Journal of Childhood and Elementary Studies
Volume 1, Issue 1, 18 - 27
e_ISSN: 3110-8113
DOI: 10.64268/joces.v1i1.100

Ball-based learning media and children's engagement in developing gross motor skills in early childhood education

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Article Info

Article history:

Submitted: Nov 15, 2024
Accepted: Mar 01, 2025
Published: Jun 12, 2025

Keywords:

Ball-Based Learning Media; Early Childhood Education; Gross Motor Skills; Human Factors; Learning Engagement.

Abstract

Background: Gross motor development is a fundamental aspect of early childhood education that supports children's physical coordination, balance, and readiness for learning. Effective stimulation of gross motor skills requires learning experiences that actively engage children through meaningful movement and interaction. Learning media play an important role as mediators between children and movement-based learning activities. However, the use of ball-based learning media is often examined only in terms of motor outcomes, with limited attention to children's engagement and human factor perspectives.
Aims: This study aims to analyze the implementation of ball-based learning media in developing gross motor skills among children aged 5–6 years, with a focus on children's engagement, coordination, and learning experiences.
Method: This study employed a classroom action research design using the Kemmis and McTaggart model. The research was conducted in two cycles involving 21 children aged 5–6 years at RA Bintang Zhafira. Data were collected through observation, performance tests, and learning documentation, and analyzed using descriptive qualitative analysis supported by percentage-based developmental achievement.
Results: The findings show a significant improvement in children's gross motor skills through ball-based learning activities. Gross motor achievement increased gradually from the pre-cycle stage to the end of Cycle II, exceeding the established mastery criteria. Children demonstrated improved coordination, balance, throwing and catching accuracy, as well as higher engagement in learning activities.
Conclusion: Ball-based learning media effectively support the development of gross motor skills and children's engagement in early childhood education. The use of concrete and interactive media oriented toward human factors contributes to meaningful and holistic learning experiences.

To cite this article: Ayu, S. M., & Sulistia. (2025). Ball-based learning media and children's engagement in developing gross motor skills in early childhood education. *Journal of Childhood and Elementary Studies*, 1(1), 18–27

INTRODUCTION

Gross motor development is a fundamental component of early childhood education and plays a crucial role in supporting children's physical, cognitive, and social growth in an integrated manner. Education during the age range from birth to six years is considered a critical phase, as development occurs rapidly and is highly responsive to environmental stimuli (Pertiwi et al., 2021). At this stage, learning experiences that involve meaningful physical activities directly contribute to children's readiness to participate in learning processes at subsequent educational levels.

Early childhood education is not solely oriented toward the achievement of early academic skills, but also toward the formation of basic motor abilities that enable children to interact effectively with their environment. Gross motor development includes body coordination, balance, agility, and movement control, which serve as the foundation for learning activities and children's daily lives. The Developmental Achievement Standards for children aged 5–6 years emphasize the importance of mastering coordinated movements, integrating eye, hand, and foot movements, and engaging in physical play with rules as indicators of optimal motor development (Sulistyo et al., 2021).

The process of motor stimulation in early childhood does not always occur optimally within educational settings. Various factors, such as children's physical conditions, characteristics of the learning environment, and instructional approaches, may influence the effectiveness of the stimulation provided (Sahara et al., 2021). Research shows that structured and unstructured physical activity can significantly support the development of gross motor skills in early childhood, enhancing coordination, balance, and movement competency (Moon et al., 2024; Wang et al., 2024). Gross motor skill proficiency in preschoolers is associated with increased engagement in physical play and activity interventions (Biino et al., 2025). Local evidence also highlights that physical activity experiences, such as outdoor play and structured movement practice, contribute positively to motor development in young learners (Abusleme-Allimant et al., 2023; Ulfah & Khoiriah, 2025). Guidelines for integrating physical activity into early childhood classrooms further emphasize its role in promoting self-regulation and sustained engagement (McGowan et al., 2024).

