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ORIGINAL RESEARCH

The effect of static and dynamic ball service training methods on seak takraw service ability reviewed based on cognitive intelligence level: Experimental study on sepak takraw athletes aged 12-15 years in Wonogiri Regency

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Abstract

The purpose of this study was to test the interaction between cognitive intelligence level and training method on basic sepak takraw service technique ability. This research method used experimental research with 2x2 factorial design. The sample consisted of 20 male athletes aged 12-15 years in Wonogiri Regency separated into 4 groups of 5 people each. The basic tennis technique skill test used advanced sepak takraw technique test and data analysis used two-way variance (ANOVA) with a significance level of 0.05. The results of the study showed that (1) there was a difference in ability between low and high cognitive intelligence groups on sepak takraw service ability. (2) static and dynamic training methods had different effects on improving sepak takraw service skills. (3) there was an interaction effect between cognitive intelligence level and training method on sepak takraw service skills. The conclusion of this study is that the dynamic training method in the high cognitive intelligence group has a greater influence when compared to the dynamic training method in the low cognitive intelligence group. Furthermore, the static training method in the high cognitive intelligence group has a greater influence when compared to the static training method in the low cognitive intelligence group. The importance of this study is personalization in sepak takraw learning and training. Coaches must consider the level of cognitive intelligence of athletes when choosing a training method (static or dynamic) to maximize training results. This can increase the effectiveness of training and accelerate the development of athletes' service abilities.

Introduction

Sepak takraw originated from a traditional game that is generally popular in Southeast Asian countries. The sport is recorded to have started in Malaysia, and therefore, it is considered a traditional Malaysian sport before it began to spread to other Southeast Asian countries. Initially, the sport was played based on rules set by the players (Saharullah & Wahyudin, 2018). The size of the field, the duration of play and the winning of a set were mostly determined by the teams involved in the game. The nature of the sport is a combination of elements of football, volleyball, basketball, badminton, gymnastics and the ancient sport of sepak raga. Due to its rapid progress and wider recognition worldwide, sepak takraw was modified into a competitive sport and included standard rules that were enforced to regulate match play. The introduction of sepak takraw at the 10th Asian Games in Beijing in 1990, and its subsequent presentation at the 1998 Commonwealth Games held in Kuala Lumpur, Malaysia, have further contributed to the increasing popularity of sepak takraw. It has been reported that the sport is one of the fastest growing in Asia, and more than 20 countries around the world including Argentina, Australia, Brazil, Canada, Korea, Germany, England, India, Japan, Puerto Rico, Spain and the United States have embraced the sport. Sepak takraw is played on an area twice the size of a

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badminton court. The court is separated by a 1.52 m high net. A team consists of three players commonly known as the feeder, 'tekong'/server and spiker or killer. The serve or kick-off is the first kick in a Sepak Takraw game which is done by a tekong into the opponent's court. Then the opposing player tries to control the ball using his feet, head and other body parts except the hands, by touching it three times alternately or by one person. A good serve is a serve that is done quickly and precisely, so that the opponent cannot anticipate, control the ball and even cannot return the ball perfectly to the opponent's court so as to get a point. Factors that influence the Sepak Takraw serve include technical, physical, tactical and mental factors. Technical factors prioritize good movement/ psychomotor processes.

Serving in sepak takraw plays a very crucial and useful role in determining the course of the game. As the initial stage of each rally, serving is not only about starting the game, but also a strategy to gain points or at least control the tempo of the match. A strong and accurate serve can put immediate pressure on the opponent, forcing them to play defensively from the start. Techniques and variations in serving, such as fast, slow, or with certain effects, can trick the receiver and create opportunities for the team to attack immediately. At the professional competition level, superior serving ability is often the difference between victory and defeat, because teams that are more consistent in delivering quality serves tend to dominate the game (Irawan et al., 2021). Therefore, intensive training and development of serving techniques are an important focus for sepak takraw players to improve the overall performance of the team. Superior serving ability in sepak takraw does not only depend on physical skills, but is also closely related to the cognitive intelligence of the players. Players must have a deep understanding of the dynamics of the game, be able to read the opponent's movements, and make the right decisions in a matter of seconds. This process involves various aspects of cognitive intelligence such as perception, attention, and problem solving. For example, players must pay attention to their opponent's position and weaknesses to decide which type of serve is most effective. In addition, they must have a strong memory to remember the opponent's playing patterns and responses from previous serves.

