (good)	Eligible
B_15	0.05 (very hard)	-0.32 (negative)	Not Eligible
B_16	0.20 (hard)	-0.20 (negative)	Not Eligible
B_17	0.87 (easy)	0.32 (good)	Eligible
B_18	0.97 (very easy)	0.25 (enough)	Eligible
B_19	0.93 (very easy)	0.34 (good)	Eligible
B_20	0.94 (very easy)	0.41 (good)	Eligible
B_21	0.75 (moderate)	0.44 (good)	Eligible
B_22	0.46 (moderate)	0.16 (weak)	Not Eligible
B_23	0.97 (very easy)	0.21 (enough)	Eligible
B_24	0.95 (very easy)	0.31 (good)	Eligible
B_25	0.73 (moderate)	0.26 (enough)	Eligible
B_26	0.96 (very easy)	0.17 (weak)	Not Eligible
B_27	0.96 (very easy)	0.28 (enough)	Eligible
B_28	0.97 (very easy)	0.25 (enough)	Eligible
B_29	0.90 (easy)	0.50 (good)	Eligible
B_30	0.98 (very easy)	0.40 (good)	Eligible

Note: items are eligible if the power difference is >0.2 and pBis is at least sufficient

Based on the results of the field trial, six items were discarded, and 24 items were used.

To measure the freestyle swimming skill variables, a performance checklist was used, compiled based on the basic swimming technique components. The aspects assessed included body position, gliding technique, arm and leg coordination, breathing pattern, rhythm, and overall efficiency (swimming fluency and stability). Each aspect was scored on a scale of 1-5, ranging from "very poor" to "very good." The assessments were conducted by two experienced observers to minimize bias and increase inter-rater reliability. The freestyle swimming skills instrument used a 25-meter swimming test. Assessments were conducted by three raters (certified swimming coaches) on movement quality (process-oriented). The assessment instrument was found to be valid with a loading factor between 0.735 and 0.894, an AVE of 0.597 and 0.744, and a composite reliability of 0.883 and 0.935, indicating its validity and reliability (Khory et al., 2025).

Research's Implementation

The research was conducted during the first six weeks of the course in a swimming pool. At the beginning of the research, participants from the experimental and control groups were selected and matched based on initial characteristics such as knowledge and 25-meter freestyle swimming skills through baseline data or pre-research observations. Weeks 1-5 consisted of treatment activities. The experimental group received swimming lessons from a lecturer in session I and peer tutoring in session II each week. Thus, the sample participated in eight learning sessions (in-class practice by the lecturer and outside of class practice by the tutor). Peer tutors with better swimming skills assisted the tutees through demonstrations, technique corrections, and direct feedback. The material covered basic techniques (footwork, hand stroke, breathing), movement coordination, and automation of freestyle swimming patterns. The control group used part and whole practice guided by the lecturer in class practice (session I) and was assigned to practice independently outside of class practice using the

part and whole approach (session II). The experimental and control groups both participated in eight swimming learning sessions. In week 6, all participants were tested using a knowledge instrument and a 25-meter freestyle swimming skills test as a posttest only. The posttest results were used to compare the learning effectiveness between the experimental and control groups.

Data Analysis

Descriptive statistics in the form of mean, standard deviation, minimum, maximum, skewness, and kurtosis were used to describe the results of the knowledge and skills assessment (Hair et al., 2014). The multivariate test was conducted in the following order:

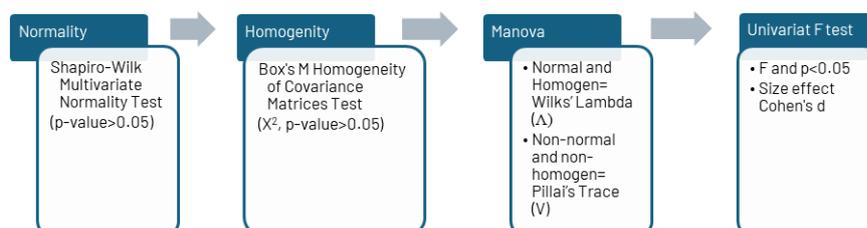


Figure 2.

Steps of Data Analysis

Analysis using the RStudio application, multivariate statistical test using a significance of 0.05 (Hair et al., 2014).

RESULTS AND DISCUSSION

Result

Descriptive statistics of the measured dependent variables, namely, students' swimming knowledge and skills. The results of the descriptive analysis show that the experimental group had a higher average knowledge (Mean = 20.4) compared to the control group (Mean = 16.76), and swimming skills (Mean = 3.41) compared to the control group (Mean = 2.55). The following table contains the descriptive statistical data analysis.

