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Enhancing the Number Recognition Ability of Group A Children through Number Ball Educational Play Tools (APE) at TK ABA Tanggul

Endang Susilowati*[*1], Basuki Hadi Prayogo[2], Trio Suwargono[3]
[1,2,3] Universitas PGRI Argopuro Jember, Jember, Jawa Timur
e-mail: *[1]emilaalfa@gmail.com, [2]b.hadiprayogo@gmail.com , [3]suwargonotrio@gmail.com

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ABSTRACT

This study aims to improve the cognitive ability of 4–5-year-old children in recognizing numerical symbols through the use of number ball educational play tools (APE) at Aisyiyah Bustanul Athfal Kindergarten for the 2024/2025 academic year. The background of this research lies in the low cognitive achievement at the early preoperational stage, where children require meaningful and concrete stimulation appropriate to their developmental level. This study is a Classroom Action Research (CAR) conducted in two cycles using the Kemmis & McTaggart model. The subjects were 15 Group A children. Instruments used included observation sheets and documentation. Pre-cycle results showed that only 26.7% of the children were in the "Developing as Expected" (BSH) category, with none in the "Very Well Developed" (BSB) category. After the first cycle, the percentage increased to 53.3% (BSH+BSB), and in the second cycle reached 80%, with 6 children (40%) in the BSB category and another 6 (40%) in BSH. These results indicate that the number ball media is effective in enhancing early childhood number symbol recognition skills. Therefore, concrete play-based learning such as

number ball activities can enhance symbolic concept understanding and support the achievement of the zone of proximal development in accordance with Vygotsky's theory.

Introduction

Early Childhood Education (ECE) is a form of systematic intervention designed to provide educational stimulation to children from birth to six years old, with the aim of supporting their overall developmental potential according to their stage. With structured and enjoyable learning processes, ECE plays a fundamental role in guiding children's optimal growth (Fitria et al., 2024; Pandia et al., 2022). ECE institutions are not only caregiving centers but also serve as the primary foundation for preparing children to enter the next stage of formal education. Stimulation in ECE encompasses various aspects of development, such as cognitive intelligence, socio-emotional skills, and physical maturity (Nada et al., 2024).

In the cognitive development phase, one of the essential skills that must be fostered from an early age is number recognition. This ability includes recognizing numerical symbols, naming numbers, and associating number symbols with corresponding quantities (Khoiriyati & Saripah, 2018; Utami & Eliza, 2022). Mastery of number concepts in early life plays a crucial role in forming the foundation of mathematical and logical thinking, which is necessary for future learning (Cresswell & Speelman, 2020). Therefore, providing appropriate, engaging, and age-appropriate stimulation is essential to optimally develop number

recognition skills (Wiyani, 2021).

Initial observations at TK ABA Tanggul revealed that most Group A children still struggled with recognizing numbers 1–10. They were unable to correctly distinguish number shapes, had difficulty reciting numbers in sequence, and could not accurately match numbers with object quantities. This is suspected to be due to conventional teaching methods and a lack of attractive, age-appropriate learning media (Fitri & Hariani, 2019; Rangkuti & Rangkuti, 2020). Furthermore, the use of interactive media has proven to enhance children's focus and memory in learning basic math concepts, including numbers (Rahmawati & Damayanti, 2023). Early childhood learning should be designed through enjoyable and meaningful play activities (Dwijantie, 2024). Play is not merely recreational but also an effective learning tool for young children (Hidayati et al., 2024). According to Suyadi (2021), through play, children more easily understand concepts because they are actively engaged physically, emotionally, and cognitively.

