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Original Article Research

Analysis of Skill Development in Throwing Placement for Indonesian National Boccia Athletes Through Structured Drill Training

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Abstract

Boccia is a sport for athletes with cerebral palsy that requires high accuracy and consistency. The ability to place the ball as close as possible to the jack is the main measure of victory. This study aims to analyse the impact of applying structured drill training methods on improving the ball placement skills of Indonesian national Boccia athletes on the left and right targets. The research method used a quasi-experimental design with a pre-test and post-test single group design and a repeated measures design. The research sample consisted of 10 elite Indonesian national Boccia athletes who were preparing for international championships. Data collection tools were carried out using a Boccia ball throwing skill test on athletes with cerebral palsy. The data were analysed using IBM SPSS Statistics 27 software with repeated ANOVA tests. The results of the tests in the subject effects table showed differences in the pre-test and post-test mean data for ball placement skills on the jack on the left and right targets, with a sig. value of $p<0.05$. These results indicate that Boccia athletes were able to place the ball on the jack accurately and consistently after the intervention. From these results, it was concluded that structured drill training was effective in improving ball placement skills on the jack in Indonesian national Boccia athletes. These findings provide practical guidance for coaches in designing periodic training programs and for future researchers to integrate psychological factors such as competition anxiety into training interventions.

Keywords: Boccia, Athletes, cerebral palsy, Drill exercises, Throwing accuracy

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1. INTRODUCTION

Boccia is a unique and challenging Paralympic sport designed specifically for athletes with severe physical disabilities, such as cerebral palsy, muscular dystrophy, or spinal cord injuries. As a precision sport, Boccia demands a high level of motor control, tactical strategy, and mental concentration. The main objective of the game is to throw coloured balls as close as possible to the jack ball (white target ball), or to move the opponent's balls away from the jack, but it also involves a deep understanding of angles, speed, and spin to perform complex manoeuvres such as blocking the opponent's path, creating favourable setups for teammates, or strategically repositioning balls. With the increasing recognition of disabled athletes' achievements on the international stage, the development and improvement of the quality of Indonesian national boccia athletes has become crucial in efforts to bring pride to the nation in various competitions, including the Paralympics and World Championships.

Boccia has experienced a steady increase in popularity and competition intensity globally, with teams from countries such as Great Britain, Brazil, and South Korea consistently dominating the medal tally. The success of these countries is largely due to the early application of sports science and dedicated long-term training programs. In Indonesia, the development of boccia as a high-potential sport is a national priority, but historically, resources and structured training methodologies have been limiting factors. National team training is often constrained by limited access to technology and a reliance on general training rather than specific, targeted training. The theoretical foundation of this research is rooted in motor learning theory, specifically the principle of deliberate practice. This concept, popularised by Young et al (2021) states that expert performance is not simply the result of innate talent, but is developed through highly structured, goal-oriented, and repetitive training sessions. Deliberate practice differs fundamentally from general practice in that it involves specific, targeted tasks designed to improve particular skills, with immediate and constructive feedback provided to the learner (Macnamara et al., 2014).

Resolving complex game situations in Boccia is a basic skill that can be repeated, such as controlling ball speed, release angle, and trajectory. Although research on motor learning in able-bodied athletes is extensive, exploring areas such as skill retention and the effects of various feedback methods, there is still a significant gap in the literature Kasper (2019) regarding the specific application of deliberate practice principles to the unique biomechanics and cognitive demands of Boccia athletes with severe physical disabilities. This highlights the need for training programs that are not only systematic but also tailored to the specific biomechanical realities of each athlete's disability. Furthermore, a meta-analysis of the relationship between deliberate practice and athletic performance found that while deliberate practice is a consistent predictor of skill at the sub-elite level, its influence diminishes among elite athletes (Macnamara et al., 2014). This suggests that for high-performance teams such as Indonesia's, training must also include other factors such as tactical decision-making and mental resilience, which are crucial differentiators at the highest levels of competition.

The Indonesian boccia team will be prepared for international boccia events, even though Indonesian National Boccia has great potential to bring pride to Indonesia on the international stage. However, initial observations and evaluations by coaches indicate significant technical obstacles, namely inconsistency in throwing accuracy, especially under competitive pressure. Several indicators that often appear in the field include (1) difficulty in controlling distance, with athletes often failing to place the ball at the right distance (too short or too far when the jack is in the long distance area) (2) variability of movement, with unstable movement automation resulting in frequent changes in throwing patterns when athletes experience fatigue or loss of focus, which directly impacts the accuracy of the throw, (3) The lack of blocking and pushing patterns during training and trial matches, Indonesian boccia athletes are often less precise in placing the blocking ball, making it easy for opponents to move it. The above inconsistency issues are very important to resolve, given that international competitions are approaching.

