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DEVELOPING PHYSICAL ACTIVITY-BASED ULAR TANGGA RAHASIA LEARNING MEDIA TO ENHANCE EARLY CHILDHOOD GROSS MOTOR SKILLS

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Abstract

This study aimed to develop a physical activity-based Ular Tangga Rahasia media to improve early childhood gross motor skills. This research employed a Research and Development (R&D) method using the 4D development model consisting of define, design, develop, and disseminate stages. The research subjects consisted of 30 children aged 5–6 years. Data collection instruments included expert validation sheets, teacher response questionnaires, observation sheets, and children's gross motor skill tests. Data were analyzed using descriptive quantitative analysis and paired sample t-test. The results showed that the developed media had a very high level of validity, with an average score of 90% from media experts, 92% from material experts, and 93.5% from language experts. The practicality test results obtained an average score of 93% categorized as very practical. In the effectiveness test, the average gross motor skill score increased from 61.6 in the pretest to 86.3 in the posttest, with an improvement of 24.7 points. The paired sample t-test results showed a significance value of 0.000 (<0.05), indicating that the media effectively improves early childhood gross motor skills. Improvements were observed in balance, coordination, agility, strength, and locomotor movement indicators. Therefore, the physical activity-based Ular Tangga Rahasia media is considered valid, practical, and effective and can be used as an innovative learning media to improve early childhood gross motor skills.

INTRDUCTION

Gross motor development is a crucial aspect of early childhood growth because it is directly related to children's ability to perform physical activities such as running, jumping, kicking, and maintaining body balance. These abilities not only contribute to physical health but also support children's cognitive, social, and emotional development. Recent studies indicate that structured physical activity stimulation has a significant influence on improving gross motor skills in preschool children. A study conducted by Ren et al. (2025) found that a 12-week structured physical activity program significantly improved children's gross motor development compared to regular activities. The results showed that children who received systematically designed physical activity interventions demonstrated better movement coordination, balance, and body strength than those in the control group. These findings emphasize that physical activity based learning is essential in early childhood education.

Furthermore, Wang & Zhou (2024) through a recent meta-analysis, reported that training focused on motor development has a greater impact on improving gross motor skills compared to general physical activity. The findings indicate that physical activities specifically designed to train fundamental movement skills are more effective in improving children's locomotor and non-locomotor abilities. Other studies also reveal that children's involvement in physical activity from an early age plays an important role in shaping optimal motor development patterns. James et al. (2024) found that consistent physical activity in early childhood is positively correlated with motor skill development, particularly when supported by an active and participatory learning environment. This suggests that learning

activities providing opportunities for active movement should become an integral part of kindergarten instruction.

Learning interventions focusing on fundamental movement skills have also been proven effective in improving children's gross motor abilities. Roscoe et al. (2024) demonstrated that a fundamental movement skills intervention program for children aged 4–5 years significantly improved balance, coordination, and agility. These findings were reinforced by Sheng et al. (2024), who reported that structured training focused on gross motor skills significantly enhanced physical fitness and movement abilities in children aged 4–5 years. These findings highlight the importance of integrating structured physical activity into early childhood learning to support gross motor development.

The relationship between physical activity and fundamental movement skill development is also influenced by the learning environment. Spring et al. (2023) found that children with higher levels of physical activity demonstrated better fundamental movement skill development than those with lower activity levels. A longitudinal study by Palmer et al., (2025)further revealed that motor development in children aged 3–5 years significantly improved when they were consistently given opportunities to engage in movement activities during learning. These findings indicate that learning environments that provide opportunities for movement exploration are important factors in enhancing gross motor development.

Play-based learning approaches also represent an effective strategy for improving gross motor skills in early childhood. Grady et al. (2025), through a systematic review and meta-analysis, reported that physical activity based interventions in early childhood education significantly improve children's physical activity levels, fundamental movement skills, and socioemotional development. This suggests that play-based learning involving physical activity can serve as an effective alternative for improving gross motor skills. Additionally, Barratt et al. (2025) emphasized that physical literacy in early childhood can develop optimally through pedagogical approaches that integrate movement activities into learning. Therefore, learning designed in the form of active play becomes essential for implementation in kindergarten settings.