Movement-based learning in early childhood is closely related to human factors, including attention, motivation, perception, and emotional engagement. Studies in child development and motor learning indicate that motor skills develop not only through repetitive movements, but also through children's active interaction with their environment and the learning media used (Goodway et al., 2019; Diamond, 2015). Learning approaches that overlook children's engagement and experiential learning risk providing suboptimal stimulation, even when physical activities are included.

Learning media play a strategic role in mediating the interaction between children and the learning experiences designed by educators. Media do not merely function as tools for delivering content, but also serve as means to attract attention, enhance engagement, and create meaningful learning experiences for children (Yono and Sodikin, 2020). In the context of early childhood education, learning media should ideally be concrete, interactive, and capable of actively involving children through exploration and direct experience (Farida, 2016).

Ball media are among the learning tools commonly used to support the development of children's gross motor skills. Activities such as throwing and catching balls involve visual-motor coordination, balance, movement accuracy, and the ability to anticipate the direction and speed of objects (Siregar et al., 2019; Prima et al., 2023). These characteristics indicate that ball-based activities not only stimulate physical aspects, but also integrate children's cognitive and affective processes into a holistic learning experience.

International studies have demonstrated that movement-based play activities contribute significantly to children's motor development and learning engagement. Research by Logan et al. (2015) and Barnett et al. (2016) reported that structured physical play enhances motor coordination and children's self-confidence. Other findings emphasize that motor learning is closely associated with attention, self-regulation, and cognitive engagement (Robinson et al., 2018; Pesce et al., 2019). However, most of these studies primarily focus on motor outcomes as

final results, with limited attention given to the role of learning media as interactional tools that mediate children's learning experiences from a human factor perspective.

Previous national-level studies have generally emphasized the effectiveness of throwing and catching activities, the role of teachers, or causal relationships between ball games and improvements in children's gross motor skills (Juliandra, 2022; Panjaitan et al., 2023; Pradaya et al., 2020; Rahma et al., 2023; Gunawan, et al., 2024). These approaches have not explicitly positioned ball media as learning tools that function as bridges between children and learning experiences involving attention, coordination, and active engagement. This gap highlights the need for studies that integrate a human-centered perspective in the analysis of motor learning in early childhood education.

These conditions raise questions regarding how learning media are utilized in classroom practices to support children's gross motor development through meaningful interaction and learning engagement. Classroom-based research plays a critical role in bridging the gap between theoretical studies and actual instructional practices in early childhood education settings.

This study aims to analyze the implementation of ball media in developing the gross motor skills of children aged 5–6 years at RA Bintang Zhafira. The research focuses on how ball-based learning activities support children's gross motor development through engagement, coordination, and repeated learning experiences within the classroom context.

This study offers a conceptual contribution by positioning ball media as learning tools oriented toward human factors in early childhood education. It also contributes theoretically by integrating perspectives on motor development, movement-based learning, and human factors within the context of early childhood education. Practically, the findings are expected to serve as a reference for educators in designing play-based learning activities that not only stimulate gross motor skills, but also support children's engagement and holistic learning experiences.

METHOD

This study employed a Classroom Action Research (CAR) approach using the spiral model proposed by Kemmis and McTaggart, which emphasizes continuous improvement of teaching and learning practices through iterative stages of planning, action, observation, and reflection (Bahri, 2012; Rahmawati et al., 2021). This approach was selected because it enables researchers to work collaboratively with classroom teachers to directly improve gross motor learning practices within an authentic educational setting. The study was conducted in two consecutive cycles, with each cycle designed based on reflection outcomes from the previous cycle to enhance the quality of instructional implementation through throwing and catching ball activities. The cyclical process of the classroom action research is visually presented in Figure 1.

