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DEVELOPMENT OF BOCCIA BALL FOR CHILDREN WITH DISABILITIES

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Abstract

The problem in this research is how to develop a boccia ball that is valid and effective for children with special needs and disabilities at SLB-D. D1 YPAC, Palembang City? The aim of this research is to find out the results of the development of boccia ball to find valid and effective children with special needs and disabilities at SLB-D. D1 YPAC, Palembang City. This research is research and development (R&D). The data collected in this research is data sourced from validators and test implementation. To analyse the data generated from the questionnaire, researchers used a quantitative percentage formula. The final product of this research is in the form of boccia ball media which is intended for training children with special needs at SLB D.D1 YPAC Palembang City in practicing and playing boccia games. The final product is packaged in a guidebook resulting from the development of the boccia ball which is equipped with a guide to the boccia game skills training program using the boccia ball resulting from the development product. The development product has the meaning of being very suitable for use because based on research results from validation media experts have a value of 100% which is very valid, and game experts have a value of 91.67% which is very valid. Meanwhile, the average validation value for boccia ball development products is 95.8%, which is very valid. Meanwhile, the average validation value for boccia ball development products is 95.8%, which is very valid. The results of the effectiveness test show that the boccia ball developed influences improving the boccia game skills of children with special needs at SLB D.D1 YPAC Palembang City. With the change in skill value before using the boccia ball, the result of the development product was 17.1 points, increasing to 24.2 points. The average increase was 7.1 points from 10 students after being given training. The use of this product can improve performance for boccia sports athletes in the city of Palembang. Helping coaches overcome deficiencies in the aspect of training facilities, namely very minimal football equipment and helping to accelerate the development of Boccia's sporting achievements in Palembang.

Keywords: Development, Boccia Ball, Disabilities

INTRODUCTION

Boccia is a paralympic sport specifically designed for individuals with severe motor impairments, such as cerebral palsy (Bhoopalan & Viswanathan, 2024). The sport not only improves motor skills but also supports the social and emotional development of children with disabilities. However, standard Boccia balls are often less suitable for children, especially in terms of weight and size, which can hinder their active participation. Research by (Fitri et al., 2022) highlighted the importance of accessibility of inclusive sports facilities

in Indonesia and Malaysia, suggesting that the availability of appropriate equipment is crucial for the participation of children with disabilities in sports. In addition, several studies have shown that social environment support (BZ et al., 2024; Darmawan, 2018; Subrata, 2023) and adequate facilities (Daulay et al., 2022) have a significant effect on the motivation to learn PJOK of junior high school students. Therefore, the development of adaptive Boccia balls tailored to the needs of children with disabilities is important to increase their participation in physical activity and support inclusive physical education.

Modified boccia games significantly enhance gross motor skills in children with intellectual disabilities by promoting coordination, balance, and manipulative movement abilities. Research indicates that engaging in modified boccia activities leads to measurable improvements in gross motor manipulative movements, as evidenced by pretest and posttest comparisons showing increased performance scores in targeted throwing tasks (Abdillah et al., 2023; Bulu Baan et al., 2023). These games provide varied movement stimuli that encourage active participation, thereby fostering muscle strength and overall physical fitness (Dzakiyyah, 2024; Fazari et al., 2023). Additionally, the inclusive nature of boccia games enhances social interaction among peers, contributing to improved self-confidence and motivation to engage in physical activities (Fazari et al., 2023; Puspitaningsari et al., 2022). Overall, the structured yet enjoyable format of modified boccia serves as an effective intervention in the physical education of children with intellectual disabilities, facilitating their gross motor development and active participation in sports (Abdillah et al., 2023; Puspitaningsari et al., 2022).

The prototyping process is crucial in the development of adaptive sports equipment for children with disabilities, as it facilitates continuous validation of design concepts and user needs. Various methodologies, such as set-based and rapid prototyping, allow designers to create and test multiple iterations of products, ensuring that they meet the specific requirements of young athletes with disabilities (Berg & Fon, 2018). For instance, a case study on developing a Paralympic shooting jacket highlighted the importance of integrating qualitative data and 3D design technologies to address the unique needs of disabled athletes (Hobbs-Murphy et al., 2024). Additionally, the use of rapid prototyping technologies, such as 3D printing, enables multidisciplinary teams to iteratively refine their designs based on user feedback, which is essential for creating functional and accessible equipment (Thomann et al., 2017). Overall, these processes not only enhance the design quality but also promote inclusivity by actively involving end-users in the development stages (Schifferle & Kollegger, 2021).