However, preliminary observations conducted at Raudlatul Jannah Kindergarten and Soda Mutiara Kindergarten indicated that children's gross motor development was still not optimal. Learning activities were predominantly focused on seated tasks and worksheets rather than physical movement activities. In addition, the instructional media used by teachers were limited and not specifically designed to stimulate active movement. This condition resulted in children having limited opportunities to develop coordination, balance, and agility. Okilanda et al. (2025) reported that fun game-based gross motor learning significantly improved movement coordination among children aged 5–6 years. This finding suggests that active play can serve as an effective solution for improving gross motor development.

Previous studies also indicate that engaging learning media can increase children's participation in learning activities. Sartika & Alimudin (2025) explained that innovative learning media enhance children's engagement in the learning process, which in turn improves developmental abilities. Additionally, Adilah et al. (2024) stated that systematically designed educational learning can optimize gross motor development in early childhood.

Therefore, it is necessary to develop innovative learning media that encourage children to move actively and participate in learning activities.

Besides the limited media, gross motor learning in kindergarten has not maximally utilized educational games. In fact, educational games designed based on physical activity can provide enjoyable learning experiences while improving children's gross motor skills. Adistiarachma & Purwati (2022) stated that innovation in early childhood education should be implemented by developing attractive, interactive media that align with children's developmental characteristics. Therefore, the development of game based learning media is important to support more effective learning processes.

Based on these problems, it is necessary to develop innovative learning media capable of increasing children's physical activity while training gross motor skills. One of the media that can be developed is the "Ular Tangga Rahasia" physical activity based learning media. This media is designed as a large board game integrating various movement activities such as jumping, balancing, running, and body coordination. Through this game, children not only learn in an enjoyable way but also directly engage in physical activities that improve gross motor skills. The development of the "Ular Tangga Rahasia" media is expected to provide an innovative, engaging, and effective learning alternative to enhance gross motor skills of early childhood students at Raudlatul Jannah Kindergarten and Soda Mutiara Kindergarten. Therefore, this study aims to develop physical activity based "Ular Tangga Rahasia" media to improve gross motor skills in early childhood.

METHODS

This study employed a quantitative approach using research and development (R&D) to produce a physical activity-based "Ular Tangga Rahasia" learning media aimed at improving early childhood gross motor skills. The study also employed a one-group pretest–posttest design to measure the effectiveness of the developed media. The development model used was the 4D model consisting of four stages: define, design, develop, and disseminate. This model was selected because it is systematic and appropriate for developing learning products that are valid, practical, and effective in early childhood education contexts (Mulyatiningsih, 2019; Thiagarajan et al., 1974). In addition, the development procedure followed the research and development concept emphasizing gradual validation and product testing (Sugiyono, 2019).

The study was conducted at Raudlatul Jannah Kindergarten and Soda Mutiara Kindergarten, involving children aged 5–6 years as research subjects. The population consisted of all Group B students from both institutions. The sampling technique used purposive sampling based on age criteria (5–6 years) and active participation in learning activities. The total sample consisted of 30 children, divided into two stages: a limited trial involving 10 children and a field trial involving 20 children. Ethical considerations were implemented by obtaining formal approval from both schools, and all participants' identities were kept confidential throughout the research process.

Research data were collected through observation, expert validation questionnaires, and documentation. The instruments used in this study consisted of: (1) media validation sheets, (2) material validation sheets, (3) gross motor skill observation sheets, and (4) teacher response questionnaires. The validation process involved media experts and material experts to assess the feasibility of the developed product prior to field implementation. The validation

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results were quantified using a Likert scale and converted into percentage scores to determine the validity level of the media.