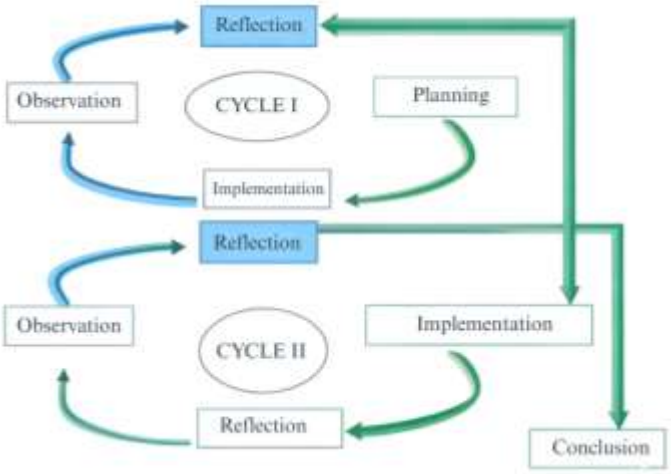

Figure 1. Classroom Action Research Cycle Based on the Kemmis and McTaggart Model

The research participants consisted of 21 children aged 5–6 years who were enrolled as students at RA Bintang Zhafira. All children were actively involved in the learning activities designed throughout the research period. The study was conducted over a two-week period in accordance with the school's activity schedule. The classroom teacher served as a collaborator involved in planning and implementing the instructional actions, while the researcher acted as the action designer, observer of the learning process, and facilitator of reflection. This collaborative pattern was intended to ensure that the implemented instructional actions were relevant to daily classroom practices and had the potential for sustainability after the completion of the study.

Data were collected through observation, performance tests, and learning documentation. Observation was used to record children's engagement, responses to learning activities, and the implementation of throwing and catching ball activities in accordance with the action plan. Performance tests were used to assess children's gross motor skills, particularly in the aspects of throwing, catching, movement coordination, and balance. Documentation in the form of photographs and field notes was used to support observational findings and to strengthen the reflection process in each cycle. All data collection instruments were developed based on relevant indicators of gross motor development for children aged 5–6 years within a play-based learning context.

Data analysis was conducted using descriptive qualitative analysis by integrating data from observations, performance tests, and learning documentation. Children's gross motor skill development was analyzed by calculating the percentage of developmental achievement based on the comparison between the scores obtained by the children and the maximum possible scores for each indicator. The percentage calculation was conducted using the following formula:

$$P = \frac{\sum BP}{\sum BM} \times 100\%$$

Where:
P represents the percentage of developmental achievement obtained by the child, ∑BP refers to the total weighted score obtained across all assessment indicators, and ∑BM refers to the total maximum weighted score that could be achieved.

This formula is a modified percentage calculation used to quantitatively describe the level of children's gross motor development.

The analysis results from each cycle served as the basis for reflection to evaluate the achievement of the instructional objectives and to determine necessary improvements for the subsequent cycle. The continuous process of analysis and reflection enabled both the researcher and the teacher to gain a comprehensive understanding of learning dynamics and to ensure that the implemented actions contributed meaningfully to improving instructional quality and children's gross motor development.

RESULT AND DISCUSSION

The presentation of the research findings begins with an initial mapping of the gross motor skills of children aged 5–6 years at RA Bintang Zhafira prior to the implementation of the instructional intervention. Based on the initial observational data presented in Table 1.1, children's gross motor abilities showed varying levels of achievement, with a predominance in the categories of emerging and developing as expected. Several children were still classified in the not yet developed category for certain gross motor indicators, indicating the need for more structured and contextualized instructional intervention.

Table 1. Baseline Distribution of Gross Motor Skill Development Levels among Children Aged 5–6 Years

Development Level	Frequency (n)	Percentage (%)
Not Yet Developed (BB)	6	28.6
Beginning to Develop (MB)	7	33.3
Developing as Expected (BSH)	8	38.1
Very Well Developed (BSB)	0	0.0
Total	**21**	**100**

Note. BB = Not Yet Developed; MB = Beginning to Develop; BSH = Developing as Expected; BSB = Very Well Developed.

Table 1 presents the baseline distribution of gross motor skill development levels among children aged 5–6 years prior to the implementation of the instructional intervention. The results indicate that most children were classified as either beginning to develop (33.3%) or developing as expected (38.1%). However, a substantial proportion of children (28.6%) remained at the not yet developed level, suggesting that gross motor skills had not yet developed optimally. These findings highlight the need for a structured and contextually relevant instructional intervention to support gross motor development in early childhood.