If weaknesses in specific training programs are not immediately addressed, athletes risk stagnating in their performance (Jayanthi et al., 2021). The training model applied in the field does not emphasise measurable training specifications, which often makes it difficult for coaches to track the detailed progress of individual athletes' throwing accuracy, making evaluation important. Non-specific training sessions or training that is adapted to actual matches, when repeated continuously, will have an impact on physical development but not on the technical substance of the actual match (Ribič et al., 2025) & (Kambitta Valappil et al., 2025). Therefore, developing a specific throwing placement skill training program is vital to enhance their competitiveness at the regional and international levels. Although the dedication of the Indonesian team is increasing, significant challenges remain in transitioning from basic training to a more advanced and data-driven approach. The current paradigm often lacks the consistent and measurable feedback required for rapid skill acquisition and refinement. Consequently, a systematic training program designed to meet these specific needs is not only beneficial but also an essential prerequisite for reaching the podium on the global stage (Makaruk et al., 2024).This study aims to provide an applicable framework for optimising training for Boccia athletes. Therefore, this research aims to analyse the effect of structured drill training on the throwing skills of Indonesian national Boccia athletes. The results of this study are expected to contribute to the development of Boccia training programs.

2. METHODS

2.1 Participants

Samples are one of the most important parts of research methodology, where the accuracy and validity of research data are determined by the research sample (Suresh et al., 2011). The sample was selected through purposive sampling, which aims to better match the sample with the objectives and targets of the research, thereby increasing the accuracy of the research and the reliability of the data and research results (Campbell et al., 2020). The sample in this study consisted of boccia athletes. From the selection process, a group of elite athletes from the Indonesian National Boccia Team was obtained, consisting of 10 athletes, 6 male athletes and 4 female athletes. The sample was classified according to international boccia competition numbers, namely BC1, BC2, BC3, and BC4, who were actively training in preparation for international boccia competitions.

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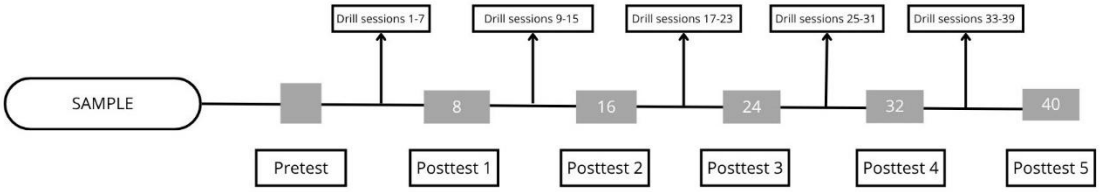
2.2 Research Design

This study is a quantitative descriptive study using a quasi-experimental model (Ranganathan & Aggarwal, 2018). The research design uses a repeated measures design. This study will use one treatment group by providing a structured drill training program with precision and accuracy materials of 3 and 5 metres. Each sample is given the same structured drill training program for 3 months and is measured six times, counting from the pretest and posttest data measurements. Repeated measurements are taken every eight meetings to see the effect of structured drill training on the throwing skills of Indonesian national boccia athletes. The following is an illustration of the pretest-posttest repeated measures design:

Figure 1.

Research Design



Explanation:

Pretest : Initial measurement of throwing skills

Post-Test (1,2,3,4,5) : repeated measurements every 8 treatments in each drill session

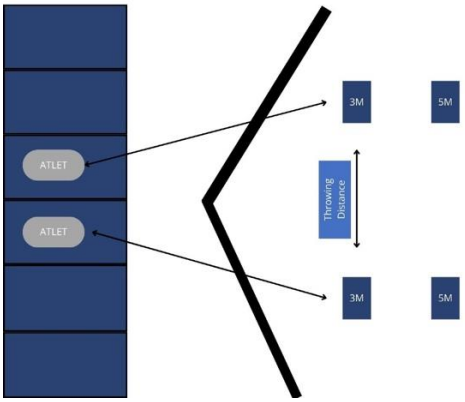
Drill sessions : Structured drill training program for 3 and 5 metres

2.3 Instruments

The instrument used in this study to obtain pretest and posttest data was a boccia ball throwing skill test for athletes with cerebral palsy, with a validity of 0.99 and reliability of 0.98 (Hambali et al., 2024).The formulation of the material was adjusted to the needs of the research test. In terms of precision and accuracy techniques for throwing skills, targets were provided at distances of 3 metres and 5 metres, as shown in the following figure:

Figure 2.

