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Development of Boccia Sports Training Aid for People with Cerebral Palsy Disabilities Based on Bet (Boccia Equipment Tools)

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Abstract: This study aimed to develop Boccia sports training aids for athletes with cerebral palsy disabilities in the Special Capital Region of Jakarta. The research used a research and development design with the ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages. The participants involved in this study included experts in testing and measurement, disability experts, Boccia coaches, and athletes with cerebral palsy disabilities. The final product was the Boccia Equipment Tools (BET), which consisted of a Boccia ramp, ball holder, small goal, high goal, stick helmet, bowling target, and point target. Expert validation results showed that BET was highly feasible, with feasibility, effectiveness, and training applicability scores of 82%, 82%, and 81%, respectively. The effectiveness test involving 17 athletes over 16 training sessions showed a significant improvement in Boccia throwing accuracy. The mean score increased from 13.94 in the pretest to 28.05 in the posttest, and the paired sample test showed a significant difference with $p = 0.000$. These findings indicate that BET is feasible and effective for supporting Boccia training, particularly in improving throwing accuracy among athletes with cerebral palsy disabilities. Future studies should examine the durability and long-term use of BET in wider training contexts.

Keywords: Boccia; Cerebral Palsy; Boccia Equipment Tools; Training Aids; Throwing Accuracy



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INTRODUCTION

One of the most popular competitive sports among athletes with severe disabilities was boccia. It was the only team-based game available for individuals with severe disabilities in most countries. Boccia could be played by athletes with neuromuscular disorders that significantly affected their motor system, such as muscular dystrophy, Friedreich's ataxia, and multiple sclerosis (Barak et al., 2016). Boccia is a ball precision game based on strategy that has been developed for individuals with cerebral palsy (R. I. Doewes et al., 2022; Rahayu et al., 2023; Roldan et al., 2020). Individuals with cerebral palsy experience non-progressive motor disorders caused by developmental imperfections and damage to one or several parts that are responsible for controlling the brain and motor activity, especially movement so that because of this nervous control disorder, individuals tend not to have conscious and effective movement control (Raharjo et al., 2021). Boccia is a Paralympic sport for athletes with cerebral palsy and other similar conditions, such as muscular dystrophy, which causes disabilities similar to cerebral palsy (Oliviera et al., 2021). Boccia is played indoors on a hard court surface similar to a badminton court (R. Doewes et al., 2020).

The classification system consisted of four categories: BC1—athletes with cerebral palsy (CP) who had limited trunk movement and poor sitting balance but were able to throw the ball, usually overhand; BC2—athletes with CP who had better sitting balance than BC1 athletes and were usually able to pick up the ball from the floor and throw it either overhand or underhand; BC3—athletes with CP who were unable to hold and release the ball and, therefore, were allowed to use a ramp and an assistant; and BC4—athletes who had severe physical disabilities with diagnoses other than CP, such as progressive muscular dystrophy (Barak et al., 2016).

Boccia originated in Southern Europe and was played by athletes with various levels of physical disabilities, including cerebral palsy (Puma dkk., 2020). The game was initially designed for players with cerebral palsy (CP) and recently described as a target sport played with soft leather balls, which request precision and strong tactical skills (Roldan et al., 2020). Boccia is a parasport, which involves throwing coloured balls at a target ball (jack) from a seated position, consisting of a series of rounds in which players must try to place game balls (in red or blue colour) as close as possible to target ball, in white colour (Reina et al., 2018).

The boccia game started with the target ball (jack) being thrown by one of the competing players. Then, the player who threw the jack and their opponent took turns throwing red or blue balls, depending on the assigned color, to get as close as possible to the target ball and earn points. In this case, the boccia player performs a throwing technique to approach the jack ball, and points will be awarded to the player whose color ball (red/blue) is closest to the jack ball, so accuracy is needed (R. Doewes et al., 2020). Therefore, boccia required technical skills, precision, strategic planning, and mental toughness (Suchecky, 2021). Additionally, boccia activities required fitness components such as upper body strength, dynamic stability, perceptual motor awareness, and visual-motor coordination, which were essential not only for sports but also for daily functions (Barak et al., 2016).

