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TECHNOLOGY-BASED ANALYSIS OF BUTTERFLY SWIMMING

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Abstract

The problem addressed in this study is related to the optimal butterfly stroke swimming skills of beginner athletes at the SeaRIA Aquatic Swimming Club. This study aims to describe the level of butterfly stroke swimming skills of beginner athletes at SeaRIA Aquatic Swimming Club. The subjects of the study were beginner athletes aged 7–9 years at SeaRIA Aquatic Swimming Club. The instrument used was a butterfly stroke swimming skills test. Data analysis was conducted using descriptive statistics and video recording technology based on the results of the butterfly stroke swimming performance. Skill assessment was carried out by three licensed judge. The assessment of 11 athletes showed that the level of mastery of butterfly stroke swimming skills included: (1) body position mastery of 71.77%, categorized as good; (2) arm movement mastery of 63.69%, categorized as good; (3) leg movement mastery of 50.56%, categorized as fair; (4) breathing technique mastery of 63.18%, categorized as good; and (5) movement coordination mastery of 58.64%, categorized as fair.

Keywords: Analysis, butterfly stroke, technology

INTRODUCTION

Indonesia is a country that continuously encourages development in various sectors, three of which are sports. Sport is understood as physical activity involving body movement and is carried out in a structured, planned, and continuous manner to achieve certain goals. Sports activities provide various benefits, especially in improving physical fitness and health (Wu et al., 2023) (Hartwig et al., 2021). Structured exercise improves quality of life, fatigue, and psychological functioning (Ningrum et al., 2025). Efforts to develop and foster sports are an important part of improving the quality of Indonesia's human resources, because through sports, the values of personality, discipline, sportsmanship, and character can be instilled, while also encouraging achievements that can foster a sense of pride both individually and collectively as a nation and state.

Swimming is one of three sports enjoyed by various groups of people. This activity is carried out in water and involves full body movements, thus providing significant benefits for physical fitness and health (Ferreira et al., 2024).

Swimming can be participated in by all age groups, both children and adults, as well as by men and women, for various purposes, such as education, recreation, and achieving sporting achievements (Omar et al., 2021). In the context of competitive sports, swimming success is largely determined by the swimmer's speed.

Swimming performance is influenced by several key factors, including technical ability, physical condition, and mental aspects of the athlete (Mahyudi et al., 2025) (Lee & Jeon, 2025). Judging in swimming competitions is based on the swimmer's recorded time. To achieve optimal speed, swimmers are required to minimize water resistance while moving. Therefore, speed is a very important component of physical condition in **improving the performance of swimming athletes**. Increased speed **can be achieved through** mastering effective swimming techniques, thereby reducing drag, increasing propulsion, and combining the two efficiently (Toussaint et al., 2015). In swimming, there are four styles: freestyle, breaststroke, butterfly, and backstroke (Armen & Rahmadani, 2018).

The butterfly stroke is characterized by simultaneous arm movements followed by simultaneous leg movements. This stroke is known as one of the three most challenging swimming strokes because it requires stronger arm pulls and thrusts than other swimming strokes. To successfully perform the butterfly stroke, an athlete must possess a complete set **of physical components, such as speed, strength, endurance, flexibility, coordination, and balance** (Qi et al., 2023). The dominant muscle strength used in this stroke includes the arm muscles, core muscles, and leg muscles, which play a crucial role in generating propulsion while swimming (Morais et al., 2021). Mastering the butterfly stroke requires a thorough understanding of basic techniques and the ability to integrate more complex movements. Furthermore, to improve performance while minimizing the risk of injury, aspects such as body proportions, movement coordination, breathing patterns, and the quality of technique execution need to be systematically studied and practiced (Khallaf, 2025).