The gross motor skill observation instrument measured five indicators, namely: balance, coordination, agility, strength, and locomotor skills (running, jumping, and crawling). Each indicator was assessed using a structured observation rubric with a scoring scale ranging from low to high performance levels. These measurements were conducted twice, namely during the pretest (before implementation) and posttest (after implementation), in accordance with the one-group pretest–posttest design.

Data collection procedures followed the stages of the 4D development model. The define stage included needs analysis, learner characteristics analysis, and curriculum analysis. The design stage involved designing the "Ular Tangga Rahasia" learning media and preparing activity components. The develop stage included expert validation and limited trials to assess the feasibility and practicality of the media. The disseminate stage involved field trials to implement the media in learning activities at both kindergartens. This procedure aligns with systematic instructional design principles in educational product development (Branch, 2020; Plomp & Nieveen, 2020).

Data analysis was conducted using both descriptive and inferential statistical techniques. Descriptive analysis was used to calculate the percentage of expert validation results and teacher responses, which were then categorized into validity and practicality levels. The effectiveness of the media was analyzed using a paired sample t-test to compare pretest and posttest scores. The significance level was set at $\alpha = 0.05$. In addition, the improvement in gross motor skills was calculated using the mean gain score between pretest and posttest results.

RESULT AND DISCUSSION

RESULT

This study employed the 4D development model consisting of define, design, develop, and disseminate stages. In the initial phase, the research results focused on needs analysis and the design of the physical activity-based "Ular Tangga Rahasia" media to improve early childhood gross motor skills.

1. Define Stage

The needs analysis was conducted through observations, teacher interviews, and documentation of learning activities at Raudlatul Jannah Kindergarten and Soda Mutiara Kindergarten. The observation results indicated that the gross motor skills of children aged 5–6 years were not yet optimal, particularly in jumping, balance, coordination, and agility activities. Gross motor learning was still limited to routine activities, resulting in low levels of active movement among children. Teachers also reported that structured and engaging physical activity-based game media were not yet available.

Table 1. Results of Gross Motor Needs Analysis

Indicator	Optimal	Not Optimal
Two-foot jumping	9	21
Balance	8	22
Coordination	10	20
Agility	11	19

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Indicator	Optimal	Not Optimal
Directed running	12	18

These results indicate that more than 60% of children still require gross motor stimulation through structured physical activity.

2. Design Stage

The "Ular Tangga Rahasia" media was designed in the form of a large game board measuring 3 × 2 meters, allowing children to move directly within the game squares. The media was equipped with physical activity cards, foam dice, and usage guidelines. Each square contained gross motor activities such as jumping, balance walking, zig-zag jumping, crawling, and short-distance running.

Table 2. Media Specifications

Component	Description
Board size	3 × 2 meters
Number of squares	25 squares
Activity cards	30 cards
Users	Children aged 5–6 years
Duration	20–30 minutes

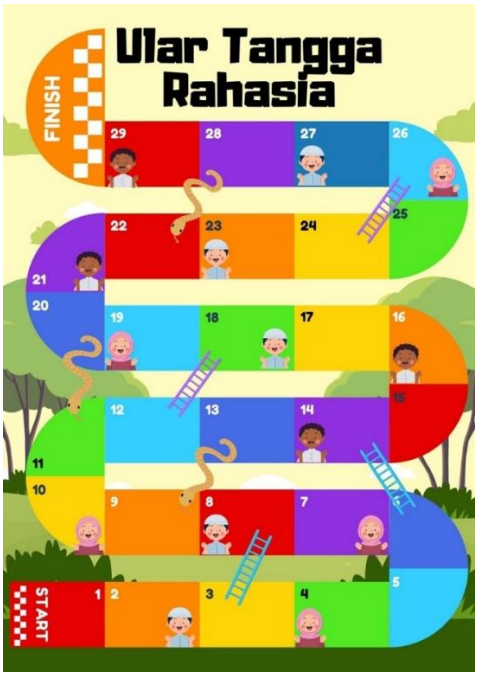

Figure 1. Ular Tangga Rahasia Game Board Design

Figure 1 illustrates the design of the "Ular Tangga Rahasia" board, displaying a colorful game board with activity squares, ladders, and snakes directing children to perform gross motor movements. Figure 2 presents the physical activity cards containing movement instructions such as two-foot jumping, balance walking, crawling, and catching and throwing a ball.