The specific throwing techniques in boccia were unique to each player due to their specific capacities and limitations (Putra et al., 2023). However, boccia athletes had their own throwing techniques based on their physical limitations and classification categories (Kataoka et al., 2020). Training models needed to include various exercises to help athletes adapt to competing against opponents with better techniques so that their confidence and motivation were not diminished. A well-structured training model could help athletes remain confident and motivated during competitions.

Boccia players used several tools during their training, referred to as Boccia Equipment Tools (BET). The Boccia Equipment Tools (BET) were a set of tools designed to support the smooth running and conformity of the game to the established standards. Among these were the Boccia Balls, which consisted of colored balls used by each team to differentiate the competing teams. The Boccia Ramp was an assistive device used by players with physical limitations to throw the ball with the necessary precision (Romero et al., 2017). The Boccia Court consisted of a flat area divided into specific zones, including the target zone where the balls were aimed. Marking Tape was used to mark the boundaries of the court and important zones within the game. The Scoreboard and Score Indicators functioned to record and display scores clearly for both players and spectators. The Stopwatch or Timer was used to regulate the game time and limit the duration of each ball throw. Lastly, Floor Protectors were used to shield the floor from damage caused by the thrown balls during the match. Overall, these tools were designed

to ensure that the game of boccia was played fairly, safely, and in accordance with the applicable rules.

Based on field observations conducted by researchers in the first week of February, various issues were found among boccia athletes with cerebral palsy in the Special Capital Region of Jakarta. These included a lack of training equipment, inadequate training models, low interest in watching and analyzing techniques from previous matches or games they had played, and low motivation in learning the basic boccia technique of placing the ball accurately. The accuracy and quality of the ball placement technique, which was fundamental to playing boccia, were not well-developed among the athletes. Furthermore, there was a lack of training equipment since licensed equipment had to be imported from abroad at high costs.

Practicing boccia required concentration and an enjoyable atmosphere to prevent athletes from feeling bored, as monotonous coaching methods could reduce engagement. Some key factors in an athlete's success depended on their enjoyment of training, concentration levels, and enthusiasm in following instructions and training programs to the best of their ability (Knapp, 2024). Proper training equipment also played a crucial role in attracting beginner boccia players. Therefore, interesting and engaging training equipment could encourage young athletes to participate in training sessions with enthusiasm and comfort, making it easier for them to absorb technical skills taught by their coach.

Based on observations of beginner boccia athletes in Jakarta, it was found that the application of placement and breaking techniques was still not optimal, and athletes often struggled due to insufficient training equipment. Moreover, the limited equipment made training sessions repetitive and dull, leading to boredom and fatigue among the athletes. Training aids were necessary to help athletes further develop their techniques while also preventing boredom. Using varied training tools could make practice sessions more enjoyable and effective. The development of training aids needed to be prioritized domestically because most of the equipment used relied on expensive imports. Since no local manufacturers had developed boccia training equipment, researchers aimed to create locally-produced training tools at an affordable price and with easy accessibility. Additionally, this research could open opportunities for local businesses to produce

boccia training equipment domestically. Moreover, these locally made products could potentially be exported, contributing to national revenue.

METHOD

The research approach used the Research and Development (R&D) method with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) (Rusdi et al., 2022). The ADDIE model helped structure the training content systematically and had been used in the development of training procedures in various fields. The model development steps consisted of preliminary research, model development planning, as well as validation, evaluation, and revision of the model.

The preliminary research involved literature studies and field research to analyze the need for training aids for athletes with cerebral palsy disabilities. Observations were conducted on boccia games in national competitions such as Peparnas 2021 in Papua and Pepaparnas 2023 in Palembang. The model development planning was carried out through several stages: analyze (examined the need for training aids based on literature and field conditions), design (designed training aids, including training scenarios, tool designs, and training materials), development (realized the training aid products, conducted validation by experts and athletes, and revised the product based on feedback), implementation (conducted trials on a small scale with 3 athletes and on a large scale with 17 athletes to assess the effectiveness of the training aids), and evaluation (evaluation was conducted at each stage to refine the product before it was widely used).

