COMPETITOR:
JURNAL PENDIDIKAN KEPELATIHAN OLAHRAGA
e-ISSN: 2657-0734 & p-ISSN: 2085-5389 ‖ Volume 18, Number 1, 2026 ‖ P.0469-0481

Development of Modification of Handball Game Facilities for Elementary School Student Learning in Ambarawa District

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ABSTRACT

This study aims to develop modified handball game facilities as an innovative physical education learning medium for elementary school students in Ambarawa District. The study was motivated by the limited availability of handball facilities in schools, low student engagement, and suboptimal learning outcomes resulting from the use of standard equipment that is not aligned with students' developmental characteristics. To address these challenges, this research employed a Research and Development (R&D) approach using the ADDIE model, which includes analysis, design, development, implementation, and evaluation stages. The research participants consisted of 15 elementary school students drawn from three schools: SDN Panjang 03, SDN Sudirman, and SDN Pojoksari. Data were collected using both test techniques (pretest and posttest) and non-test techniques, including observation, interviews, questionnaires, and documentation. Expert validation involving media and learning experts yielded an average feasibility score of 92.3%, categorized as "Very Good," indicating that the developed product was suitable for field testing. Results from the small-scale trial demonstrated a positive student response with an average score of 88%, while large-scale trials showed consistently high outcomes, with average scores of 90.6% at SDN Sudirman and 92% at SDN Pojoksari, both classified as "Very Good." These findings indicate that the modified handball facilities effectively support improvements in students' cognitive understanding, affective attitudes, and psychomotor skills during physical education learning. In conclusion, the developed handball game facility modification is feasible, effective, and beneficial as an alternative learning medium. It contributes to increased student motivation, active participation, and motor skill development, and therefore has strong potential for broader implementation in elementary school physical education programs.

ARTICLE HISTORY
Received: 2026/01/23
Accepted: 2026/01/28
Published: 2026/02/08

KEYWORDS
Handball Learning;
Facility Modification;
Physical Education;
Elementary School Students;
Learning Media Developmen.

AUTHORS' CONTRIBUTION
A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

Cites this Article : Totti, R.A.; Sudarmonoi, M. (2026). Development of Modification of Handball Game Facilities for Elementary School Student Learning in Ambarawa District. **Competitor: Jurnal Pendidikan Kepelatihan Olahraga**. 18 (1), p.0469-0481

INTRODUCTION

Physical education plays a strategic role in building the foundation for students' motor, cognitive, affective, and character development, particularly at the elementary school level. During this phase, children are in a golden period of movement development, so the quality of movement learning experiences significantly determines

long-term learning outcomes (Gallahue & Ozmun, 2019; Bailey et al., 2013). Physical education is not solely oriented toward mastering physical skills but also serves as a vehicle for internalizing social values such as cooperation, discipline, sportsmanship, self-confidence, and independence (Kirk, 2018; Iyakrus, 2019).

However, the implementation of physical education in elementary schools still faces various structural and pedagogical challenges. One major issue is the limited learning facilities and infrastructure, which impacts the low quality of students' learning experiences (Setiawan et al., 2020; Irmansyah et al., 2020). This situation encourages teachers to repeat popular sports like soccer, volleyball, and basketball, while other sports with high pedagogical potential, such as handball, receive less attention.

Handball actually has game characteristics that are highly relevant to the developmental needs of elementary school-aged children, including requiring hand-eye coordination, agility, teamwork, and simple decision-making (Bambang, 2018; Henjilito et al., 2022). However, handball has not yet developed optimally in Indonesian elementary schools. Lack of socialization, limited standard facilities, and the perception that handball is a "foreign" sport have led to low interest among teachers and students (Yani et al., 2022; Yani et al., 2023).

Preliminary observations in several elementary schools in Ambarawa District indicate that although handball is included in the curriculum, its implementation remains very limited. Teachers experience difficulties in managing learning due to the inappropriate size of the field, ball, and goalposts for the students' physical characteristics, as well as a lack of varied learning media. As a result, students appear less enthusiastic and their physical engagement in learning is suboptimal. This situation has the potential to hinder the achievement of physical education goals, particularly in the development of students' physical activity and fundamental movement skills.