One alternative learning medium that can be used is educational play tools (APE), designed to support children's cognitive, motor, social, and emotional development through active and enjoyable learning experiences. These tools must be developmentally appropriate, safe, and attractive (Ministry of Education and Culture, 2021; Suyadi, 2021). In the context of this study, the type of APE implemented is number balls—balls labeled with numbers, designed to support number concept

learning (Mbi et al., 2025). Number ball APE encourages children to learn through motor activities such as throwing, catching, and recognizing numbers on balls. This medium allows children to learn through play, which aligns with their developmental nature. Research by Fatmawati (2023), Mbi et al. (2025), and Putri (2019) indicates that using number ball APE effectively enhances cognitive skills, particularly number recognition in early childhood. With this tool, the learning process becomes more active and engaging. APE methods motivate children not only to listen to the teacher but to participate in stimulating play activities that foster thinking, observation, and fine and gross motor skills (Guslinda & Kurnia, 2018). This concept is expected to significantly improve number recognition skills of Group A children at TK ABA Tanggul.

Several previous studies have discussed the use of learning media to improve number recognition in early childhood. For instance, Pango & Janul (2024) used number block media focused on visual symbol recognition. Meanwhile, Wae et al. (2022) developed number ball games for 5–6-year-olds (Group B), emphasizing symbolic thinking. Similar studies by Pratiwi et al. (2021) and Ariani et al. (2020) used educational games, but were limited to cognitive aspects or older age groups. Astuti et al. (2020) developed manipulative visual media that lacked physical activity involvement. These findings indicate a gap in existing research, particularly in providing learning media suitable for the developmental

characteristics of 4–5-year-olds (Group A), who need both cognitive and gross motor stimulation. Thus, this study contributes to filling that gap by developing and implementing an active, enjoyable, and integrated number ball media. This media not only supports symbolic number recognition but also encourages physical involvement through ball-throwing and catching activities, making it more developmentally appropriate for young children.

Based on this background, the researchers conducted classroom action research focusing on improving number recognition of numbers 1–10 in Group A children (ages 4–5) through integrating gross motor and cognitive activities using number ball APE. This study was conducted at TK Aisyiyah Bustanul Athfal (ABA) Tanggul as a response to the learning needs of early childhood and to address the lack of research exploring active play media for number recognition in this age range.

Methods

This study employed a Classroom Action Research (CAR) approach using the model developed by Kemmis and McTaggart (1998), which involves four stages: planning, action, observation, and reflection (Figure 1). The model was implemented in two cycles, consisting of the following phases: (1) the planning phase involved designing the intervention plan, preparing the learning media, and setting success indicators; (2) the action phase included activities for introducing

numbers using number ball APE with teacher guidance; (3) the observation phase was conducted by monitoring the children's progress through observation sheets and documentation; and (4) the reflection phase aimed to evaluate the results and determine the necessary improvements, with the possibility of continuing to the next cycle (Arikunto, 2016; Kemmis & McTaggart, 1998).

The research subjects were Group A children at TK Aisyiyah Bustanul Athfal Tanggul, Jember Regency—15 children aged 4–5 years who were identified as having difficulty recognizing numbers based on initial observations. Sampling was done using purposive sampling, selecting children requiring special intervention aligned with the study's focus (Sugiyono, 2019). The school's conducive environment and active teacher involvement were key considerations in selecting the research site and subjects. The research was carried out over two cycles to test the effectiveness of the Number Ball APE in improving number recognition, with full support from classroom teachers as collaborators.

The research stages began with preliminary observation to assess the children's initial abilities. Each cycle involved planning the learning strategy, implementing learning using the Number Ball APE, observing the process and outcomes, and reflecting on goal achievement. Data were collected through direct observation using observation sheets, documentation in the form of photos and videos, and informal interviews with teachers (Sugiyono, 2019; Creswell, 2014). Instruments

included observation sheets, assessment rubrics, and achievement qualification tables designed based on number recognition indicators adapted from the Ministry of National Education Regulation No. 58 of 2009 (Table 1). The results of each cycle were analyzed to determine the effectiveness of the intervention and plan improvements for the next cycle.

Table 1. Learning Implementation Qualification

No.	Achievement Percentage	Criteria
1	80% – 100%	Very Well Developed (BSB)
2	66% – 79%	Developing Well (BDB)
3	51% – 65%	Developing as Expected (BSH)
4	35% – 50%	Beginning to Develop (MB)
5	0% – 34%	Not Yet Developed (BB)

Source: Adapted from Ministry of National Education Regulation No. 58/2009 and Arikunto, S. (2008).