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Figure 2. Ular Tangga Rahasia Physical Activity Cards

The media was designed to encourage active movement, collaborative play, and structured gross motor stimulation. The results of the design stage indicated that the media was aligned with early childhood characteristics and gross motor development indicators prior to expert validation in the develop stage.

3. Develop Stage (Expert Validation)

The develop stage aimed to determine the feasibility of the physical activity-based "Ular Tangga Rahasia" media through validation by media experts, material experts, and language experts before field testing.

A. Media Expert Validation

Table 3. Media Expert Validation Results

Aspect	Max Score	Obtained Score	Percentage	Category
Appearance	20	18	90%	Very Valid
Attractiveness	20	19	95%	Very Valid
Practicality	20	17	85%	Very Valid
Safety	20	18	90%	Very Valid
Rule clarity	20	18	90%	Very Valid
Average			90%	Very Valid

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Table 3 shows that the media expert validation obtained an average score of 90% categorized as very valid. The attractiveness aspect received the highest score of 95%, indicating that the media design was appealing for early childhood learners. The appearance, safety, and rule clarity aspects each obtained 90%, indicating that the media was easy to use and safe. The practicality aspect obtained 85%, suggesting that the media was easy to use but required minor revisions related to font size and color. Overall, the media was considered feasible with minor revisions.

B. Material Expert Validation

Table 4. Material Expert Validation Results

Aspect	Percentage
Suitability with motor indicators	92%
Suitability with child development	94%
Suitability of physical activities	90%
Suitability with learning objectives	93%
Activity implementation	91%
Average	92%

Table 4 indicates that the material expert validation obtained an average score of 92% categorized as very valid. The suitability with child development aspect obtained the highest score of 94%, indicating that the activities matched early childhood characteristics. The suitability with motor indicators scored 92%, demonstrating that the media covered balance, coordination, agility, and locomotor skills. These results indicate that the media is appropriate for improving children's gross motor skills.

C. Language Expert Validation

Table 5. Language Expert Validation Results

Aspect	Percentage
Instruction clarity	95%
Language simplicity	93%
Age appropriateness	92%
Communicativeness	94%
Average	93.5%

Table 5 shows that language expert validation obtained an average score of 93.5% categorized as very valid. The instruction clarity aspect achieved the highest score of 95%, indicating that the instructions were easy to understand. The communicative aspect scored 94%, showing that the language used was simple and interactive. Overall, the media was declared feasible without major revisions and ready for field testing.

4. Limited Trial

The limited trial was conducted with 10 children at Raudlatul Jannah Kindergarten to determine the practicality level of the "Ular Tangga Rahasia" media before the field trial. The assessed aspects included children's interest, physical activity, rule comprehension, and ease of use by teachers.

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Table 6. Limited Trial Practicality Results

Aspect	Percentage
Children interested in playing	95%
Children actively moving	93%
Children understand the rules	90%
Teacher ease of use	94%
Average	93%

Table 6 shows that the limited trial obtained an average score of 93% categorized as very practical. The children's interest aspect obtained the highest score of 95%, indicating that the media attracted children's attention. The physical activity aspect obtained 93%, showing that children were actively involved during the game. Furthermore, rule comprehension obtained 90%, indicating that the instructions were easy to understand. These results indicate that the "Ular Tangga Rahasia" media is practical for use in learning activities.

5. Field Trial

The field trial was conducted in two institutions: Raudlatul Jannah Kindergarten involving 15 children and Soda Mutiara Kindergarten involving 15 children, with a total sample of 30 children. The assessment of gross motor skills included indicators of balance, coordination, agility, strength, and locomotor skills. Measurements were conducted through pretest and posttest after the implementation of the media.