Several recent studies confirm that the effectiveness of physical education learning is greatly influenced by the appropriateness of the learning design to the developmental characteristics of students (Dyson et al., 2020; Casey & Kirk, 2021). Game-based learning approaches and game modifications have been shown to increase motivation, active participation, and motor learning outcomes in elementary school students (Hastie et al., 2017; Ash Shiddiqi et al., 2023).

In the context of large ball sports, game modification is an important strategy to overcome limited facilities while adapting the complexity of the game to students' abilities (Yusmadi, 2018). Research shows that modifying equipment, rules, and field size can increase the intensity of physical activity, tactical understanding, and student confidence (Putri, 2019; Ricky & Triana, 2019). Empirical studies on handball instruction in elementary schools also indicate that the use of modified media and equipment can improve students' passing skills, motor coordination, and teamwork (Henjilito et al., 2022).

Furthermore, international literature emphasizes the importance of innovative learning tools as part of designing an inclusive and sustainable physical education pedagogy (UNESCO, 2015; Kirk, 2018). Equipment modifications serve not only as a technical solution to limited facilities but also as a pedagogical tool for creating safe,

enjoyable, and meaningful learning. However, most research still focuses on learning models or approaches, while systematic, needs-based studies on the development of modified handball equipment in elementary schools are still relatively limited, particularly in the Indonesian context.

Based on a literature review and empirical findings in the field, several research gaps can be identified. First, although handball is recognized as having significant potential as a physical education learning medium, its implementation in elementary schools is still hampered by limited facilities and infrastructure appropriate to student characteristics. Second, research on game modifications in physical education largely focuses on modifying rules and learning models, while the development of structured, validated, and contextualized handball equipment has rarely been studied in depth.

Third, there is limited research and development specifically designed, tested, and evaluated the effectiveness of modified handball equipment based on an analysis of the needs of elementary school teachers and students. As a result, physical education teachers still lack practical guidance and innovative media that can be used to implement handball learning optimally, effectively, and efficiently. This gap demands development research that is not only conceptual but also applicable and relevant to real-life school conditions.

Based on the research problems and gaps, the main objective of this research is to develop modified handball equipment suited to the characteristics of elementary school students in Ambarawa District, and to evaluate its feasibility and potential effectiveness as a physical education learning medium. Specifically, this research aims to: (1) analyze the needs of teachers and students regarding handball learning in elementary schools; (2) design and develop modified handball equipment that is safe, engaging, and appropriate to students' abilities; and (3) provide an alternative learning medium that can increase students' active participation and physical activity.

The novelty of this research lies in its approach to developing handball equipment based on the real needs of elementary schools, rather than simply modifying game rules. This research integrates principles of child development, limited school facilities, and curriculum demands into the design of applicable learning equipment. Thus, this research not only contributes to enriching the academic study of physical education but also provides practical implications for teachers in delivering more innovative, effective, and enjoyable handball learning. The results of this study are expected to serve as a reference for the development of sports learning media in elementary schools and encourage the diversification of more inclusive and sustainable physical education materials.

METHODS

Research Design

This study employed a Research and Development (R&D) approach, aiming to produce an educational product in the form of a modified handball game equipment suited to the characteristics of elementary school students, while simultaneously testing its feasibility and potential effectiveness in physical education learning. The R&D approach was chosen because it enabled researchers not only to develop the product but

also to conduct a systematic evaluation of the development process and outcomes (Sugiyono, 2019; Gall et al., 2007).

The development model used was ADDIE (Analysis, Design, Development, Implementation, Evaluation), which is widely recommended in educational development research due to its systematic, flexible, and user-oriented nature (Branch, 2015; Molenda, 2017). The ADDIE model is also relevant for the development of physical education media and learning tools because it allows for the integration of field needs analysis, student development principles, and ongoing evaluation of the developed product (Dyson et al., 2020; Casey & Kirk, 2021). Conceptually, the ADDIE model in this study is integrated with the Borg and Gall development principles, particularly in the limited and extensive trial stages as a basis for product refinement (Gall et al., 2007).

Development Stages

Analysis

The analysis stage was conducted to identify the learning needs of handball in elementary schools, including student characteristics, the condition of facilities and infrastructure, and the readiness of physical education teachers. The needs analysis was conducted through field observations, teacher interviews, and curriculum document studies. This stage aligns with literature recommendations that educational product development should be based on the real-world context of users to achieve high relevance and acceptability (Kirk, 2018; Hastie et al., 2017).