Observation data were analyzed using a descriptive quantitative approach, focusing on calculating the level of achievement in children's number recognition. The calculation was based on scores recorded on observation sheets and assessment rubrics, then converted into percentages using the formula:

$$P = (f/N) \times 100$$

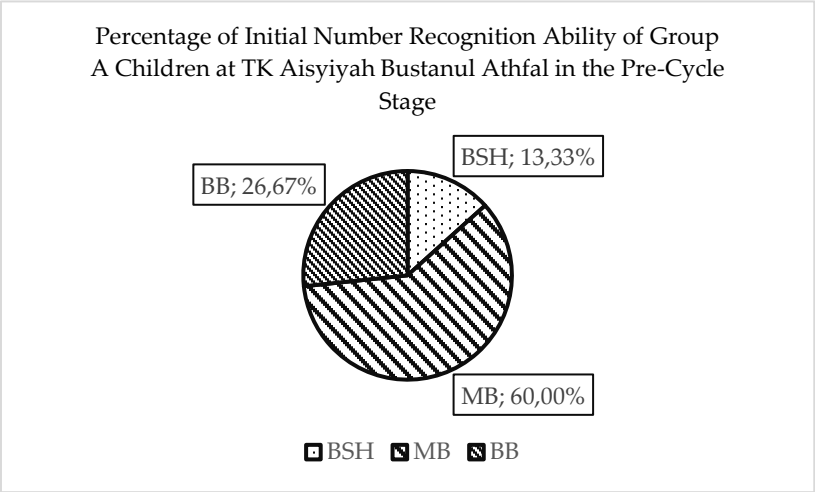
where P indicates the percentage of achievement, f is the total score obtained by each child, and N is the total number of participants

observed. The resulting percentages were interpreted using the qualification table to determine each child's level of number recognition development.

Results and Discussions

TK Aisyiyah Bustanul Athfal (ABA) Tanggul in Jember is an Islamic-based early childhood education institution under Aisyiyah's management, actively involved in academic and non-academic activities and serving as a model for the Merdeka Curriculum through the "TK Penggerak" program. Despite its strengths, initial observations showed that many Group A children struggled with number recognition due to insufficiently varied learning methods. Therefore, a more enjoyable and interactive approach, such as using number ball APE, was needed to improve children's cognitive skills in a concrete and meaningful way.

Figure 1. Recapitulation of Initial Number Recognition Ability of Group A Children at TK Aisyiyah Bustanul Athfal in the Pre-Cycle Stage

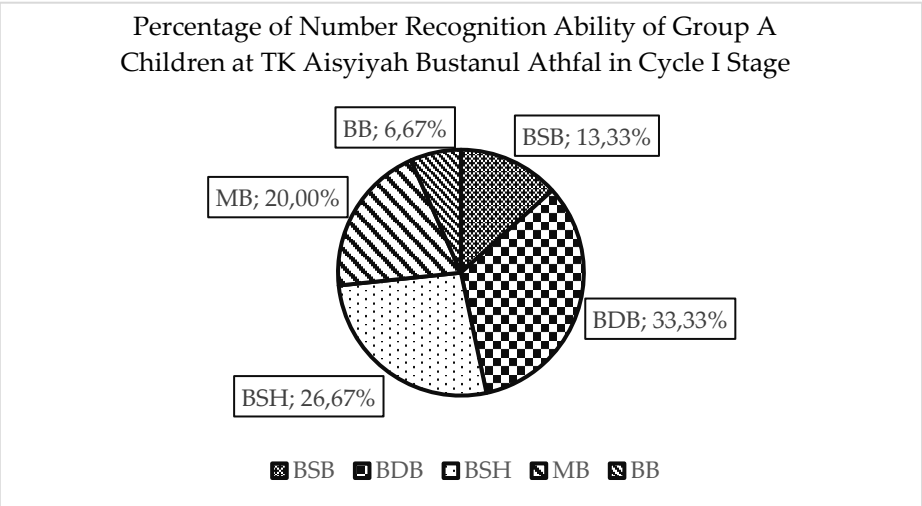


Based on pre-cycle observations of 15 Group A children at TK ABA Tanggul in the 2024–2025 school year, number recognition skills were still low (Figure 1). Only 2 children (13.33%) reached the Developing as Expected (BSH) category, while 9 children (60%) were in Beginning to Develop (MB), and 4 children (26.67%) were in Not Yet Developed (BB). None were in the BDB or BSB categories. With a minimum achievement (BSH and above) of only 13.33%, far below the 35% success threshold, an improved learning strategy more aligned with early childhood characteristics was required.