6. Effectiveness Test Results

Table 7. Gross Motor Pretest and Posttest Results

School	Pretest	Posttest	Gain
TK Raudlatul Jannah	62.4	86.7	24.3
TK Soda Mutiara	60.8	85.9	25.1
Average	61.6	86.3	24.7

Table 7 presents the pretest and posttest scores of gross motor skills in both schools. The average pretest score was 61.6, while the posttest score increased to 86.3, with a gain score of 24.7.

7. Statistical Test

Statistical testing was conducted using a paired sample t-test to determine differences before and after using the media.

Table 8. Paired Sample t-test Results

Variable	Mean	SD	t-value	Sig
Pretest	61.6	6.2		
Posttest	86.3	5.4	14.82	0.000

Table 8 shows that the significance value is 0.000 < 0.05, indicating a significant difference between pretest and posttest scores. The paired sample t-test results show a t-value of 14.82 with a significance value of 0.000 (<0.05), indicating a statistically significant difference between pretest and posttest scores.

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8. Improvement of Each Gross Motor Indicator

Table 9. Improvement of Motor Skill Indicators

Indicator	Pretest	Posttest	Improvement
Balance	60	85	25
Coordination	62	88	26
Agility	59	84	25
Strength	63	87	24
Locomotor	64	88	24

Table 9 shows that all gross motor indicators experienced improvement. The highest improvement occurred in coordination with an increase of 26 points, while the lowest improvement occurred in strength and locomotor indicators with an increase of 24 points. The average validation score obtained was 92%, categorized as very valid.

9. Teacher Responses to the Media

Table 10. Teacher Responses to the Media

Aspect	Percentage
Easy to use	96%
Interesting	95%
Increases physical activity	97%
Supports learning	94%
Average	95.5%

Table 10 presents teacher responses to the media. The average score obtained was 95.5%. The highest percentage was found in the "increases physical activity" aspect at 97%, followed by "easy to use" at 96%, "interesting" at 95%, and "supports learning" at 94%

DISCUSSION

The findings of this study demonstrate that the physical activity-based Ular Tangga Rahasia media has high levels of validity, practicality, and effectiveness in improving early childhood gross motor skills. The increase in gross motor scores suggests that integrating structured physical activities into game-based learning creates an active learning environment that supports children's movement engagement. Similar patterns have been reported in studies showing that structured physical activity interventions contribute significantly to motor development in early childhood (Ren et al., 2025; Wang & Zhou, 2024).

From a pedagogical perspective, the effectiveness of this media can be explained through play-based learning principles, where children learn optimally through direct experience and active involvement. Game-based activities allow repeated practice of movement skills, which is essential for motor development (Grady et al., 2025). In addition, repetitive locomotor and non-locomotor activities—such as jumping, balancing, and running—support the development of coordination and motor control (Adi et al., 2022). The structured nature of the game also requires children to follow rules and respond to instructions, which can enhance attention and engagement during learning (James et al., 2024).

The high validation results indicate that the media meets key criteria of early childhood learning tools, including attractiveness, safety, and developmental suitability. This is in line with previous findings that well-designed learning media can increase children's participation

and learning engagement (Purwanto et al., 2024). In contrast to unstructured play, the Ular Tangga Rahasia media integrates physical activities systematically, ensuring that each task contributes to specific gross motor skill indicators.

The practicality findings during implementation show that the media can be applied effectively in classroom settings. Children actively participated and were able to follow the game rules, which supports previous research indicating that game-based learning increases children's physical activity and engagement levels (Arfi et al., 2024; Widayati et al., 2023). The use of movement-based play also allows children to explore physical activities directly, making the learning process more meaningful.

The statistical results further confirm a significant improvement in gross motor skills after the implementation of the media. Similar results have been found in studies showing that fun game-based learning approaches improve children's motor coordination and physical performance (Darussalam et al., 2025). In addition, structured physical activity programs have been shown to enhance multiple components of motor development simultaneously (Sheng et al., 2024).