The validation, evaluation, and revision stage involved three experts, namely two boccia coaches and one disability expert lecturer, who assessed the product based on validity, practicality, and effectiveness. The evaluation assessed the product based on economic, safety, comfort, and completeness aspects. Feedback from experts was used to improve the product before small- and large-scale trials were conducted. The research instruments included interviews in the preliminary study to analyze the needs of athletes and questionnaires to assess product quality based on the Likert scale with five response options. Data from experts and boccia coaches were analyzed to ensure that the developed training aids were effective and feasible for use in boccia training for athletes with cerebral palsy disabilities.

RESULT AND DISCUSSION

Result

Boccia Equipment Tools (BET) are equipment used in boccia sports to support the game. The final product of the development of boccia sports training aids REFERRING TO BET is to produce boccia sports training support equipment products. This development produces several variations of new basic technique training models for athletes with cerebral palsy disabilities in the boccia sport. The following is a list of the development results.



Figure 1. Boccia Ramps



Figure 2. Balls Place



Figure 3. Small Goal



Figure 4. High Goal



Figure 5. Stick helmet



Figure 6. Bowling Target



Figure 7. Poin Target

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Based on the model feasibility data collected by the researcher from each expert, which consisted of one test and measurement expert lecturer, one disability expert lecturer, and two boccia sports coaches, the feasibility test percentage results for the product, as assessed by experts, were obtained as shown in the table below:

Table 1. Product Feasibility Test Percentage Results

No	Aspect	Percentage	Description
1	Product Feasibility	88%	Could Be Used Without Revision
2	Product Effectiveness	78%	Could Be Used With Revisions
3	Training With Product	74%	Could Be Used With Revisions

From the results of this product feasibility test, the final percentage obtained for the BET tool reached 80%, which meant that the BET tool fell into the "Good" category.

The effectiveness test was used to determine whether the BET training aid had an impact before and after its use. A sample of 17 participants was given a boccia ball accuracy throwing test as an instrument and underwent training using the BET tool for 16 sessions. The test results are as follows. The pretest and posttest results for the boccia ball accuracy throwing test are presented in the table below.

Table 2. Statistical Description

No	Pretest	Posttest	No	Pretest	Posttest
1	3.00	6.83	11	2.00	3.83
2	4.17	6.50	12	2.00	3.50
3	3.17	7.17	13	1.83	3.67
4	2.67	6.50	14	1.50	3.50
5	2.33	4.17	15	1.67	3.67
6	2.17	4.17	16	1.50	3.50
7	2.17	4.00	17	3.00	7.17
8	1.83	3.50			
9	2.17	3.67			
10	2.33	4.17			
			Mean	2.32	4.68
			SD	0.65	1.38

Based on Table 2, it was found that the pretest mean was 2.32 and the posttest mean was 4.68. The standard deviation for the pretest was 0.65, while for the posttest, it was 1.38. A more detailed statistical description is presented in the appendix.

Normality testing in this study used the Shapiro-Wilk test with SPSS version 25. The results of the normality test are presented in the table below.

Table 3. Normality Test Results

Data	Sig.	Description
Pretest	0.063	Normal
Posttest	0.373	Normal

Based on the normality test results in Table 3, the pretest value of $0.063 > 0.05$ and the posttest value of $0.373 > 0.05$ indicate that the pretest and posttest results were normally distributed. A more detailed explanation is presented in the appendix.

The homogeneity test was conducted to determine whether the population variance was evenly distributed. The homogeneity test results are presented in the table below.

Table 4. Homogeneity Test Results

Data	Sig.	Description
Pretest-Posttest	0.553	Normal

Based on the homogeneity test results in Table 4, the value of $0.553 > 0.05$ indicates that the data were homogeneously distributed. A more detailed explanation is presented in the appendix.