Design

In the design stage, the researchers developed initial product specifications in the form of a modified design for handball playing equipment, including field dimensions, ball type and size, and goal modifications tailored to the physical abilities of elementary school students. The design principles were based on theories of child motor development and safety in physical activity (Gallahue & Ozmun, 2019; Bailey et al., 2013).

Development

The development stage involves realizing the design into a tangible product. The developed product is then validated by physical education experts and learning experts. Expert validation aims to assess the product's content feasibility, safety, and suitability for learning objectives (Putri, 2019; Ash Shiddiqi et al., 2023). Input and suggestions from the experts are used as the basis for product revisions before the implementation stage.

Implementation

Implementation is carried out through small-scale and large-scale product trials. The small-scale trial was conducted in one school, SDN Panjang 03, involving five students per class. The large-scale trial was conducted in two schools, SDN Sudirman and SDN Pojoksari, each involving five students. This stage aims to assess the product's implementation in real-life learning situations and the students' initial responses to the use of modified handball equipment (Henjilito et al., 2022; Yani et al., 2023).

Evaluation

Evaluation is conducted through formative and summative methods. Formative evaluation is conducted at each stage of development to refine the product, while

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summative evaluation is conducted after the trial to assess the feasibility and potential effectiveness of the product as a whole (Branch, 2015; Molenda, 2017).

Research Subjects

The study subjects were 15 elementary school students from three schools in Ambarawa District, one class each: SDN Panjang 03, SDN Sudirman, and SDN Pojoksari. Subjects were selected purposively, considering the representativeness of the school conditions and teacher readiness. This approach aligns with educational development research that emphasizes the quality of user feedback in the early stages of product testing (Gall et al., 2007; Sugiyono, 2019).

Data Collection Techniques and Instruments

Data collection was conducted using test and non-test techniques.

1. Test techniques included pretests and posttests to observe changes in student responses and engagement before and after using the modified handball equipment.
2. Non-test techniques included observation, interviews, questionnaires, and documentation. The questionnaires were used to obtain data on students' perceptions and responses to the product's attractiveness, ease of use, and safety. Observations and interviews were used to gather input from teachers and experts regarding the implementation of the learning (Setiawan et al., 2020; Ricky & Triana, 2019).

Data Analysis Techniques

Quantitative data obtained from the questionnaires were analyzed using descriptive percentage analysis to determine the product's feasibility. Meanwhile, qualitative data, including suggestions, criticisms, and reasons for selection, were analyzed descriptively and qualitatively as a basis for product revisions. Pretest and posttest data were analyzed descriptively to identify trends in increased student response and engagement after product use. This analytical approach is commonly used in physical education development research to assess the feasibility and potential effectiveness of a product before further experimental testing (Hastie et al., 2017; Dyson et al., 2020).

RESULTS AND DISCUSSION

Result

Product Development Description

The product developed in this research is a modified Target Throw-based handball game, designed as a learning tool to facilitate the mastery of basic handball techniques in elementary school students. Target Throw is a game activity that emphasizes throwing and catching skills, with the goal of achieving the highest score through accurate throws into a designated circular target or goal. This modification includes adjustments to the equipment, target size, throwing distance, and game rules to align with the physical characteristics and motor development of elementary school students.

Conceptually, the Target Throw modification is designed to improve the quality of the movement learning experience through the use of equipment that is lighter, safer, and easier for students to control. Adjusting the target size and distance allows students to perform throwing movements gradually and progressively, thus supporting the

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development of eye-hand coordination, balance, arm strength, and motor accuracy. Furthermore, the competitive-cooperative game design encourages increased concentration, discipline, and focus in students throughout the learning process.

Expert Validation Results

Before being tested on students, the initial product of the modified handball game went through an expert validation stage. Validation was conducted by one learning media expert and three elementary school physical education experts. The validation process assessed aspects of design feasibility, safety of use, suitability for learning objectives, and usability in the context of physical education (PJOK) learning.