Behavioral observations during activities also showed that the children appeared passive, unenthusiastic, and easily distracted when introduced to numbers through conventional means. Verbal methods or worksheets tended to bore the children and did not actively engage them. The teacher was more dominant in the learning process, while the children lacked meaningful, concrete experiences. Therefore, in Cycle I,

a learning intervention using number ball APE was designed as a more enjoyable and interactive approach. This media aimed to foster active engagement in learning through play, stimulate cognitive and motor skills, and enhance comprehensive number concept understanding.

Figure 2. Recapitulation of Number Recognition Ability of Group A Children at TK Aisyiyah Bustanul Athfal in Cycle I

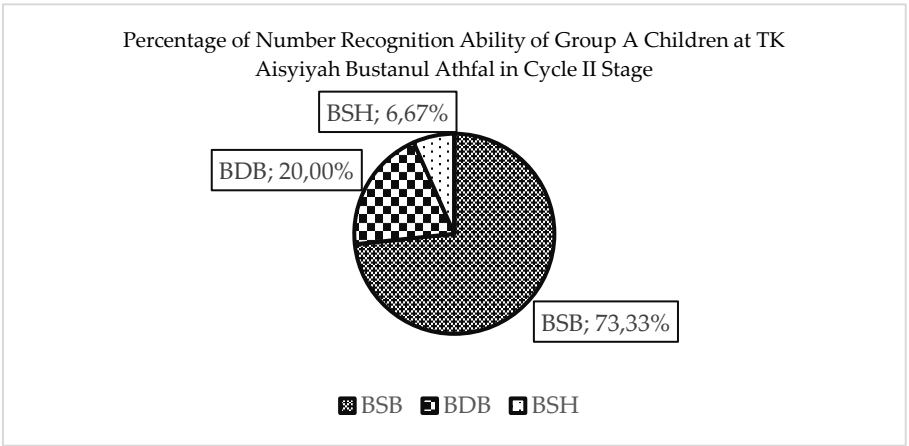


Observation results in Cycle I showed an improvement in number recognition compared to the pre-cycle stage (Figure 2). Of the 15 children, 11 (73.33%) reached at least the Developing as Expected category (BSH and above), with 2 children (13.33%) in BSB, 5 (33.33%) in BDB, and 4 (26.67%) in BSH. The remaining 4 children (26.67%) were still in the MB and BB categories. The use of number ball APE proved effective in enhancing number comprehension through play activities such as throwing and catching balls, matching numbers to object quantities, and directly recognizing numeric symbols. The children

became more active, focused, and engaged, showing significant progress from the pre-cycle phase.

Despite most children showing improvement, some challenges remained. A few children struggled to distinguish similar-looking numbers (e.g., 6 and 9) and inconsistently matched numbers with quantities. Their concentration also tended to wane toward the end of sessions, especially those needing more intensive guidance. Therefore, refinements were necessary in Cycle II, such as differentiated activities based on individual abilities, additional visual and verbal stimuli, and varied games to help maintain focus. Individual support and time management were also crucial to ensure all children, including those still in MB and BB, reached optimal development.