Boccia Throwing Skills Test Instrument



2.4 Procedures

This study was conducted in the city of Surakarta. The sample was given a structured drill training program involving throwing balls at distances of 3 metres to the left and right and 5 metres to the left and right targets. This was done because this technique is one of the main parts of boccia and is demonstrated by every player during a match (Hambali et al., 2024). The structured drill training consisted of preparation, execution and follow-through stages. Each athlete was given structured drill training for 3 months (January, February and March), with 16 structured drill training sessions given each month.

Pretest and posttest data collection was carried out through simulated trials with assistants. Every 8 treatments, tests were conducted to collect data on the development of left and right target throwing skills, resulting in 6 post-test measurements from pretest-posttest 1, 2, 3, 4, and 5. Data scoring was carried out by counting the number of balls that hit the target at a distance of 3 and 5 metres using 6 balls, 3 balls for a distance of 3 metres and 3 balls for a distance of 5 metres. One ball was counted as 17 points, and six balls were counted as 100 points with a data error of 0.5%. The pre-test and post-test data for each measurement will be processed and compared statistically and displayed with graph plots to determine the development of the athletes' throwing skills.

2.5 Data Analysis

Statistical analysis techniques were used to process the data from the pretest-posttest results for throwing skills. The data was analysed after being reduced from the assessment sheets to Microsoft Excel, then processed using IBM SPSS Statistics 27 software. In this study, repeated measures ANOVA data analysis was used to analyse the differences between three or more treatments. The data from the repeated measures ANOVA analysis are interpreted as follows: the residual results will be tested for normality using the Shapiro-Wilk test. If the data are normally distributed, then the prerequisite assumption of the repeated measures ANOVA test is fulfilled. Next, the homogeneity of variance (sphericity) test is performed using Mauchly's output. If the sig value is <0.05, it is concluded that the research data do not meet the sphericity variance assumption. In this case, it can be corrected using the Greenhouse-Geisser correction for the effect test. If the sphericity assumption is met, the decision is based on the assumed sphericity value in the table of tests of within-subject effects. The results of the inferential test on multivariate analysis within subject effects and between subject effects are used to see whether there are differences in the pretest and posttest 1,2,3,4,5 data with a significance level of P value 0.005.

3. RESULTS

The data in this study were obtained from pretest-posttest measurements conducted on Indonesian national boccia athletes. The measurements were taken using a boccia ball throwing skill test on athletes with cerebral palsy at distances of 3 metres and 5 metres, which was conducted five times during the period of January, February, and March. Each month, 16 structured drill exercises were provided. The complete details of the measurement results are shown in the table below:

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Table 1.

Descriptive data of pretest and posttest of 3-metre and 5-metre throwing skills tests.

Descriptive Statistics					
	Mean	Std. Deviation	Mean	Std. Deviation	N
Pretest	3.33	13.47467	3.34	15.55778	10
Posttest1	4.66	20.53831	5.16	18.51846	10
Posttest2	5.33	19.12561	5.18	16.67200	10
Posttest3	6.66	22.25209	5.33	17.36567	10
Posttest4	6.17	15.82579	5.16	16.69464	10
Posttest5	6.01	11.66619	5.67	14.12681	10
	Jarak 5 Meter		Jarak 3 Meter		

After conducting a descriptive test on the above data, a normality test was then conducted. The normality test is a prerequisite assumption in repeated measures ANOVA. The criteria used to determine whether data is normally distributed or not are as follows: if $p>0.05$ (5%), the data is considered normally distributed, and if $p<0.05$ (5%), the data is considered not normally distributed. The results of the normality test using Shapiro-Wilk are presented in the following table:

Table 2.

Results of normality tests for pretest and posttest data on left and right target throwing skills

Tests of Normality left				Tests of Normality right		
	Shapiro-Wilk			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual for Pretest	.832	10	.035	.768	10	.006
Standardized Residual for Posttest1	.920	10	.359	.854	10	.064
Standardized Residual for Posttest2	.822	10	.027	.831	10	.035
Standardized Residual for Posttest3	.917	10	.333	.894	10	.186
Standardized Residual for Posttest4	.909	10	.276	.887	10	.155
Standardized Residual for Posttest5	.781	10	.009	.891	10	.175

Based on the data in the table above, it can be seen that in the normality test results in the table above, the sig value is >0.05, which means that the pretest and posttest Throwing Placement

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Skills data are normally distributed. After conducting the normality test, to meet the requirements of the repeated measures ANOVA test as a parametric or non-parametric test, it is assumed that the measured data groups are uniform or homogeneous. The homogeneity test in this study uses Mauchly's Test of Sphericity. If the significance value p>0.05, then the sphericity assumption is fulfilled, and to determine the research objectives, the sig. sphericity assumed value can be used using Tests of Within-Subjects Effects.