Cognitive intelligence also plays a role in controlling psychological pressure during a match. Players who can stay calm and focused under pressure are able to execute better serves, reducing the risk of errors that can benefit the opponent. Therefore, developing cognitive intelligence through mental training and game strategy is as important as physical training. The combination of solid service techniques and sharp cognitive intelligence makes a sepak takraw player more effective and contributes greatly to the success of his team (Jufrianis et al., 2021). To achieve this, of course, requires a level of intelligence in understanding a movement, because the cognitive aspect is the basis for achieving good psychomotor aspects. Intelligence is a variety of experiences experienced from the surrounding environment so that it produces an ability for individuals to remember something, interpret a concrete or abstract concept, understand the relationship between an event or object that exists and be able to apply it to solve a problem faced by the individual. A high cognitive level affects a person's ability to overcome problems. Short-term memory plays an important role in the entire cognitive process in influencing a person's intelligence and academic performance, as well as in Sepak Takraw. The achievement of technical mastery and playing intelligence can be obtained effectively through stages of the coaching process that are appropriate to the needs of the athlete and his age (Pizarro et al., 2019). This makes cognitive intelligence very much needed in Sepak Takraw because when serving requires quick and precise decision making to make it difficult for the opponent and get points.

In the results of the study entitled "Analysis of Double Event Number Scores in the Sepak Takraw Sport Branch (Case Study of the 2019 ASEAN School Games Final Indonesia vs Thailand) that the score from the service is 25%, the rest from other parts (Kartika & Hakim, 2020). In addition, the results of research on Sepak Takraw matches show that 24% of the points in the Sepak Takraw game are obtained from the kick-off or service. So a tekong in Sepak Takraw is required to have good service skills in order to make an initial attack, make it difficult for the opponent, and get points. Wonogiri Regency is one of the contingents that always takes part in the Provincial POPDA championship and often gets achievements, but in the last few years Wonogiri Regency has experienced a decline in terms of achievements and athletes. This is proven by the fact that athletes from Wonogiri Regency this year have not qualified for the Central Java PPLP team. Due to the regeneration and coaching of athletes that have not been optimally carried out by Wonogiri Regency, Wonogiri Regency in terms of regeneration and coaching is still lagging behind other regencies.

This result is further strengthened by direct observation through the results of observations and interviews with coaches during training in the Wonogiri Regency team, that deficiencies or weaknesses were found in a tekong. The results of the service carried out by the tekong often go out, wide of the field or are still off target and get caught in the net, thus harming the team, failure or error in serving means a loss of opportunity for the team. This is because there is no appropriate training method used to practice serving in Sepak Takraw in Wonogiri Regency. Therefore, the researcher wants to create a new training model. This training model aims to find out which training model is right/effective to improve good service results.

The training model used is a static ball service training model, for example, a hanging ball service and a target ball. This is useful for increasing ankle flexibility, developing good coordination between the feet and other body parts, maintaining body balance, increasing speed, leg muscle explosiveness and improving service ability. While the dynamic ball service training model, for example, a ball thrown at a distance that has been adjusted to train timing. This training model aims to determine which training model is appropriate/effective to improve good service results. With this research, it is expected that Wonogiri Regency has a training model, especially in terms of service that can support the abilities of athletes, especially tekong, so that it can improve the achievements of athletes in Wonogiri Regency.

Dynamic training methods are used as a variation of training for coaches and athletes in Wonogiri, especially male athletes aged 12-15 years. In addition, the cognitive intelligence level group that is used as a difference is the low and high cognitive intelligence levels to see if there is a difference in sepak takraw service ability.

Methods

This research is an experimental research with the research design used is a 2 x 2 factorial design. The research method is basically a way to obtain data with a specific purpose (Sugiyono, 2013). A factorial experiment is an experiment in which almost or all levels of a factor are combined or crossed with all levels of each other factor in the experiment.

The form of the factorial design of this study can be described in Table 1.

The population in this study was the Sepak Takraw team of Wonogiri Regency. The sample of this study used purposive sampling technique, which is a sample determination technique with certain considerations (Sugiyono, 2013). The criteria for the research sample used were junior Sepak Takraw athletes in Wonogiri district aged 12-15 years, totaling 20 students.

Table 1
A 2 x 2 factorial design.