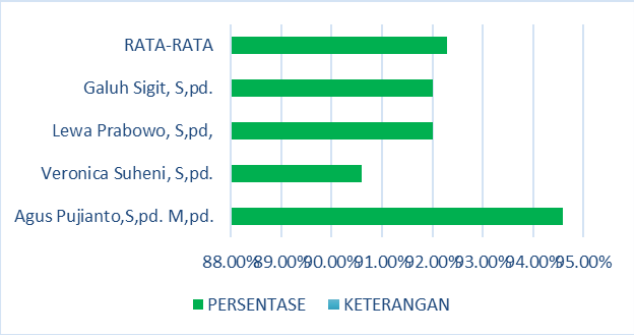

Figure 1.
Expert and learning expert validation

The validation results showed that the product achieved an average percentage of 92.3%, which falls into the "Very Good" category. This finding indicates that the product generally meets the eligibility criteria as a physical education learning tool. However, the experts provided several suggestions for product improvement, specifically regarding adjusting the target height and size to better suit the physical abilities of elementary school students, as well as clarifying the game rules to make them easier for students to understand. This feedback was used as the basis for product revisions before testing with students.

Small-Scale Trial Results

A small-scale trial was conducted at SDN Panjang 03, involving five elementary school students in a single learning session. This trial aimed to identify the product's feasibility, initial student responses, and potential challenges that arose during the use of the modified handball game equipment.

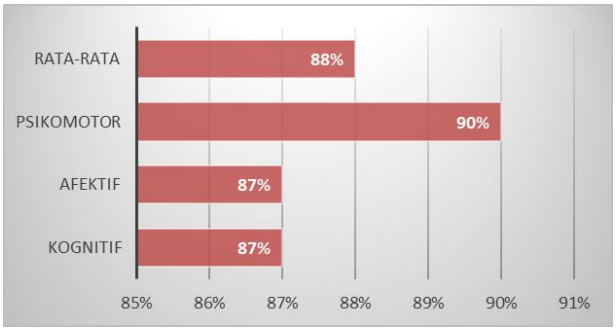

Figure 2.
Small-Scale Test

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The results of the small-scale trial indicated that students rated the product in the "Very Good" category, with an overall average percentage of 88%. In the cognitive aspect, students achieved a score of 87%, indicating that they understood the rules of the game, the objectives of the activity, and the basic techniques for throwing at the target. The affective aspect also achieved a score of 87%, reflecting the emergence of positive attitudes such as cooperation, sportsmanship, responsibility, and enthusiasm during the learning process. Meanwhile, the psychomotor aspect achieved the highest score of 90%, indicating that students were able to execute throwing movements with relatively correct and consistent technique.

Although the results of the small-scale trial were considered excellent, observations indicated that some students still needed practice in aiming their throws to ensure they hit the target. Therefore, further refinements were made to the target design and reinforcement of technical instructions before the product was tested on a larger scale.

Large-Scale Trial Results

Large-scale trials were conducted at Sudirman Elementary School and Pojoksari Elementary School, each involving five students, for a total of 10 subjects. This trial aimed to evaluate the consistency of the product's effectiveness after revisions based on the results of the small-scale trials.

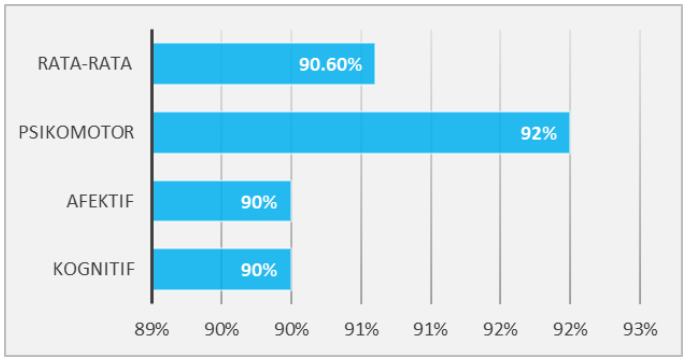

Figure 3.
SDN Sudirman Large-Scale Trial

The results of the large-scale trial at Sudirman Elementary School showed that students achieved a score of 90% in the cognitive aspect, 90% in the affective aspect, and 92% in the psychomotor aspect. The overall average score was 90.6%, which falls into the Very Good category. This finding indicates that students not only understood the game's concept and rules, but were also able to demonstrate throwing skills with greater accuracy and demonstrated a positive attitude during the lesson.