Based on observations, it was found that basic athletes from the SeaRIA Aquatic swimming association still have suboptimal motor skills. This condition

occurs even though the coach has provided programmed training. In training, athletes are not only required to be able to perform swimming techniques, but also to execute them correctly, effectively, and efficiently. Various weaknesses are still visible when athletes perform the butterfly stroke, resulting in suboptimal body movements and impacting the achievement of less than optimal times. Therefore, mastering the correct and quality technique is essential for athletes to be able to maximize the effectiveness of movements and increase the efficiency of travel time in the butterfly stroke (Pinto et al., 2025). With good mastery of technique and increased swimming speed, athletes are expected to achieve optimal training results and achieve satisfactory times in competitions.

Swimming is a form of physical activity performed in a water environment and is known to provide health benefits while providing a sense of enjoyment for those who participate (Wróblewski et al., 2024). As a sport competed in the Olympics, swimming has its own appeal because it presents technical and physical challenges that can be done for both achievement and recreation (Maglischo, 2003). Swimming ability requires swimmers to be able to overcome the water resistance that arises when the body moves forward in the water (Cherevichko & Smirnov, 2025).

The butterfly stroke is known for its dynamic and aesthetic movement patterns, making it beautiful to perform. However, despite its beauty, the butterfly stroke presents a high level of technical difficulty for swimmers (Maglischo, 2018). Performing the butterfly stroke requires a combination of muscle strength and technical mastery for effective execution (Bompa & Haff, 2013). The greater a swimmer's technical mastery, the greater their contribution to improved performance and optimal achievement. The basic butterfly stroke technique encompasses several key elements: body position, arm movement, leg movement, breathing technique, and overall coordination (Shirai et al., 2025). Unlike other swimming strokes, the butterfly stroke demands more complex body movements, particularly vertical up and down strokes, which require high levels of coordination and strength (Gorbenko et al., 2025).

The method for assessing the accuracy of butterfly swimming technique using video analysis technology is a modern approach used to objectively and systematically evaluate and improve the quality of athlete technique. Through video recording, each phase of movement such as body position, arm pull and push, leg movement, breathing technique, and coordination can be observed in detail and repeatedly, so that technical errors that are difficult to see directly can be identified more accurately (Flourizel et al., 2024). The use of video analysis allows coaches and athletes to obtain effective visual feedback to improve movement efficiency and reduce water resistance (Liu & Wang, 2023). In the context of butterfly swimming, which has a high level of movement complexity, video technology is very helpful in understanding vertical movement patterns and synchronization between body segments. In addition, video-based biomechanical analysis has also been shown to improve athlete performance through more precise and data-driven technique improvements (Yu et al., 2024).

METHOD

This study employed a quantitative approach with data analysis in the form of descriptive statistics presented as percentages. The focus of the study was directed at measuring and describing the phenomena under study through objective numerical data (Sugiyono, 2016). The method used was performance assessment, utilizing an assessment sheet or format as the research instrument. The research sample was determined and a butterfly swimming skills test was conducted. The test results were recorded on video, then analyzed and scored by three competent assessors using a predetermined assessment format. The assessment data were then processed and presented in descriptive statistics with percentage calculations. This study aimed to determine the level of butterfly swimming skills mastery of basic athletes from the SeaRIA Aquatic swimming association through an analysis of technical components including body position, arm movement, leg movement, breathing technique, and overall motor coordination (Arikunto, 2013).

This study was conducted at the swimming pool (FIK UNP) from January 10–20, 2026. The research subjects were 11 basic athletes from the SeaRIA

Aquatic swimming association. A sample is a subset of a population selected to represent the characteristics of the population being studied. In this study, all members of the population served as the sample due to its relatively small size. The sampling technique used was total sampling, which involves selecting all members of the population as research subjects to obtain more comprehensive and representative data (Creswell J, 2015).