Cognitive Intelligence Level	Training Method	
	Static Ball B_1	Dynamic Ball B_2
Low A_1	A_1B_1	A_1B_2
High A_2	A_2B_1	A_2B_2

A_1: Low Cognitive Intelligence Level; A_2: High Level of Cognitive Intelligence; B1: Static Ball Service Training Method; B2: Dynamic Ball Service Training Method; A_1B_1: Athletes with low cognitive intelligence trained using static ball service training method; A_1B_2: Athletes with low cognitive intelligence trained using dynamic ball service training method; A_2B_1: Athletes with high cognitive intelligence trained using static ball service training method; A_2B_2: Athletes with high cognitive intelligence trained using dynamic ball service training method.

The instruments and data collection in this study used cognitive intelligence and sepak takraw service skills test instruments on cognitive intelligence tests using instruments from the Digit Span Test (Turner & Ridsdale, 2004). To conduct this test, a worksheet is required that has a series of numbers of 3 to 8 digits or 3 to 10 digits for forward and 3 to 7 digits or 3 to 9 digits for backward. The researcher will show the series of numbers to the sample in stages of difficulty by adding 1 digit when going up a level. For the forward test item, the sample is required to rewrite the series of numbers from the front number to the back number in sequence. For the backward test item, the sample is required to write the series of numbers from the back number to the front number in sequence. There will be 2 opportunities in 1 level of difficulty with different series of numbers. The sample is required to continue to rewrite the series of numbers that the researcher sees until the sample makes 2 mistakes in 1 level of difficulty. If 2 mistakes occur in one level of difficulty, the researcher will end the test.

After the data is collected, data analysis techniques were carried out, namely Normality testing using Shapiro Wilk because the sample was less than 50. The two-way 2x2 analysis of variance (ANOVA) method

was used to test this hypothesis. All data were analyzed using the SPSS statistical package program and a significance level of 0.05 was accepted.

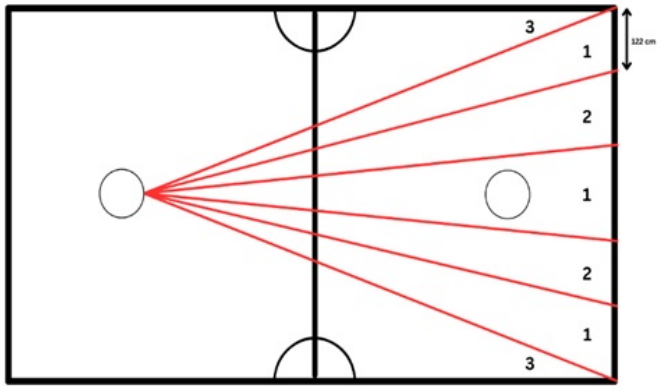

Figure 1. Placement of lines and points on the service test (Hanif et al., 2020).

Results

In this study, there are two independent variables and one dependent variable studied. The independent variables consist of attributive variables studied are (A) the level of cognitive intelligence consists of two groups, namely low cognitive intelligence level (A1) and high cognitive intelligence level (A2). Manipulative variables or treatment variables, namely training methods (B). This variable consists of two, namely static ball service training methods (B1) and dynamic ball service training methods (A2). As a dependent variable is the sepak takraw service ability (Y). The data presented include data descriptions, analysis prerequisite testing and hypothesis testing. The following is a description of the results of the initial test and the final test of sepak takraw service skills, so a histogram of the values can be made as follows.