To analyze the difference test between pretest and posttest, a paired sample test was used to examine the mean differences. The decision-making criterion was that if the t-value was greater than the t-table value and the significance value was less than 0.05, there was a significant difference. The test results are presented in the table below.

Table 5 Difference Test Results

Data	t-value	Sig.	Description
Pretest-Posttest	9.334	0.000	Significant Difference

From the test results shown in Table 5, the findings can be interpreted as follows. The t-value of 9.334 with a significance of $0.000 < 0.05$ indicates that the test results showed a significant difference.

Discussion

The process of boccia training requires training aids that can help develop techniques more effectively while also preventing boredom. Additionally, using a variety of training aids makes practice sessions more enjoyable. The researcher conducted observations at boccia training centers in Jakarta, analyzing the training process and the training aids used by coaches for ball placement, breaking, and pushing drills, which were limited to cones and balls. Ideally, training media should be utilized to create an engaging training atmosphere that enhances basic skills. However, boccia training aids are currently unavailable, and if they exist, they are expensive because they are imported. Therefore, this study focused on developing a boccia training aid called the Boccia Equipment Tool (BET).

In developing this training aid, the researcher designed a tool that specifically targets the techniques being trained, aiming to improve weak fundamental skills. The development of the Boccia Equipment Tool (BET) followed the ADDIE method, which consists of five stages: Analyze, Design, Development, Implementation, and Evaluation. The final product of this research includes several training aids: Rampa Boccia, Small Goal, High Goal, Stick Helmet, Bowling Target, Point Target, and Ball Holder. Here are the functions of the developed tools: 1) The Boccia Ramp was a launcher designed to propel the Boccia ball toward the target, allowing players to direct the ball without having to throw it directly. 2) The small goal had a smaller size and was often used to provide a greater challenge in targeting the ball to a limited area. 3) The tall goal had a larger size and a higher position, presenting a greater challenge in terms of accuracy and throwing technique. The ball had to be released more carefully to pass over the height of the goal. 4) The Boccia stick helmet was a tool used in the game of Boccia to assist players with mobility limitations, particularly those who could not throw the ball with their hands. This tool allowed players to direct the ball using a stick mounted on their helmet. 5) Bowling targets in Boccia training aimed to improve ball accuracy and control skills, as well as to train strategies and throwing techniques. 6) Circular point targets with different scores at each center could be used in Boccia practice to enhance players' accuracy and strategy skills. The center of the target had the highest score, and the farther from the center, the

lower the score given. 7) The container used to store the balls during Boccia training aimed to help players manage their balls in a more organized and efficient manner.

Based on expert assessments from four professionals—one expert in testing and measurement, one expert in disabilities, and two boccia specialists—the final evaluation of the Boccia Equipment Tool (BET) yielded the following results: BET Feasibility Factor: 82% (Highly Feasible), BET Effectiveness Factor: 82% (Highly Feasible), and Training with BET: 81% (Highly Feasible). Overall, the validation results indicate that the Boccia Equipment Tool (BET) is highly suitable for training beginner athletes.

According to the effectiveness test conducted, significant improvements were observed after 16 training sessions using BET. The initial and final tests, which involved target-based throwing assessments, produced a significance value of $0.000 < 0.05$. This result indicates that training with BET led to a notable improvement in boccia throwing tests. The pretest average throw score was 13.94, while the posttest average score increased to 28.05, reflecting an improvement of 14.118 points or 101%.

CONCLUSION

The development of the *Boccia Equipment Tool* (BET) produced seven types of training tools with an effectiveness rate of 80% based on expert evaluations. These tools were proven to be suitable for use in boccia training, especially for beginner athletes, as they improved technical skills and strategy while creating a more interactive training atmosphere. In addition, mass production of BET was expected to increase accessibility for clubs and regional teams at more affordable prices. For further development, research on the product's durability and further studies are needed to refine its design and functionality to better support the training of boccia athletes.

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