The instrument used in this study was a skills test (performance test), specifically the butterfly swimming test. Movement analysis in sports research can be defined as the process of providing objective feedback to students and instructors through various approaches, three of which utilize video recordings and quantitative data to evaluate movement quality. Based on the format or assessment sheet used, butterfly swimming skills were evaluated through five main indicators broken down into 14 assessment items. In line with the characteristics of quantitative descriptive research, the data obtained are presented according to the conditions and phenomena encountered during the fieldwork. Butterfly swimming skill levels were classified into numerical scores based on the points listed on the assessment sheet, then analyzed using percentage statistics. The final butterfly swimming skill score was determined by taking the median value from the three judges' assessments. For example, if the first judge gave a score of 2, the second judge gave a score of 2, and the third judge gave a score of 3, then the final butterfly swimming skill score obtained by the sample would be 2.

RESULT AND DISCUSSION

Body Position There are three movement sub-indicators observed in body position, each with a highest score of three and a lowest of one. Of the 11 samples studied, 7 people (67.73%) scored between 7 – 9 which is included in the good category; 2 people (22.27%) scored between 5– 6.9 which is included in the sufficient category; and 2 people scored between 3 – 4.9 (10.00%).

Arm Movement There are three movement sub-indicators observed in arm movement, each with a highest score of three and a lowest of one. Of the 11 samples studied, 4 people (32.27%) scored between 7 – 9 which is included in the good category. 7

people (67.73%) scored between 5 – 6.9 which is included in the sufficient category. and there were no students with scores between 3 – 4.9 (0.00%). Leg Movement There are three movement sub-indicators observed in leg movement, each with a highest score of three and a lowest of one. Of the 11 samples studied, 3 people (23.18%) got a score between 7 – 9 which is included in the good category. 5 people (49.55%) got a score between 5 – 6.9 which is included in the sufficient category. Meanwhile, 3 students (27.27%) got a score between 3 – 4.9 which is included in the less category. Breathing There are two movement sub-indicators observed in breathing, each with the highest score of three and the lowest one. Of the 11 samples studied, 2 people (14.09%) got a score between 4.66 – 6 which is included in the good category. 7 people (71.82%) got a score between 3.33 – 4.65 which is included in the sufficient category. Meanwhile, 2 students (14.09%) got a score between 2 – 3.32 which is included in the less category. Movement Coordination There are three movement sub-indicators observed in movement coordination, each with the highest score of three and the lowest one. Of the 11 students studied, 4 (28.18%) scored between 7 and 9, which is considered good. 5 (57.73%) scored between 5 and 6.9, which is considered adequate. 2 (14.09%) students scored between 3 and 4.9, which is considered poor.

Based on the overall assessment, the results of the butterfly swimming mastery data were obtained for each athlete. The assessment was carried out by judges with expertise in the sport of swimming using assessment forms or technology-based observation sheets from video recordings. Based on this assessment, butterfly swimming mastery scores were obtained for the sample. Of the 11 samples observed, the maximum score was 39, the minimum score was 20, the standard deviation was 3.33, and the average score was 27.41. For more clarity, see the frequency distribution table and bar histogram below:

Table 1. Frequency Distribution of Butterfly Swimming Movement Mastery Data

Class Interval (Value)	Frequency		Category
	Absolute	Relative	
34-45	2	22,27%	Very Good
22-33	7	55,46%	Good

10-21	2	22,27%	Poor
Total	11	100%	

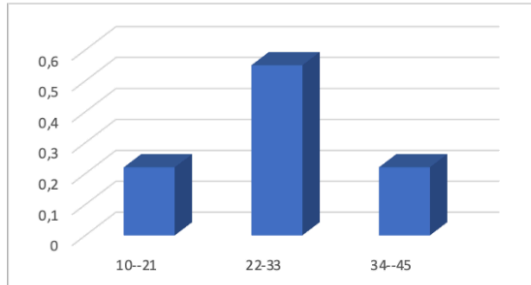


Figure 1. Histogram of Butterfly Stroke Mastery Data

Based on the table and histogram, 2 (two) people (22.27%) have mastery of butterfly swimming movements which are included in the good category with scores between 34 - 45. 7 (seven) people (55.46%) have mastery of butterfly swimming movements which are included in the sufficient category with scores between 22 - 33. 2 (one) (two) people (22.27%) have mastery of butterfly swimming movements which are included in the less category with scores between 10 - 21. The average score for mastery of butterfly swimming movements is 26.41 in the sufficient category. Based on the results of the analysis, it can be concluded that the level of mastery of butterfly swimming movements of basic athletes of the SeaRIA Aquatic swimming association is at a sufficient level.