The improvement across all gross motor indicators suggests that the media supports comprehensive motor development. This finding aligns with studies indicating that integrated movement activities are more effective in developing fundamental motor skills compared to isolated exercises (Palmer et al., 2025; Spring et al., 2023). The variation of movement tasks within the Ular Tangga Rahasia media enables children to practice different types of motor skills in a structured manner.

However, the results of this study may also be influenced by several external factors. Children's motivation and interest in game-based activities can contribute to increased participation during learning. In addition, teacher involvement in guiding the activities may affect how well children perform the movements. Previous studies emphasize that teacher facilitation and learning environment play important roles in optimizing children's motor development (Simatupang et al., 2024) Therefore, the improvement observed in this study should be interpreted by considering these supporting factors.

It is also important to note that not all studies report consistently positive results regarding game-based learning interventions. Some findings suggest that without proper structure, play activities may not significantly improve motor skills. This highlights the importance of combining play elements with structured physical activity, as implemented in the Ular Tangga Rahasia media.

This study has several limitations. The sample size was relatively small and limited to two institutions, which may affect the generalizability of the findings. The use of a one-group pretest–posttest design without a control group limits the ability to establish causal relationships. In addition, the duration of the intervention was relatively short, which may not fully capture long-term effects on motor development.

Despite these limitations, this study provides important implications. Theoretically, it supports the view that structured play-based physical activity contributes to children's motor development. Practically, the Ular Tangga Rahasia media can be used as an alternative learning tool for early childhood educators to facilitate active and engaging learning environments.

Future research is recommended to involve larger and more diverse samples, apply experimental designs with control groups, and extend the duration of intervention. Further development could also explore the integration of digital elements to enhance the adaptability of the media.

The novelty of this study lies in the integration of traditional game concepts with structured physical activity tasks in the Ular Tangga Rahasia media. This combination provides a unique approach that not only emphasizes play but also systematically targets gross motor development in early childhood learning.

CONCLUSION

This study developed a physical activity-based *Ular Tangga Rahasia* learning media using the 4D model and demonstrated that the media is valid, practical, and effective in supporting early childhood gross motor development. The integration of structured physical activities within a game-based format encourages active participation and facilitates the development of multiple motor skill components. This study contributes to early childhood education by offering an innovative learning medium that combines traditional game concepts with structured movement activities to enhance gross motor skills. Practically, the *Ular Tangga Rahasia* media can be utilized by early childhood educators as an alternative instructional tool to create more active, engaging, and meaningful learning experiences, and it has the potential to be applied more broadly in various learning contexts to support children's physical development.

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Declarations

Author Contribution Statement

The first author contributed to research conceptualization, media development design, data collection, data analysis, and preparation of the initial manuscript draft. The second author contributed to methodology validation, statistical analysis, interpretation of results, and critical revision of the manuscript. The third author contributed to media design development, refinement of article structure, academic language editing, and manuscript finalization. All authors have read and approved the final version of the manuscript and take responsibility for the content of the article.

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Data Availability Statement

The datasets generated during this study, including expert validation results, teacher response questionnaires, and pretest–posttest gross motor skill data, are available from the corresponding author upon reasonable request. The data are not publicly available to protect the confidentiality of participants.

Declaration of Interests Statement
The authors declare that they have no financial or non-financial conflicts of interest that could influence the results of this study. The research was conducted independently without any specific commercial interests.

AI Use Statement
In preparing this manuscript, the authors used AI-assisted tools, including ChatGPT (OpenAI, GPT-5.3), QuillBot, Grammarly, and Perplexity AI, in a limited capacity to support initial structuring, sentence paraphrasing, grammar correction, and improvement of academic clarity. All AI-generated outputs were reviewed, verified against the research data, and revised by the authors. AI tools were not used to generate data, conduct statistical analyses, or draw research conclusions. The authors take full responsibility for the accuracy and integrity of the manuscript.

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