Figure 3. Recapitulation of Number Recognition Ability of Group A Children at TK Aisyiyah Bustanul Athfal in Cycle II

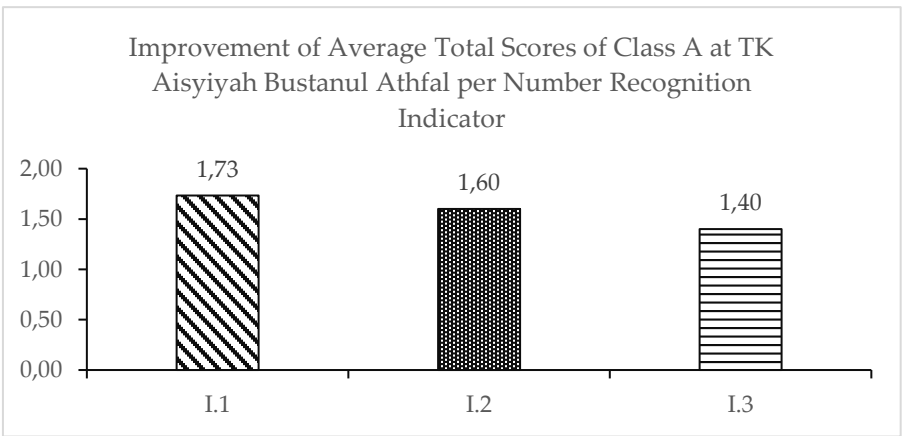


Cycle II observations (Figure 3) showed a significant improvement in children's number recognition. Of the 15 participants, 11 children

(73.33%) reached BSB, 3 (20.00%) were in BDB, and 1 (6.67%) in BSH. No children remained in the MB or BB categories, indicating that 100% had reached the minimum expected category (BSH and above). This shows that learning with number ball APE was effective in enhancing number understanding in early childhood.

In addition to numeric achievement, children's enthusiasm increased during Cycle II. They actively participated, expressed joy, and engaged in better social interactions. Cognitively, they could recite numbers 1–10 in order, match number symbols with quantities, and understand basic concepts like "more" and "less." Their motor coordination and focus also improved—they threw balls with better movement control and followed teacher instructions more orderly, indicating that APE use also supported cognitive, motor, and behavioral development.

Figure 4. Recapitulation of Number Recognition Ability of Group A Children at TK Aisyiyah Bustanul Athfal in Cycle II Stage.



Furthermore, evaluation results per indicator from pre-cycle to Cycle II showed significant improvement across all assessed aspects (Table 2 and Figure 4). Indicator I.1, measuring active participation in learning, rose from a 1.47 average in the pre-cycle to 2.33 in Cycle I and further to 3.20 in Cycle II. This indicates that children, initially passive and disengaged, became substantially more involved through systematic, engaging play-based learning using number ball APE. Indicator I.2, assessing mastery of numbers 1–10, progressed from 1.73 to 2.33 and then to 3.33, showing increased confidence in reciting complete number sequences. Indicator I.3, evaluating the ability to match number symbols with quantities, improved from 1.87 to 2.73 to 3.27, indicating better understanding of symbol-quantity relationships.

Table 2. Average Scores per Indicator of Number Recognition Activities from Pre-Cycle to Cycle II in Class A, TK Aisyiyah Bustanul Athfal

Indicator	Pre-Cycle	Cycle I	Cycle II	Increase
I.1	1.47	2.33	3.20	1.73
I.2	1.73	2.33	3.33	1.60
I.3	1.87	2.73	3.27	1.40

The findings show a significant improvement in children's number recognition after implementing number ball APE—from only 13.33% in the BSH and above category during the pre-cycle to 66.67% in Cycle I and 100% in Cycle II. This increase affirms that using concrete media is

not only effective but essential for teaching 4–5-year-olds. According to Jean Piaget's cognitive development theory (1952), children at this age are in the preoperational stage, reliant on symbolic representation but not yet capable of structured logical thinking. A key limitation in this stage is difficulty understanding abstract concepts like numbers and quantities without real visual or manipulative support. Therefore, the success of the number ball APE stems not just from its playful design but from its functional ability to transform abstract symbols into tangible, manipulable, and sensory experiences. Children not only "see" numbers, but also "touch," "throw," and "match" them physically, reinforcing understanding through motor and perceptual pathways.