The prototyping process plays a crucial role in customizing adaptive sports equipment for children with disabilities by facilitating iterative design and user feedback. Through methodologies such as set-based and rapid prototyping, designers can create multiple iterations of equipment tailored to the specific needs of young athletes, ensuring that the final product is both functional and user-friendly (Berg & Fon, 2018). Co-design approaches, involving collaboration with stakeholders like parents and physical therapists, further enhance this process by integrating insights that promote physical activity and self-efficacy among children (Bolster et al., 2021). Additionally, the use of advanced technologies, such as 3D printing, allows for the creation of personalized devices that not only meet functional requirements but also resonate with children's interests, thereby boosting their confidence and social interactions (Hamidi, 2019; Hobbs-Murphy et al., 2024). Overall, these prototyping strategies ensure that adaptive sports equipment is effectively customized to support the unique abilities and preferences of children with disabilities.

METHOD

Research Design

This study used a Research and Development (R&D) approach adopting the Borg and Gall model, which was simplified into several main stages: (1) preliminary research and needs analysis, (2) product design, (3) product development, (4) expert validation, (5) limited testing, (6) product revision, and (7) final product testing. The goal was to develop a Boccia ball that is safe, functional, and suitable for children with disabilities.

Participants

Participants in this study included 5 special education teachers and 2 physical education experts involved in the product validation stage, 10 children with disabilities (aged 8–12 years) from a special school (SLB) who participated in the product trial, and 2 therapists who provided feedback on the functionality and safety of the product. Purposive sampling was used to select participants who had direct experience in adapted physical activity or therapy for children with disabilities.

Data Collection Instruments

Data were collected using the following instruments observation sheets to assess the functionality and safety of the product, expert validation questionnaires using a Likert scale to evaluate design, material, safety, and accessibility aspects, interviews with teachers and therapists to gain qualitative feedback, and product trial documentation (photos, videos, and field notes).

Product Development Process

Preliminary Study: Literature review and field observation were conducted to identify the needs and characteristics of Boccia balls suitable for children with disabilities.
Design and Prototype Development: A prototype of the Boccia ball was designed using soft, lightweight, and durable materials. Adjustments were made based on ergonomic aspects and sensory needs.

Table 1. Material Specs and Ball Weight

Variable	Development Aspects	Indicator	Specification	Modification
Boccia Ball	Heavy	Standard	275gr +/- 12gr	Fixed size weight
				The diameter of the circle is fixed
				Latex based material
		Burden	275gr +/- 12gr	Fixed size weight
				The diameter of the circle is fixed
				Rubber based material

Expert Validation: The prototype was evaluated by experts in physical education and special needs education.

Table 2. Instrument Grid

Variable	Aspect	Observation Indicator	Scale		
			Item	Yes	No
Boccia Ball Modifications	Tool Suitability	Heavy specs	1		
		Material spec	2		
		Circle Spec	3		
	Tool Usefulness	Objective	4,5		
		Benefit	6		
		Eligibility	7,8		
		Security	9		
		Convenience	10,11		
		Comfort	12		

Limited Trial: The product was tested on a small group of children with disabilities. Observations focused on how the children interacted with the ball, their motor responses, and enjoyment.

Revisions: The product was revised based on expert and user feedback.
Final Testing: The improved product was tested again to assess functionality and user satisfaction.

Data Analysis
Quantitative data from expert questionnaires were analyzed using descriptive statistics (mean and percentage). Qualitative data from interviews and observations were analyzed using thematic analysis to identify key issues and improvements needed in the product design.

RESULTS

The development of boccia balls for children with special needs and disabilities was carried out at SLB-D. D1 YPAC, Palembang City from 30 August to 10 October 2024. This development involved several informants and research objects. Research informants are colleagues who assist researchers in carrying out research tasks, while research objects are students who are involved in testing or implementing the results of development products in the form of boccia balls which are used when practicing boccia games. The product implementation was tested on 10 SLB D.D1 YPAC students in Palembang City. The training was carried out over 8 meetings, starting with an initial test and ending with a final test.

The development carried out by the researchers was based on the implementation of a preliminary study when the researcher's made observations where children really needed the availability of balls so that in training, they could quickly reach a degree of automatization in mastering game techniques. The results of the initial questionnaire study distributed on the need for balls in children's training at SLB-D.D1 YPAC Palembang, more than 90% really need a lot of balls to support training performance. Training without the support of ball availability is very ineffective, making it difficult to develop high quality techniques and achieve good match performance. It is very difficult for trainers to determine variations in training so that apart from being ineffective, the targets in training do not match the targets set.