Table 3.

Results of the homogeneity test of pretest and posttest data for left and right target throwing skills

Mauchly's Test of Sphericity

Measure: Score Test

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[c]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Left	.039	22.969	14	.073	.574	.872	.200
Right	.113	15.507	14	.372	.656	1.000	.200

left and right throwing skills

The value in Mauchly's Test of Sphericity table P>0.05 means that it can be concluded that the data on the accuracy of left and right target throws is homogeneous. After determining the value of Mauchly's Test of Sphericity, to answer the research hypothesis, use the sig. sphericity assumed value in the test of within subject effects table. The repeated measures ANOVA test was conducted to determine whether there were differences in the results of repeated measurements. After conducting normality and homogeneity tests on the repeated measures ANOVA results, the data used to answer the hypothesis in this study was obtained using the within-subject effects test table as follows:

Table 4.

Results of the test of within-subject effects Placement of left and right target throws

Tests of Within-Subjects Effects[a]

Measure: Score Test Throwing

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Left	Sphericity Assumed	7380.400	5	1476.080	5.996	.000	.400

Right	Sphericity Assumed	3392.733	5	678.547	2.555	.041	.221

It is known that the sig. value for sphericity assumed for the left target is 0.000, which is smaller than 0.05 (0.000<0.05), while the sig. value for sphericity assumed for the right target is 0.041 p<0.05, it can be concluded that there is a significant difference in the average throwing placement skills of the left and right targets of athletes after being given structured drill training. The graph of the average difference can be seen from the profile plot graph as follows.

Figure 2.

Graph plots of data for 5 meter left and right target throws

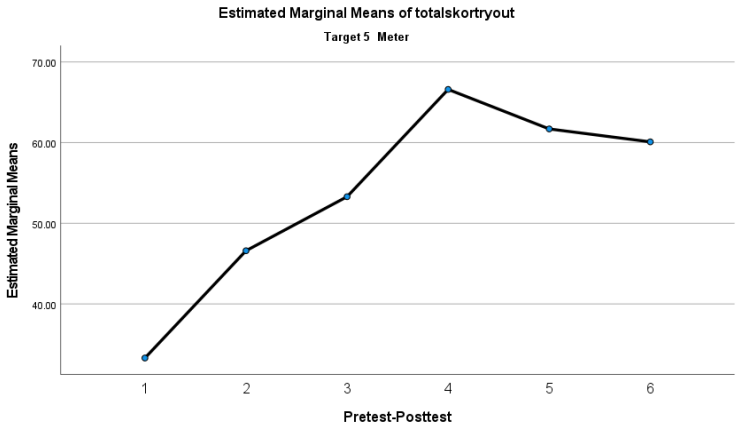
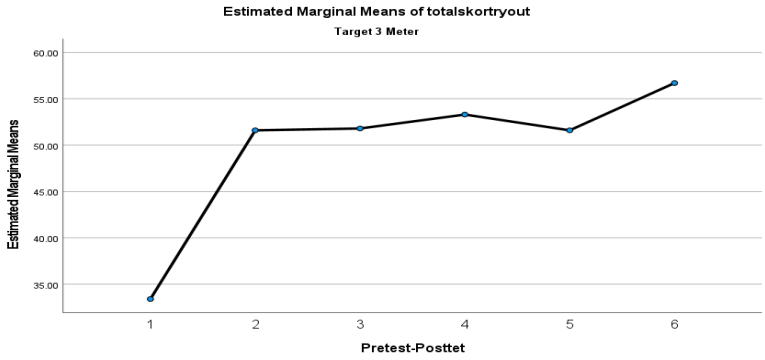


Figure 3.