However, not all children achieved optimal results by the end of Cycle I. Some still did not reach BSH. This study reveals that merely providing concrete media is not enough without comprehensive social support. According to Vygotsky's concept of the Zone of Proximal Development (ZPD) and scaffolding, children in the actual zone (undeveloped) require intensive social interaction from more capable peers or teachers to achieve higher cognitive performance (Shabani et al., 2010). Observations showed that children who grasped numbers faster were more socially active, initiated interaction, shared strategies, and helped peers with number sequences. Conversely, children less socially engaged showed slower progress even with the same APE. This emphasizes that learning success lies not only in the media but also in

the interactive social context in which it is used.

ZPD becomes highly relevant when some children at the beginning could not independently recite number sequences or match numbers to quantities. However, when playing with more capable peers or responding to guiding teacher questions like "how many balls did you take?" or "can you match this number with the number of balls?", they showed significant performance improvement. This suggests they operated within the ZPD, with their development mediated through meaningful social interaction. This process produces not only cognitive output but also specific internal mental development.

The success of APE in this study is inseparable from the teacher's role as an active scaffolding agent. Teachers did not just provide tools but also gave directions, verbal stimuli, and positive reinforcement to help children relate play experiences to abstract number symbols. This aligns with Vygotsky's idea that cognitive development is not purely individual but socially and culturally constructed. In the research implementation stage, teachers acted not only as facilitators but also as co-constructors in the learning process. Unfortunately, scaffolding was not fully optimal in Cycle I, as some struggling children did not receive sufficient individualized intervention, highlighting the need for differentiated scaffolding strategies. In Cycle II, this was improved, contributing to more children reaching the BSB level.

This study supports previous findings showing that concrete media

in number learning improves numerical understanding more effectively than conventional methods. Pango & Janul (2024) found that number blocks helped children visually recognize number symbols, while Wae et al. (2022) showed that number ball games enhanced symbolic thinking in 5–6-year-olds. Other studies by Pratiwi et al. (2021) and Ariani et al. (2020) also emphasized the benefits of ball-based educational media, though mostly focused on symbolic aspects and older age groups (Group B). This study not only confirms those findings but fills a research gap by targeting 4–5-year-olds (Group A) and integrating gross motor elements via dynamic number ball media, enhancing number recognition and children's physical engagement.

Based on these results, it is recommended that ECE educators, particularly Group A teachers, adopt an integrative approach using concrete activities such as number ball media. This type of media aligns with the sensory-motor and early preoperational development stages and simultaneously encourages cognitive, motor, and social involvement. Teachers should also design activities linking mathematical symbols to real-life experiences and social interactions as part of scaffolding in the child's proximal development zone. This way, child-centered, developmentally appropriate numeracy learning innovations can be implemented more effectively.

Conclusion

Based on the classroom action research conducted over two cycles

at PAUD Permata Ibu, it can be concluded that sensory play is proven to be effective in enhancing the concentration abilities of children aged 5–6 years. The implementation of play activities using water media in Cycle I and bead media in Cycle II significantly improved the children's ability to maintain attention, show interest, complete tasks, ignore distractions, and understand and respond to teacher instructions. This was evidenced by the increase in the average observation score from 2.66 in Cycle I to 3.83 in Cycle II, with the percentage of concentration achievement rising from 66.5% to 95.7%. These findings address the initial issue identified in the study: children's low concentration during learning activities that lacked exploratory and sensory elements.

The study also proposes that a multisensory experience-based learning strategy can serve as an innovative approach to improving concentration in early childhood. Sensory play allows children to engage actively, calmly, and attentively, as these activities align with their developmental characteristics that require concrete experiences and sensory stimulation. Thus, this approach not only enhances learning engagement but also helps cultivate thinking skills and persistence from an early age.

The implications of these findings suggest that early childhood educators should make greater use of varied, well-structured sensory learning media in their daily teaching practices. Early childhood education institutions are also encouraged to provide facilities and

dedicated time for sensory exploration as part of core learning. This research offers practical contributions to the development of enjoyable teaching methods while strengthening the literature on the effectiveness of sensory play in supporting children's concentration development. For future development, this study can serve as a foundational reference in designing long-term interventions or integrating sensory play into the broader thematic curriculum of early childhood education.

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