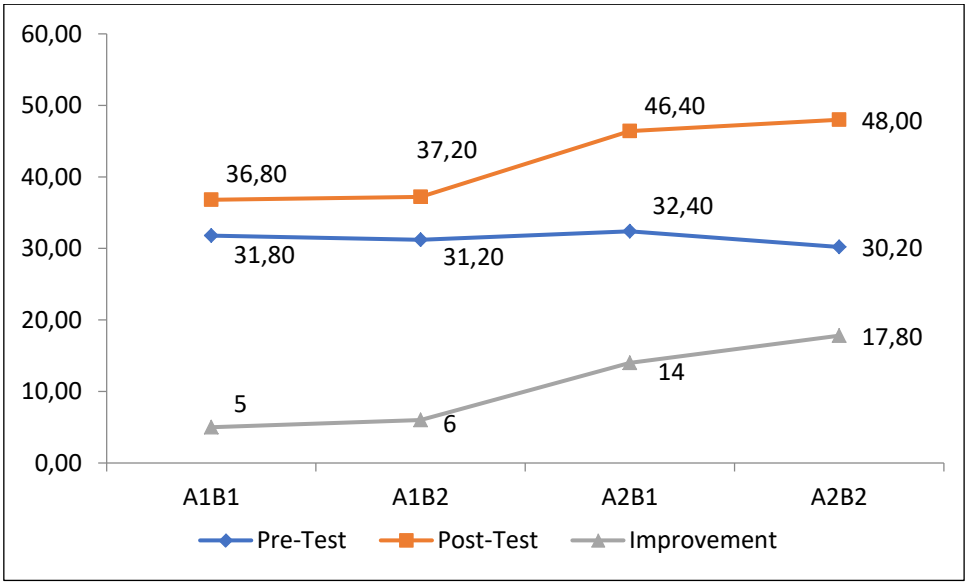

Figure 2. Average value of initial and final test results of sepak takraw service skills for each group based on cognitive intelligence level and training method.

Table 2
Average value of initial and final test results of sepak takraw service skills for each group based on cognitive intelligence level and training method.

Factor		Training Method (B)			
Cognitive Intelligence Level (A)	Level	B_1	B_2	Average	$B_2 - B_1$
	A_1	5	6	5.5	
	A_2	14	17.8	12.9	
Average		9.5	11.9		2.4
$A_2 - A_1$				7.4	-

A_1B_1: Athletes with low cognitive intelligence trained using static ball service training method.
A_1B_2: Athletes with low cognitive intelligence trained using dynamic ball service training method.
A_2B_1: Athletes with high cognitive intelligence trained using static ball service training method.
A_2B_2: Athletes with high cognitive intelligence trained using dynamic ball service training method.

Table 3
Two way Anova test results sepak takraw service skills test.

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	536.200[a]	3	178.733	68.744	.000
Intercept	2376.200	1	2376.200	913.923	.000
Cognitive	500.000	1	500.000	192.308	.000
Exercise	20.000	1	20.000	7.692	.014
Cognitive * Exercise	16.200	1	16.200	6.231	.024
Error	41.600	16	2.600		
Total	2954.000	20			
Corrected Total	577.800	19			

a. R Squared = .928 (Adjusted R Squared = .915)

If the low and high cognitive intelligence groups are compared, then the difference in the average value of sepak takraw service skills at both levels of cognitive intelligence can be seen and it is known that the high cognitive intelligence group has a value of increasing sepak takraw service skills by 7.4 higher than the low cognitive intelligence group. Static and dynamic training methods have different effects on sepak takraw service skills. If the groups that receive static training methods and dynamic training methods are compared, then it can be seen that the treatment group with the dynamic training method has a value of increasing sepak takraw service skills by 2.4 higher than the group with the static training method. Table 2 is a prerequisite test for data analysis.

The following explanation is based on the results of the Two-Way ANOVA in Table 3. (1) In testing hypothesis 1, there is a difference in ability between the low and high cognitive intelligence groups in sepak takraw service skills with a significance value of less than 0.05 (0.000 <α= 0.05), thus (Ho) is rejected and it can be concluded that there is a difference in skill between the low and high cognitive intelligence groups in sepak takraw service skills. From this analysis, it was obtained that the high cognitive intelligence level had a greater increase than the low cognitive intelligence, with an average increase of 12.9 and 5.5 respectively. (2) In testing hypothesis 2, static and dynamic training methods have different effects on improving sepak takraw service skills with a significance value of less than 0.05 (0.014 <α= 0.05), thus (Ho) is rejected and it can be concluded that there is a different effect between static and dynamic training methods on sepak takraw service skills. From the analysis, it was obtained that the dynamic training method had a greater increase than the static training method, with an average increase of 11.9 and 9.5 respectively. (3) In testing hypothesis 3, there is an interaction effect between the level of cognitive intelligence and training methods on sepak takraw service skills with a significance value of less than 0.05 (0.024 <α= 0.05), thus (Ho) is rejected and it can be concluded that there is an interaction effect between the level of cognitive intelligence and training methods on sepak takraw service skills. This is evidenced by each interaction of the level of cognitive intelligence (low & high) and training methods (static & dynamic) obtained the lowest values 5 & 6 and the highest values 14 and 17.8. To further clarify the interaction between the level of cognitive intelligence and training methods on sepak takraw service skills can be seen in Figure 3.