Table 2.

Descriptive Statistics of Swimming Knowledge and Skills

Variable	Group	N	Mean	SD	Min	Max	Value Range
Knowledge	Experiment	30	20.4	2.71	14	24	0-24
	Control	29	16.76	7.23	3	24	0-24
Swimming Skills	Experiment	30	3.41	0.41	2.2	4.03	1-5
	Control	29	2.55	0.54	1.55	3.65	1-5

The results of the research showed that the experimental group that received peer tutoring treatment had a higher level of freestyle swimming knowledge and skills than the control group. In the knowledge aspect, the average score of the experimental group reached 20.4 with a standard deviation of 2.71, while the control group only obtained an average of 16.76 with a standard deviation of 7.23. The range of scores in the experimental group was relatively more homogeneous (14-24) compared to the control (3-24). Meanwhile, in freestyle swimming skills, the experimental group recorded an average of 3.41 with a standard deviation of 0.41, higher than the control group, which

was only 2.55 with a standard deviation of 0.54. The minimum and maximum values also showed that the experimental group's skill achievement was better (2.2–4.03) than the control group's (1.55–3.65). Overall, these descriptive data indicate that peer tutoring has a positive effect on improving freestyle swimming knowledge and skills.

Table 3.
 Test of normality prerequisites and homogeneity

Prerequisites Test	Statistic	p-value	Conclusion
Henze-Zirkler (multivariate)	HZ = 2.641	<0.001	Multivariate abnormality
Box's M Test	$\chi^2 = 25.00$, df = 3	<0.001	Homogeneity is not met

The results of the homogeneity test show a Chi-Square value (approx.) = 25.00 with df = 3 and p < 0.001, so the covariance matrix between groups is not homogeneous. The results of the multivariate normality test, Henze-Zirkler Multivariate Normality Test, HZ = 2.641, p < 0.001, are not normal. Thus, the assumption of homogeneity of covariance and the assumption of multivariate normality are not met; the interpretation of the Manova results uses Pillai's Trace, which is more robust to violations of the assumptions of normality and homogeneity. The results of the Manova are as follows.

Table 4.
 MANOVA test of the effect of group on knowledge and skills

Manova's Interpretation	Value	Approx. F	df1	df2	p-value	Decision
<i>Pillai's Trace</i>	0.540	32.873	2	56	<0.001	Significant

The results of the Pillai's Trace interpretation showed V = 0.54, F(2, 56) = 32.873, p < 0.001, indicating a group effect on the knowledge and skills variables. Next, a univariate test was conducted to examine the significance of the group effect on each dependent variable, as shown in the following table.

Table 5.
 Univariate test of the effect of peer-tutoring on knowledge and skills

Dependent Variable	Mean		F	p-value	Effect size (Cohen's d)	Interpretation
	Control	Experiment				
Knowledge	16.76	20.4	6.64	0.013	0.104	Medium
Swimming Skill	2.55	3.41	48.397	<0.001	0.459	Large

Univariate analysis revealed that knowledge differed significantly between groups (F = 6.640, p = 0.013, $\eta^2 = 0.104$; medium effect), and swimming skills differed significantly (F = 48.397, p < 0.001, $\eta^2 = 0.459$; large effect). Substantively, the treatment improved both knowledge and swimming skills, with a stronger effect on swimming skills.

Discussion

The peer tutoring learning model, which relies on peer interaction in the learning process, has been proven in this research to be an effective method for improving theoretical understanding and practical skills in physical education (Hardi et al., 2021). In the context of freestyle swimming learning, this learning model has the advantage of building closer relationships between students by creating a comfortable environment and allowing for more intensive feedback. This research revealed that the application of

peer tutoring can improve motor skills and theoretical knowledge, which are crucial for mastering freestyle swimming techniques that require complex body coordination, proper breathing techniques, and movement efficiency (Bahari et al., 2025).

One of the reasons peer tutoring is effective in swimming lessons is that it encourages easier communication between students (Zhang et al., 2021). Research shows that peer interaction often reduces communication barriers, especially in technical subjects that require in-depth understanding, such as swimming lessons. When peer tutors teach swimming techniques, they tend to use simpler language and are relevant to their own experiences, making it easier for learners to grasp difficult concepts (Wahab et al., 2020). This leads to a better understanding of basic swimming theory, including breathing techniques, arm and leg coordination, and the principles of efficient movement in the water.