A more detailed analysis of specific gross motor indicators revealed that children's ball throwing ability at the initial stage had not yet developed optimally. As presented in Table 1.2, most children reached the level of developing as expected, while a considerable proportion were still in the emerging and not yet developed categories. No children achieved the developing very well level, indicating that throwing skills were not yet evenly developed across participants. Although several children were able to throw the ball in a directed manner, many still demonstrated limitations in accuracy and consistency, highlighting the need for targeted instructional support.

Table 2. Gross Motor Skill Achievement in Throwing Activity

No.	Achievement Level	Frequency (n)	Percentage (%)
1	Not Yet Developed (BB)	4	19
2	Beginning to Develop (MB)	6	28
3	Developing as Expected (BSH)	11	53
4	Very Well Developed (BSB)	0	0
	Total	**21**	**100**

Note.
BB = Not Yet Developed; MB = Beginning to Develop; BSH = Developing as Expected; BSB = Very Well Developed.

These findings indicate that throwing skills were not yet evenly developed among children, which provides a basis for further analysis of other gross motor indicators, such as catching ability.

A similar pattern was observed in children's ball catching ability at the initial stage. The results indicate that children's catching skills had not yet developed optimally, with variations in motor readiness, hand–eye coordination, and movement timing. As shown in Table 3, children's performance was distributed across the not yet developed, beginning to develop, and developing as expected levels, while no child reached the very well developed category. These findings suggest that children still required more intensive and structured stimulation to improve their catching coordination and responsiveness.

Table 3. Gross Motor Skill Achievement in Catching Activity

No.	Achievement Level	Frequency (n)	Percentage (%)
1	Not Yet Developed (BB)	6	29
2	Beginning to Develop (MB)	8	38
3	Developing as Expected (BSH)	7	33
4	Very Well Developed (BSB)	0	0
	Total	**21**	**100**

Note.
BB = Not Yet Developed; MB = Beginning to Develop; BSH = Developing as Expected; BSB = Very Well Developed.

Overall, the results in Table 3 indicate that children's catching ability was still in the developmental stage and had not yet reached an optimal level, providing a basis for evaluating the effectiveness of subsequent instructional interventions.

The implementation of instructional actions using ball media was carried out gradually through two cycles. Observational results showed an improvement in children's gross motor abilities from the pre-cycle stage to the end of Cycle II. During the pre-cycle stage, the average level of gross motor skill achievement was 31 percent, which did not meet the mastery criteria. This value indicates that most children had not yet reached the minimum expected level of gross motor development. In Cycle I, improvement occurred gradually across meetings, with the average achievement increasing from 38 percent at the first meeting to 50 percent at the third meeting, although most children remained in the emerging and developing as expected categories.

A more substantial improvement was observed in Cycle II following instructional revisions based on reflections from Cycle I. The average gross motor achievement increased to 56 percent at the first meeting and 63 percent at the second meeting. At the third meeting of Cycle II, the average achievement rose significantly to 76 percent and reached the developing very well category. This level of achievement indicates that most children had exceeded the established mastery threshold for gross motor development. Both quantitatively and qualitatively, children

demonstrated meaningful improvements in gross motor skills, particularly in throwing and catching activities with better coordination and balance.

Overall, the research findings indicate that the application of ball media in throwing and catching activities was effective in improving the gross motor skills of children aged 5–6 years. The increase in achievement percentages from the pre-cycle stage to the end of Cycle II reflects the success of the instructional intervention in helping children reach the established indicators of gross motor development. As the final achievement in Cycle II exceeded the learning mastery criteria, the instructional action was considered successful and did not require continuation into an additional cycle. To further understand the factors contributing to the success of the instructional intervention, it is necessary to examine the reflective process conducted throughout each stage of the classroom action research.

Reflection in classroom action research plays a central role in ensuring that the implemented instructional processes effectively support children's developmental needs. Reflections at the pre-cycle stage indicated that the gross motor skills of children aged 5–6 years at RA Bintang Zhafira had not yet developed optimally, particularly in terms of movement coordination, balance, and the integration of eye, hand, and foot movements. These findings align with the view that motor development in early childhood is strongly influenced by the quality of stimulation and learning experiences provided within educational environments (Pertiwi et al., 2021; Sahara et al., 2021).