Table 2. Summary of Data Analysis for Each Butterfly Swimming Indicator

Observed Movement	Average	Percentage Average	Levels
Body Position	6,41	64,10	Good
Arm Movement	6,23	62,30	Good
Leg Movement	5,50	55,00	Good
Breathing	4,59	46,00	Poor
Coordination	5,23	52,30	Poor
Total	27,96	279,70	
Average	5,59	55,94	

Based on the table above, the results of the data analysis show that, (1) mastery of body position indicators is 64.10% with a level of good; (2) mastery of

arm movement indicators is 62.30% with a level of good; (3) mastery of leg movement indicators is 55.00% with a level of good; (4) mastery of breathing indicators is 46.00% with a level of sufficient; and (5) mastery of movement coordination is 52.30% with a level of sufficient.

Discussion

Based on the analysis, various errors were still found in each butterfly stroke swimming movement indicator performed by basic athletes from the SeaRIA Aquatic swimming association. If this condition is not immediately corrected, optimal mastery of butterfly swimming skills will be difficult to achieve. Observations show differences in training intensity, where some rarely practice according to the training schedule, while others practice according to the training schedule. These differences in training frequency and quality impact variations in swimming skill levels. Swimming skills are strongly influenced by basic motor skills that must be mastered comprehensively, because weak mastery of basic skills can cause various obstacles, such as rapid fatigue and limitations in swimming longer distances (Badruzaman et al., 2021) (Erzhuo, 2024). Furthermore, optimal swimming performance requires a combination of good technical mastery and adequate physical condition (Sugiyanto et al., 2024) (Pinto et al., 2025). One training approach that can be applied to improve technical understanding is a learning model that emphasizes personal and social responsibility in the training process. Therefore, understanding the biomechanical principles of butterfly swimming is crucial, as a lack of understanding can lead to ineffective and imprecise swimming movements.

Limited time for swimming practice is a major obstacle to improving swimming skills. However, swimming clubs provide adequate facilities and infrastructure to support swimming practice activities. Training is defined as a planned, structured, and repetitive process aimed at improving individual ability and performance (Slopecki et al., 2024). The availability of appropriate facilities and infrastructure is a crucial factor in supporting training effectiveness and achieving optimal results. Furthermore, the success of the training process is greatly influenced by the quality of the training program, which is systematically

designed and tailored to the athlete's needs (Nicol et al., 2021). Therefore, athletes can train consistently and continuously, implement appropriate training programs, maintain physical condition, and maintain a healthy lifestyle, including a balanced diet. If these aspects are implemented properly, swimming ability improvements and the achievement of desired results can be optimally realized.

5 CONCLUSION

Based on the results of the research that has been analyzed, it can be concluded that, based on the assessment carried out by 3 (three) assessors (judgment) by taking the average of 11 samples on the butterfly swimming movement of basic athletes of the SeaRIA Aquatic swimming association, the following assessments were obtained: (1) mastery of body position indicators of 64.10% with a level of good; (2) mastery of arm movement indicators of 62.30% with a level of good; (3) mastery of leg movement indicators of 55.00% with a level of good; (4) mastery of breathing indicators of 46.00% with a level of sufficient; and (5) mastery of movement coordination of 52.30% with a level of sufficient. Thus, the research conducted on eleven (11) basic athletes of the SeaRIA Aquatic swimming association obtained the result that the butterfly swimming skill was 66.45% and was in the sufficient category.

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