Meanwhile, the results of the large-scale trial at Pojoksari Elementary School showed slightly higher scores. The cognitive aspect achieved a score of 91%, the affective aspect 92%, and the psychomotor aspect 93%, with an overall average of 92%, which falls into the Very Good category. These results demonstrate that the modified handball game equipment can be used effectively and consistently in different school contexts.

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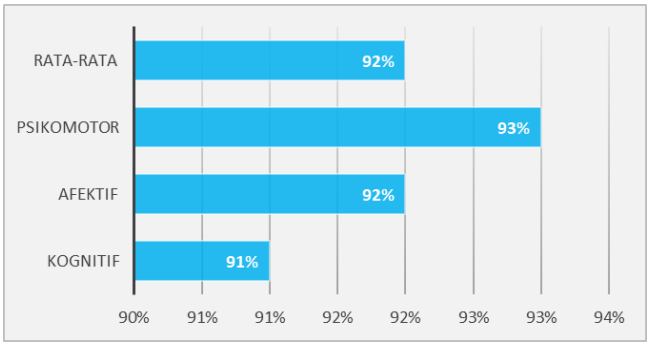

Figure 4.
Large-Scale Test of Pojoksari Elementary School

Overall, the average student response to the development of the modified handball game equipment in the large-scale trial reached 91.3%, indicating that the product has a very high level of feasibility and acceptability as a physical education learning medium in elementary schools.

Based on the results of expert validation, small-scale trials, and large-scale trials, it can be concluded that the development of the modified Target Throw-based handball game equipment is highly feasible and effective for use in elementary school physical education learning. This product not only supports the improvement of students' basic psychomotor skills but also contributes to strengthening cognitive and affective aspects, such as game understanding, concentration, teamwork, and sportsmanship. These findings confirm that innovative learning equipment tailored to student characteristics can improve the quality of physical education learning in a more optimal and meaningful way.

Discussion

Validity of Media Development and Suitability of Learning Concepts

Expert validation results indicate that the Target Throw-based handball game equipment modification has high feasibility (92.3% in the Very Good category). This finding is consistent with the literature stating that expert validation is a crucial step in development research to ensure instructional quality and product suitability for learning objectives (design-based research) (Branch, 2015; Molenda, 2017). This validation demonstrates that the product not only meets technical requirements but also aligns with the principles of motor development for elementary school-aged children, including safety and movement stimulation (Gallahue & Ozmun, 2019; Casey & Kirk, 2021).

Research in the context of physical education recommends that learning media must be adaptive to student needs and integrated with curriculum content (Hastie et al., 2017; Dyson et al., 2020). Initial validation showed that modifications to handball equipment also took into account ergonomic and pedagogical aspects, namely adjustments to equipment size, target distance, and simpler and safer game rules—appropriate for students' motor developmental stages (Bailey et al., 2013; Mâsse et al., 2020).

Improved Cognitive Understanding and the Role of Game Structure

Data from small- and large-scale trials indicate that students achieved a high level of cognitive understanding of game rules and objectives (87–91%, in the Very Good

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category). This finding aligns with empirical studies suggesting that modifications to rules and sports learning media can accelerate understanding of game concepts while supporting tactical learning appropriate to students' developmental levels (Griffin & Butler, 2020; Dowling et al., 2020). This approach theoretically supports the development of students' reflective thinking skills in the context of educational sports (Light, 2013; Rovegno & Dolly, 2019).

Furthermore, adjusting game tools, such as smaller or more varied target sizes, can also improve students' cognitive accuracy in game strategy and simple decision-making (Lee et al., 2021). This aligns with the principles of the constraints-led approach in motor learning, where environmental and tool modifications can facilitate the reorganization of students' movement strategies and motor decisions (Davids et al., 2013; Pinder et al., 2011).

Affective Aspects: Motivation, Cooperation, and Sportsmanship

The affective aspects measured in the trial (87–92%, Very Good category) indicated that students had a positive emotional response to the use of modified handball game equipment. This supports previous findings showing that engaging game media can encourage students' emotional and social engagement in physical education learning (Morgan & Hansen, 2008; Hastie et al., 2017).