Discussion

Cognitive intelligence plays a crucial role in the development of service skills in sepak takraw. Cognitive intelligence refers to an individual's capacity to understand, process, and apply information effectively. It encompasses aspects such as logical thinking, problem-solving, decision-making, and memory and attention abilities, all of which are relevant in the context of technical sports skills (Agostino et al., 2023). The Digit Span Test is one of the commonly used methods to measure working memory capacity, especially in terms of a person's concentration and cognitive abilities. This test involves repeating a sequence of increasingly long numbers in sequence (forward) or reversed (backward), and the results can provide an overview of the individual's working memory capacity and ability to retain and process short-term information (Sandkühler et al., 2023). In the context of service skills in sepak takraw, the ability to concentrate and remember relevant information is essential. The Digit Span Test can be used as a tool to identify the extent to which a player's cognitive

intelligence, especially in terms of working memory and concentration, directly contributes to their service skills. In sepak takraw, serving is not just a mechanical action but also requires deep strategic thinking. To execute an effective serve, a player must be able to understand and integrate a variety of information in a short period of time. This information includes the opponent's position on the court; their movements patterns, the strength and direction of the wind, and one's own physical and mental condition (Bais et al., 2023). Players with higher cognitive intelligence tend to be better able to analyze these situations and adjust their serving technique accordingly.

The cognitive processes involved in sepak takraw serving include several stages. First, players must have a thorough knowledge of the basic techniques of serving, including body position, footwork, and ball control. This knowledge requires a conceptual understanding based on biomechanical theory, as well as repeated practice experience (Maseleno et al., 2016). Next, players must be able to access and use working memory to recall and process information in real time during the game. For example, they must remember strategies that have been practiced, as well as identify the opponent's playing patterns from previous experiences. The ability to quickly recall this information and combine it into appropriate actions is a significant indicator of cognitive intelligence (Piatysotska et al., 2024).

Cognitive intelligence is also closely related to the player's ability to plan and make decisions quickly and accurately. In the context of sepak takraw serving, this means determining the type of serve to be used, whether it is a high-speed serve to pressure the opponent or a high-accuracy serve to exploit the opponent's weaknesses. Appropriate decision-making is often based on the ability to anticipate the consequences of certain actions and choose the best option based on a quick analysis of the situation. In addition, cognitive adaptability plays a vital role in dynamic situations such as sepak takraw matches. Players must be able to adjust their serving techniques based on changes in the court situation, such as changes in the opponent's position, weather conditions, or even changes in the opponent's mood that may affect their performance. The ability to quickly adapt a serving strategy in response to these factors is a result of well-honed cognitive intelligence.

Equally important is the role of attention and concentration in serving. High cognitive intelligence is often associated with the ability to maintain a high level of focus during a match, which is essential to ensure consistent and precise service execution. Players with high levels of concentration tend to make fewer errors and are better able to exploit their opponent's weaknesses with well-targeted serves. In the long term, developing cognitive intelligence can contribute to improving serving skills through more effective learning. Cognitively intelligent players tend to have an easier time understanding technical concepts and strategies, and are quicker to learn new skills. They are also better able to critically evaluate their own performance, identify areas for improvement, and implement more effective strategies in the future (Haryanto et al., 2024). Thus, it can be concluded that cognitive intelligence has a significant impact on serving skills in sepak takraw. It not only helps in mastering basic techniques, but also allows players to make better strategic decisions, adapt to changing situations, and maintain consistent performance throughout the match. Players who develop their cognitive intelligence can be expected to achieve higher levels of serving skills and contribute more effectively to the game of sepak takraw as a whole.

The group that received the dynamic training method approach had a better improvement in sepak takraw service ability compared to the group that received the static training method approach. Service training is one of the key components in developing sepak takraw player skills, because service is not only an attack opener but can also determine the rhythm and flow of the game (Irawan et al., 2021). In this context, the dynamic service training method is often considered more effective than the static service training method in improving players' service ability. The dynamic service training method involves various variables and changing game conditions, while static service training focuses on repeating movements in fixed and controlled conditions. This fundamental difference has significant implications for the effectiveness of training and mastery of relevant service skills in real match situations (Zulkifli et al., 2019).