South Sumatra, especially Palembang City, children with cerebral palsy are children who are active in playing boccia ball. Play both non-competitively and competitively. Meanwhile, children who are involved in competitive activities in developing boccia ball sports achievements are at one of the SLB-D.D1 YPAC Palembang schools. To help

implement achievement development training in schools, one effort that can be made is to increase the number of ball media for children's training needs. Based on researchers' observations through preliminary studies, children really need the availability of balls so that during practice they can quickly reach a degree of automatization in mastering game techniques. The specifications for ball development from boccia balls which are officially used for matches and modified as training media are expected to have the following objectives: 1) Fulfilling the expected match results, 2) Getting used to adapting to balls that have a standard weight, 3) Sufficient ball media that are lacking to practice, 4) Practicing accuracy with a ball that has a standard weight 5) Adaptation to the situation of a ball with a real circle, 6) Adaptation to the ball being made from rubber, 7) Alternative to the lack of sales of leather balls in Indonesia.

Furthermore, from the needs analysis which is equipped with the objectives to be achieved above, an initial product draft is formed which consists of a) material specifications and ball weight which are developed by taking into account the material elements and ball weight, b) preparation of a training program containing training volume, intensity training, duration of training, frequency of training where the training program is arranged based on macro cycles with daily meetings (attached). After preparing the initial draft of the boccia ball development product, the product draft was then validated and tested to determine the validity and effectiveness of the product.

The effectiveness test was carried out by testing pretest and post-test data through paired sample t test analysis with the help of the SPSS program. The Ha test criterion is accepted if the assumed value $t_{count} > t_{table}$ at α 0.05 DF N-1 (1.83). The effectiveness test results can be seen in the table below:

Table 3. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	StDev	Std. Mean	95% Confidence Lower	Upper			
Pair 1	O1 - O2	7.100	2.025	0.640	8.548	5.652	11.088	9	0.000

(Source: Researcher Document, 2024)

A paired samples t-test was conducted to examine whether there was a significant difference between the scores before (O1) and after (O2) the use of the adaptive Boccia ball for children with disabilities. As shown in Table 3, the results revealed a mean difference of 7.100, with a standard deviation of 2.025 and a standard error of the mean of 0.640. The 95% confidence interval for the mean difference ranged from 5.652 to 8.548, indicating a consistent and meaningful improvement in scores. The obtained t-value was 11.088 with 9 degrees of freedom (df), and the two-tailed significance (p-value) was 0.000. Since the p-value is less than 0.05, the difference is statistically significant. These findings indicate that the use of the adaptive Boccia ball had a positive and significant impact on the measured outcomes—such as physical activity engagement, motor skills, or participation levels—in children with disabilities.

Based on evaluation results from experts and product validity assessments, the product is then revised in accordance with suggestions from game experts and media experts. The questionnaire filled out by media experts has a percentage value of 100% which means it is very valid. This shows that the value given by media experts is perfect. However, notes conveyed verbally by media experts, the boccia ball because of the development can be revised with more detailed adjustments based on the results of the effectiveness test if the results of the effectiveness test show that there is no improvement in playing skills. On the other hand, the results of the effectiveness test showed that there was a significant increase in students' boccia playing skills. This indicates that there is no revision from media experts.

The questionnaire filled out by media experts has a percentage value of 91.67%, which means it is very valid. However, considering the advice given by game experts from the twelve statements regarding boccia ball development products, there is one statement that needs attention, namely statement number three which states that the circle of the ball adapts to the condition of the ball used for the match. The condition of the ball circle before validation and after revision is as follows:

Table 4. Game Expert Product Revisions

No	Before Revision	After Revision	Information
1	Circles with a diameter smaller than 270mm	Adapted to the diameter of a boccia match ball, namely 270mm	Fixed

Based on the table above, it is explained that the diameter of the boccia ball circle has been corrected, where before the revision the ball was designed to have a diameter below 270 mm, then revisions were made to adjust it to a diameter of 270 mm.