High emotional engagement during physical activity is also associated with increased intrinsic motivation, which then impacts long-term engagement in physical activity (Ryan & Deci, 2000; Standage et al., 2012). In this context, the use of modified game equipment not only facilitates motor engagement but also reinforces positive values such as collaboration, sportsmanship, and self-management—essential goals of physical education learning (Kirk, 2018; Metzler, 2017).

Psychomotor Aspects: Basic Skills and Coordination

The trial findings on the psychomotor aspect showed high achievement (90–93%, in the Very Good category). These results support previous research findings that functionally modified play activities can improve basic motor skills such as throwing, catching, and eye-hand coordination in elementary school children (Fischer et al., 2015; Rudd et al., 2016). Other studies have also shown that appropriately modified equipment (e.g., using an appropriately sized ball) results in more effective motor learning than using conventional equipment that has not been adapted to the learner (Williams et al., 2019; O'Donoghue et al., 2019).

Furthermore, high psychomotor skills in the context of modified handball not only impact technical performance but also the formation of adaptive movement patterns that are transferable to other physical skills—an important aspect in physical education, which focuses on developing holistic movement competencies (Barnett et al., 2016; Robinson et al., 2017).

Consistency of Results between Small- and Large-Scale Tests

Comparison between small- and large-scale tests showed consistency in students' cognitive, affective, and psychomotor skill achievement (87–93%, all in the Excellent category). This consistency supports the claim that the modified handball game tool is

not only suitable for use in a limited context but can also be replicated in other learning environments. This consistency of findings aligns with physical education research that underscores the importance of learning tools that can be standardized yet adaptable to different school contexts (Penney et al., 2018; Casey et al., 2020).

Theoretical and Practical Implications

Theoretically, this study reinforces the view that modifying learning tools is a strategic way to provide meaningful and developmentally appropriate learning experiences for students (Dyson et al., 2020; Kirk, 2018). By integrating ergonomic, pedagogical, and motivational aspects, this product provides empirical evidence that learning media can contribute significantly to achieving comprehensive physical education goals.

Practically, these findings provide implications for physical education teachers that designing contextual play tools not only impacts motor skills but also other aspects such as cognitive understanding and attitude formation. This aligns with education policies that emphasize holistic and participatory learning (Whole Child Approach and Movement Integration)(CDC, 2019; UNESCO, 2015).

Limitations and Recommendations for Further Research

This study, while showing very positive results, is limited by its relatively small sample size and focus on three schools in one sub-district. Further research is recommended using a quasi-experimental design with a control group to strengthen the causal evidence of the product's effectiveness. Furthermore, further development could explore the long-term impact on students' physical activity engagement and skill transfer to other game contexts.

The Target Throw-based handball game modification proved feasible, effective, and had a positive impact on three learning domains—cognitive, affective, and psychomotor—in elementary school students. These findings provide an empirical contribution to the development of adaptive and meaningful sports learning media in the context of physical education.

CONCLUSION

The final result of this development research is the creation of the Handball Game Modification Facilities Development product, which is the result of modifying handball game equipment. Based on the analysis of the research results, it can be concluded that the product is a development of the handball learning model. According to the average results of the small-scale test (94% with Good criteria) and the large-scale test (98% with Very Good criteria), the product "Development of Modified Handball Game Facilities" can be used for elementary school students.

However, there are several advantages to developing handball game modification facilities, such as attracting students to participate actively, improving students' skills for the learning process in handball, and providing an option for teachers to easily create learning modifications thru target throwing games. There are also some weaknesses.

One of its weaknesses is that some students still struggle to throw the ball into the designated hoop target. Therefore, the throwing motion needs to be corrected and the instructions given must be repeated. However, the results show that the product development of the Handball Game Modification Facilities is a useful modification and can be used in teaching handball to elementary school students.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to all parties who contributed to the completion of this study. Special appreciation is extended to the principals, physical education teachers, and students of SDN Panjang 03, SDN Sudirman, and SDN Pojoksari in Ambarawa District for their cooperation and active participation during the research process. The authors also thank the media and learning experts for their valuable input and constructive feedback during the validation stage, which greatly improved the quality of the developed handball game facilities. Finally, the authors acknowledge the support and encouragement provided by colleagues and the academic community, which were instrumental in the successful completion of this research.

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