Observations during the first meeting of Cycle II revealed that some children still experienced difficulties in coordinating simultaneous body movements when performing throwing and catching activities. Challenges in distinguishing the use of the right and left hands and in maintaining body balance indicated that children's gross motor skills had not yet been fully internalized. This condition reinforces previous findings that motor development depends not only on the frequency of practice, but also on children's active engagement and the quality of interaction between children and the learning media used (Goodway et al., 2019; Farida, 2016).

Instructional improvements implemented in the second meeting of Cycle II demonstrated enhanced movement coordination and increased child engagement in learning activities. Children began to show more directed motor responses and greater confidence in performing throwing and catching tasks. This improvement suggests that the use of ball media as a concrete and interactive learning tool was effective in increasing children's attention and motivation in movement-based learning. These findings are consistent with the perspective that learning media serve as an important bridge between children and meaningful learning experiences (Yono and Sodikin, 2020).

By the third meeting of Cycle II, reflective analysis showed that most children were able to perform gross motor activities with improved coordination, balance, and movement control. Children no longer showed confusion in using the right and left hands and were better able to anticipate the direction and speed of the ball. These outcomes indicate that throwing and catching activities not only stimulated physical aspects, but also engaged children's cognitive and affective processes in an integrated manner. This finding supports previous studies demonstrating that ball play contributes significantly to visual-motor coordination and movement readiness in early childhood (Siregar et al., 2019; Prima et al., 2023).

Overall, the improvement in gross motor skills from the pre-cycle stage to the end of Cycle II highlights the importance of movement-based learning that is designed with consideration of human factors, such as attention, motivation, and child engagement. Learning experiences that provide opportunities for exploration, repetition, and direct experience enable children to develop motor skills in a more stable and meaningful manner (Diamond, 2015; Robinson et al.,

2018). These findings also reinforce international research indicating that structured physical activities enhance motor coordination and learning engagement in early childhood (Logan et al., 2015; Barnett et al., 2016; Pesce et al., 2019).

Thus, the results of this study confirm that the use of ball media in gross motor learning is not only effective in improving developmental outcomes, but also relevant as a learning approach oriented toward holistic child learning experiences. Ball media function as interactive tools that mediate the relationship between children, learning activities, and the learning environment, thereby supporting gross motor development through active and reflective engagement within early childhood education contexts.

CONCLUSIONS

The implementation of ball media in throwing and catching activities was shown to effectively enhance the gross motor skills of children aged 5–6 years at RA Bintang Zhafira in a gradual and sustained manner. Improvements in developmental achievement were clearly observed from the pre-cycle stage to the end of Cycle II, with achievement percentages ultimately exceeding the established mastery criteria. These results indicate that play-based learning designed through reflective and iterative processes can optimally support the development of children's movement coordination, balance, and motor control within the context of early childhood education.

The findings underscore the role of concrete learning media as tools that mediate children's engagement and meaningful learning experiences in the development of gross motor skills. From a practical perspective, this study encourages early childhood educators to utilize ball media as part of movement-based instructional strategies that are oriented toward children's engagement and developmental needs. The limitations of this study include the relatively short duration of implementation and the limited number of participants drawn from a single educational institution. Future research is therefore recommended to involve more diverse school contexts and to further explore the relationships between gross motor learning and other developmental domains, such as children's social, emotional, and self-regulation development.

ACKNOWLEDGMENT

The authors would like to express their gratitude to the teachers and students of RA Bintang Zhafira for their active participation and cooperation during the research process. Appreciation is also extended to colleagues and reviewers whose feedback contributed to the refinement of this manuscript.

AUTHOR CONTRIBUTION STATEMENT

SMA contributed to research conceptualization, classroom action planning, data collection, and initial manuscript drafting. SS contributed to research design, data analysis, interpretation of findings, and manuscript revision. All authors have read and approved the final version of the manuscript.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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