Graph plots of data for 3-meter left and right target throws



4. DISCUSSIONS

Boccia is a game that requires accuracy and precision in its play. It is played by athletes with cerebral palsy, muscular dystrophy, or spinal cord injuries. The game of Boccia demands mastery of two main techniques: directional control and force modulation. In addition to these two aspects, hand-eye coordination is crucial in Boccia to achieve precise throwing accuracy (Sufitriyono et al., 2025). Technically, in Boccia competitions, players throw red or blue leather balls towards a white target ball. Points are awarded to the ball closest to the white ball (Doewes

et al., 2022). Therefore, specific training is required in each training program, such as structured drills. Structured drills are a common training pattern because they directly apply the concept of utility, where the training pattern refers to a form of exercise and physical movement that resembles the movements of an actual sport.

Structured drills are intended for match preparation or can be performed during physical training periodization, which allows the nervous system, muscles, and concentration to focus on the motor movements to be performed (Morgans et al., 2014). Structured drills only focus on repeating movements that have been determined by a program reviewed in terms of frequency, intensity, time, and type (FITT) and specifications, not referring to overload and progressive training program (Marcojos et al., 2025). The impact of structured drill training not only improves technical skills but also helps athletes hone their mental maturity and tactics in a match (Lestari et al., 2024). In research by Sosa et al (2025)training program must have distinctive characteristics in movements that must follow the physiological and biomechanical demands of each sport. This is an important aspect because training movements must be adapted to the techniques used in competition.

Structured drill training given to athletes with cerebral palsy has a positive effect on the left and right target throwing skills of Indonesian national boccia team athletes with cerebral palsy. Based on the results of the data analysis mentioned above, the results of the data calculation using IBM Software SPSS Statistics 27 with the repeated measures ANOVA test showed a difference in the average pretest and posttest data measured 5 times with a time interval of 8 meetings, with a sig. value of $p<0.05$ in the left and right target throwing placement skills of the Indonesian national boccia team athletes. The pattern of improvement in the results of the structured drill training program can be seen from the plot graphs in Figures 2 and 3. Thus, it can be concluded that structured drill training has a significant effect on improving the left and right target throwing placement skills of the Indonesian national boccia team athletes.

According to Porwal (2025) research, structured drills developed with an emphasis on technical precision in competition, posture, and resembling actual competition can improve athletes' technical components and performance. Training program for athletes without physical limitations have often found that 12 weeks of game-based training that resembles actual competition has a more positive impact than training that only focuses on the physical condition of athletes without incorporating the concept of actual competition (Mengistie & Kebede, 2024). In the results of the study by (Jeyanthi et al (2021). the benefits of structured drill training generally have specifications for the needs of the athletes being trained. The application of structured drills in the form of interventions by adapting physical conditions, motor skills, and match patterns is important to do, as this will become a habit of motor movements and physical skills for athletes with disabilities. Maximizing the performance of athletes with disabilities efficiently through training programming is an important focus for athletes. Training athletes with cerebral palsy with a regular and planned program, as in the research by Morriss & Wittmannová (2010), can improve the performance of boccia athletes.

The results of research by Yahagi et al (2024) also explain that regular interval training improves physical function and throwing distance in boccia athletes with severe cerebral palsy. This is supported by the results of research by Gill et al (2018) which found that athletes who participated in structured training adapted quickly to the training program provided. Consistent repetition training provides a unique motor perception at the central fatigue level, but continuous

repetition training can affect athlete performance in a manner similar to physical training patterns in improving physical performance (Nakashima et al., 2022). In the research conducted by Stark et al (2020) continuous repetition training, paying attention to actual movements in competition, improves motor function in individuals with cerebral palsy. In line with the results of research conducted by lotta et al (2025) structured drill training not only focuses on athletes without limitations but can also be given to people with disabilities who have motor control disorders.

5. CONCLUSIONS

Structured drills have a positive effect on the development of throwing skills in Indonesian national boccia athletes. The development of throwing skills in Indonesian national boccia athletes through structured drill training not only focuses on physical development but also mental development, precision, accuracy, and concentration when throwing, because structured drill training takes into account the usefulness of training movements and actual competition. The findings of this study indicate significant development within three months of structured drill training, which can be used as a reference in designing training program to improve the throwing skills of boccia athletes.

These findings emphasize the importance of a specific and adaptive training program approach tailored to the athlete's condition, especially for people with disabilities. The training program provided should not only focus on physical development but must also consider the athlete's technical and mental development to continuously improve their performance. Measurement and evaluation during training are also crucial to track the athlete's progress.

This research is expected to contribute to the development of knowledge about training program and the adaptation of structured drill training program to improve throwing accuracy skills, as well as providing practical implications for training program for athletes with cerebral palsy in boccia. It is hoped that these findings will increase efficiency and serve as recommendations for training program for boccia athletes to achieve peak performance and confidence in competition.

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