DISCUSSION

The development of Boccia ball for children with disabilities has shown significant benefits in enhancing motor skills, socialization, and emotional well-being. Research indicates that participation in Boccia can improve visual motor integration among children with intellectual disabilities, as evidenced by a study where participants demonstrated notable improvements in dexterity after engaging in Boccia sessions (Sood et al., 2017). Additionally, the introduction of motorized Boccia ramps has made the sport more accessible, allowing children with severe physical disabilities to participate and enjoy competitive play (Nakamura et al., 2023). Furthermore, Boccia serves as an effective tool for socialization and mental development, fostering psychological stability and emotional endurance through interactive gameplay (Stepanyuk, Garanenko, et al., 2023). Studies also highlight the importance of adaptive tools, such as steering boards, which have been shown to enhance throwing accuracy for children with Down syndrome, thereby promoting independence and skill development (Rosmiati et al., 2013). Overall, Boccia's adaptability and inclusive nature make it a valuable sport for children with disabilities, contributing to their rehabilitation and integration into society (Santos & Fouraux, 2021).

Participation in Boccia significantly enhances motor skills in children with intellectual disabilities by promoting visual motor integration, manipulative movement skills, and overall physical coordination. Studies indicate that Boccia games facilitate improved coordination between visual input and motor output, as evidenced by significant increases in visual motor integration scores following structured play sessions (Sood et al., 2017). Additionally, the manipulation of balls in Boccia exercises has been shown to enhance gross motor skills, with participants demonstrating marked improvements in throwing accuracy and coordination after engaging in modified Boccia activities (Abdillah et al., 2023; Bulu Baan et al., 2023). Furthermore, the structured nature of Boccia training programs not only strengthens physical abilities, such as muscle endurance and movement amplitude, but also fosters social interaction and engagement among participants, thereby enriching their overall developmental experience (Fazari et al., 2023; Stepanyuk, Lemeshko, et al., 2023).

Adaptive tools play a crucial role in enhancing the experience of children with disabilities in Boccia by promoting inclusivity, independence, and cognitive development. Assistive technology (AT) facilitates personalized engagement, allowing children with motor impairments to participate actively in the sport, which is essential for social integration and confidence building (Faria et al., 2019; Sheeja Vayola, 2023). The development of realistic Boccia game simulators, which incorporate features like real physics and multimodal interfaces, further enhances training conditions and user experience, making the sport more accessible and engaging (Faria et al., 2019; Ribeiro et al., 2017). Additionally, the integration of Boccia into educational settings fosters socialization among peers, while also contributing to motor skill improvement and logical reasoning development (Santos &

Fouraux, 2021). Overall, these adaptive tools not only bridge barriers to participation but also empower children with disabilities to thrive in both sports and educational environments (Oyedokun, 2024).

The development and testing of modified boccia balls for children with disabilities involve a systematic approach that integrates prototyping and tailored modifications to enhance motor skills and gameplay experience. Research indicates that modifications, such as using a steering board, significantly improve throwing accuracy in children with Down syndrome, demonstrating a marked increase in performance through iterative cycles of testing and refinement (Rosmiati, 2013). Additionally, the application of modified boccia games has been shown to positively influence gross motor manipulative movements in children with intellectual disabilities, with pretest and post-test results indicating substantial improvement in coordination and skill execution (Abdillah et al., 2023). The prototyping process is crucial in this context, as it allows for continuous validation of design concepts through various testing methodologies, ensuring that the final product meets the specific needs of the users (Berg & Fon, 2018). Overall, these studies highlight the importance of adaptive sports equipment in promoting inclusivity and enhancing the quality of life for children with disabilities.

This study has several limitations that should be considered. First, the sample size was relatively small and limited to a specific group of children with disabilities, which may affect the generalizability of the findings to broader populations or other types of disabilities. Second, the field testing of the adaptive Boccia ball was conducted over a short period and within a controlled environment, which might not fully reflect long-term usage or diverse real-world settings such as inclusive schools or community sports programs. Third, the evaluation of product effectiveness relied heavily on qualitative feedback and basic motor performance observations without incorporating more advanced biomechanical or psychological measurements. Finally, while the development followed a structured R&D approach, the study focused primarily on early-stage prototyping and initial trials; further development, iteration, and long-term testing are needed to refine the product and ensure its sustainability and scalability.

CONCLUSION

The development of a Boccia ball specifically designed for children with disabilities represents a significant step toward inclusive sports and adaptive physical education. This innovation addresses the unique needs of children with physical and motor impairments by offering a modified design that enhances accessibility, safety, and ease of use. The adapted Boccia ball not only enables children to participate more actively in sports activities but also fosters social interaction, self-confidence, and motor skill development.

Field testing and user feedback indicate that the modified ball improves playability and engagement among children with diverse abilities. This underscores the importance of inclusive sports equipment in supporting holistic child development and promoting equal opportunities in physical education. Future efforts should focus on refining the design based on ongoing feedback, expanding implementation in schools and community centers, and exploring its application in broader therapeutic and recreational contexts.

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