The dynamic service training method better reflects real match conditions because it involves variables such as player position, opponent movement, and environmental conditions that can change rapidly. In dynamic training, players are faced with situations where they must adapt and make decisions in a short time, such as modifying the power or direction of the serve based on the opponent's response. This fosters adaptive abilities that are very important in the dynamic sepak takraw game. In contrast, static service drills focus only on repeating technical movements without

contextual variability, thus lacking the ability to develop players' ability to adapt to changing situations in a match. Dynamic training emphasizes the development of complex motor skills through exposure to a variety of game situations. Players must adjust their body movements, speed, and technique according to changes occurring on the court. This training not only strengthens the muscle coordination required for serving, but also improves the player's flexibility and agility (Bais et al., 2023; Yudanto et al., 2024). This is in contrast to static training that focuses more on repetition of basic movements without much variability, which may only strengthen specific movement patterns but lack in developing the motor flexibility required in dynamic game situations. Overall, the dynamic service training method has a greater effect on serving ability in sepak takraw compared to the static service training method because it is more able to imitate real match conditions, improve decision-making ability, develop complex motor skills, and strengthen the cognitive and mental aspects of players. Thus, the dynamic approach not only improves technical ability but also prepares players holistically to face various challenges that arise during the match, making it a more effective choice for serving training in sepak takraw.

The interaction between the dynamic service training method and high cognitive intelligence levels has a more significant effect on service ability in sepak takraw compared to the static service training method group and low cognitive intelligence levels because of their mutually supportive nature. Dynamic service training involves a variety of movements and adaptive responses to changing situations, thus requiring high cognitive abilities to process information, make quick decisions, and adjust techniques according to field conditions. Individuals with high cognitive intelligence tend to be better able to process complex information, understand game strategies, and plan actions more effectively, making dynamic training an ideal method to improve their abilities. In contrast, static training methods that focus more on repeating certain movements without much variation or cognitive challenges are less supportive of skill development in a dynamic game context. For individuals with low cognitive intelligence, static service training provides challenges that are more in line with their information processing capacity, but is less effective in improving the service abilities needed in real game situations that require adaptive responses and technical flexibility. The combination of dynamic methods and high cognitive intelligence creates a stronger synergy in facilitating the development of more complex and varied service abilities (Jufrianis et al., 2021). The results of the study showed that there was an interaction between the cognitive intelligence level group and the training method on sepak takraw service ability. Those athletes in the high cognitive intelligence group using the dynamic training method had an average increase of 17.8 obtaining better results than athletes in the high cognitive intelligence group using the static training method with an average increase of 14. Then for athletes in the low cognitive intelligence group using the dynamic training method had an average increase of 6 obtaining better results than athletes in the low cognitive intelligence group using the static training method with an average increase of 5. Thus there will be interaction and it can be concluded that the effectiveness of a training method used in the training process is highly dependent on the ability and character of the athlete and paying attention to the characteristics of the game in the actual match.

Conclusion

This study shows that the increase in sepak takraw service ability obtained from the high cognitive intelligence group has a greater effect of improvement when compared to the low cognitive intelligence group. In the difference between static and dynamic training methods, it has a greater effect of improvement when compared to the static training method. In addition, the interaction effect between the cognitive intelligence level group and the training method on sepak takraw service ability was obtained. Thus, the dynamic training method in the high cognitive intelligence group has a greater effect when compared to the dynamic training method in the low cognitive intelligence group. Furthermore, the static training method in the high cognitive intelligence group has a greater effect when compared to the static training method in the low cognitive intelligence group.

The results of this study imply the importance of personalization in sepak takraw learning and training. Coaches must consider the level of cognitive intelligence of athletes when choosing a training method (static or dynamic) to maximize training results. This can increase the effectiveness of training and accelerate the development of athletes' service abilities. These findings also open up opportunities for further research to explore how other factors, such as motivation, self-confidence, and physical condition, may interact with cognitive intelligence levels and training methods to influence service ability in sepak

takraw. This research could be the basis for more comprehensive follow-up studies.

Authors' Contribution

Study Design: MD, RH, HN; Data Collection: RH; Statistical Analysis: RH; Manuscript Preparation: RH; Funds Collection: HN

Ethical Statement

The study was approved by the University of Sebelas Maret Ethical PSA No. 17 of 2021 Student Code of Ethics.

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Conflicts of Interest

The authors declare that there are no conflicts of interest related to this article.

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