Additionally, peer tutoring provides students with more opportunities to practice swimming techniques directly with more personalized guidance (Hartoto et al., 2021). In swimming, common technical difficulties students encounter, such as the inability to coordinate arm and leg movements or breathing patterns, can be addressed with more intensive practice and immediate feedback. Peer tutors play a crucial role in providing in-depth explanations and demonstrations, allowing students to directly see their mistakes and correct them immediately (Casey et al., 2015). This process accelerates mastery of the motor skills necessary for freestyle swimming because students are able to more quickly refine their technique because of the direct attention of a peer with a better understanding.

Psychological factors also play a crucial role in the success of peer tutoring. Learning based on social interaction between peers tends to increase students' intrinsic motivation to learn. Students who act as tutors not only benefit from teaching others but also strengthen their own understanding through the teaching process (Kim et al., 2021). Conversely, students who become learners feel more comfortable learning because they feel valued and supported. In swimming lessons, which are often physically and mentally challenging, increased self-confidence is crucial for overcoming fear or anxiety when practicing in the water. Tutoring by peers, who better understand the challenges faced, provides crucial emotional support in building students' confidence (Ompad et al., 2025).

The peer tutoring method also allows for more flexible and contextual learning (Warni et al., 2023). In swimming lessons, limited practice time is often a major obstacle to mastering basic techniques. This model provides the opportunity for more practice outside of formal lessons, with direct guidance from peers. A key advantage of this approach is that students can continue practicing outside of class under the supervision of more experienced peers, allowing for faster technique improvement. This active student involvement in the teaching and learning process reinforces experiential learning, which is crucial for mastering complex motor skills (Antonopoulos et al., 2024).

However, despite its many advantages, implementing peer tutoring also presents several challenges. One of these is inequality in students' initial abilities, which can impact learning outcomes (Widoro et al., 2024). In this research, although the

experimental and control groups were selected based on specific criteria to minimize variability, differences in students' swimming abilities still have the potential to influence the effectiveness of peer tutoring (Longueville et al., 2024). More skilled students may not provide appropriate or in-depth feedback to their peers, while lower-skilled students may struggle to receive or understand such feedback. Therefore, adequate training for peer tutors is necessary to ensure they can provide clear and constructive guidance to their tutees.

It is also important to note that while peer tutoring is highly effective in improving practical skills and theoretical knowledge, this model requires a more systematic approach to address learning challenges (Tanir et al., 2024). For example, specific training for peer tutors in providing effective feedback is essential to maximize the benefits of this method. Without proper training, there is a risk that tutors may fail to provide appropriate explanations or provide inappropriate corrections, which can impact the quality of student learning (Longueville et al., 2024). Therefore, future research could focus more on how to structure effective training for peer tutoring in the context of swimming lessons to ensure optimal outcomes.

Overall, this research demonstrates that peer tutoring is an effective learning method for improving theoretical knowledge and practical skills in freestyle swimming (Arhesa et al., 2025). This model offers benefits that not only enhance technical understanding but also support students' psychological development, such as self-confidence and motivation to practice. Considering existing challenges, such as inequalities in students' initial abilities and the need for adequate tutor training, peer tutoring can be a highly effective approach in sports learning, particularly in swimming (Widoro et al., 2024). Further research is needed to address these limitations and explore the full potential of the peer tutoring model in physical education contexts.

CONCLUSION

This research concludes that the implementation of peer tutoring has been proven effective in improving students' freestyle swimming knowledge and skills. Statistical results (MANOVA) showed a significant effect of treatment on knowledge (medium effect) and skills (large effect), thus this model is able to provide more intensive learning support through peer interaction, direct feedback, and more practice opportunities. These findings have important implications for physical education learning practices, specifically that peer teaching can be integrated as a learning support strategy for lecturers to optimize the technique correction process, increase active student participation, and strengthen the collaborative learning environment. In addition, basic training for peer tutoring needs to be considered to make the quality of feedback more consistent and effective. However, this research has several limitations, including variations in the initial abilities of tutors, which can affect the quality of guidance, the relatively short duration of the intervention, so that it does not yet describe long-term impacts, and the use of a sample of first-semester students, which limits generalization

to other populations. Rater-dependent skill assessment also leaves the potential for subjective bias, and the research's single-site swimming facility context limits comparisons with different learning environments. Despite these limitations, this research makes an important contribution to the development of more effective, student-centered swimming learning strategies.

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