

Enhancing Kindergarten Children's Ability to Recognize Geometric Shapes Through Digital Educational Media

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ABSTRACT

The ability to recognize geometric shapes is an essential aspect of cognitive development in early childhood. However, observations at TK Islam Terpadu Siti Khadijah indicated that children experienced difficulties in identifying, distinguishing, classifying, and arranging geometric shapes because learning activities were still dominated by conventional teaching methods. This study employed Classroom Action Research (CAR) consisting of two cycles, each involving planning, implementation, observation, and reflection. The participants were 13 children aged 5–6 years at TK Islam Terpadu Siti Khadijah. Data were collected through observation and analyzed using descriptive quantitative methods. The findings revealed a substantial improvement in geometry recognition skills, with mean scores increasing from 10.00 in the pre-cycle to 16.23 in Cycle I and 18.77 in Cycle II. Classical learning mastery also rose from 0% to 69.23% and ultimately reached 100%. These results

suggest that digital educational media effectively improve children's geometry recognition while encouraging active learning engagement.

Introduction

Early childhood is recognized as an essential phase in the human developmental cycle, characterized by intensive growth and development across multiple domains. During this period, the provision of appropriate, continuous, and developmentally appropriate stimulation becomes a crucial factor in optimizing children's potential and supporting the successful attainment of developmental milestones. This stage serves as the foundation for physical, cognitive, language, socio-emotional, and motor development (NAEYC, 2020), all of which influence children's readiness and success in subsequent levels of education. The quality of stimulation provided through the environment, social interactions, and parenting practices plays a significant role in fostering these developmental domains (Wahyuni et al., 2024).

Furthermore, early childhood is widely recognized as a **sensitive period**, during which children exhibit heightened responsiveness to various environmental stimuli. Therefore, early childhood education should be designed to provide meaningful, engaging, and developmentally appropriate learning experiences that support the optimization of children's physical growth, psychological development, and overall developmental potential (Ariyanti, 2024).

One important aspect of development that deserves particular attention in early childhood education is cognitive development, especially children's ability to understand basic mathematical concepts through the recognition of geometric shapes (Papadakis, 2022). Geometry recognition serves as the foundation for the development of logical thinking, object classification, spatial reasoning, and children's readiness to acquire more advanced mathematical concepts at the elementary school level (NCTM, 2023). According to Clements and Sarama (2015), children aged 5–6 years are expected to recognize, name, distinguish, classify, and arrange simple geometric shapes according to their developmental stage. At the same time, Mayer (2021) and Dong et al. (2020) argue that the rapid advancement of digital technology requires learning processes to utilize more interactive media so that abstract concepts can be presented in a more concrete, engaging, and comprehensible manner for young children.

However, numerous studies have shown that young children's competence in recognizing geometric shapes has not yet developed optimally. A study conducted by Umyati and Rocmah (2025) demonstrated that the use of contextual learning media increased the average geometry recognition ability of children aged 4–5 years from 58.05 to 86.11. These findings indicate that selecting appropriate instructional media contributes positively to improving children's understanding of geometric concepts.

A similar problem was identified at TK Islam Terpadu Siti Khadijah.

Preliminary observations of Group B children revealed that their ability to recognize geometric shapes remained within the categories of **Beginning to Develop (BD)** and **Developing as Expected (DE)**. Most children experienced difficulties in naming geometric shapes, distinguishing shapes with similar characteristics, classifying objects according to their shapes, and identifying the fundamental characteristics of each geometric figure. The observational findings indicated that the children's average score reached only 10 out of a maximum possible score of 20. Consequently, most children remained in the Beginning to Develop (BD) category, while none had reached the categories of Developing as Expected (DE) or Very Well Developed (VWD). These findings suggest that children's geometry recognition skills still require improvement through more effective instructional strategies.

The low level of children's geometry recognition ability, based on preliminary observations, was presumed to be associated with instructional practices that were still dominated by textbooks, worksheets, and verbal explanations. Such conditions limited children's opportunities to engage in active, concrete, and interactive learning experiences. According to Sirjon (2025), conventional instructional approaches are less compatible with the learning characteristics of young children, who tend to respond more positively to visual, exploratory, and play-based learning activities. In contrast, digital educational media provide richer learning experiences by integrating

images, animations, audio, videos, and interactive features capable of enhancing children's motivation, attention, and engagement throughout the learning process (Widyawati, 2025; OECD, 2021). Consistent with these perspectives, numerous previous studies have demonstrated that digital media designed according to children's developmental characteristics contribute positively to strengthening conceptual understanding, increasing active participation, and improving learning outcomes in early childhood education (Safitri, Wahyudi, & Rusdiani, 2024; Zebar & Sembiring, 2025; UNESCO, 2023).

Although the use of digital media in early childhood education has been extensively investigated, previous studies have predominantly focused on enhancing learning motivation, literacy skills, numeracy skills, or the general application of multimedia technologies. Research specifically examining the effectiveness of interactive digital educational media in improving geometry recognition skills through a Classroom Action Research approach among Group B children in early childhood education institutions remains relatively limited. This condition highlights an opportunity to further investigate the use of digital educational media as an innovative instructional approach that can assist children in recognizing, distinguishing, classifying, and arranging various geometric shapes according to their developmental characteristics.

Based on the foregoing discussion, this study aims to improve the geometry recognition ability of Group B children at TK Islam Terpadu

Siti Khadijah through the implementation of digital educational media. The findings are expected to contribute academically to the development of early mathematics learning in early childhood education, provide practical guidance for educators in implementing more innovative instructional media, and expand scholarly understanding regarding the utilization of digital technology as a means of optimizing young children's cognitive development.

Methods

This study employed the Classroom Action Research (CAR) method based on the model developed by Kemmis and McTaggart. The research was conducted through several cycles, each consisting of four interrelated stages: planning, acting, observing, and reflecting. The reflection stage was utilized to evaluate and refine the implementation of actions in the subsequent cycle (Arikunto, 2021). The study was carried out during the second semester of the 2025/2026 academic year at TK IT Siti Khadijah, Tanjung Morawa District, involving 13 Group B children aged 5–6 years as the research participants. The selection of participants was based on preliminary observations indicating that the majority of children had not yet developed optimal abilities in recognizing geometric shapes. These findings served as the basis for implementing instructional interventions aimed at improving children's geometry recognition skills.

The intervention was implemented over two research cycles, with each cycle consisting of two learning sessions, each lasting

approximately **60 minutes**. Digital educational media were employed as the primary instructional media for teaching geometric shape recognition. During the first cycle, learning activities focused on introducing basic geometric shapes through interactive digital media designed to encourage children's active participation throughout the learning process. The reflection results obtained from the first cycle subsequently served as the basis for improving the intervention in the second cycle. These improvements included enriching technology-based learning activities, providing more structured assistance to children who continued to experience learning difficulties, and integrating digital educational games to create more attractive and engaging learning experiences that were aligned with the developmental characteristics of early childhood. All learning activities were conducted based on the Daily Lesson Plan (RPPH) that had been systematically prepared prior to the implementation of the research intervention.

Research data were collected through observation, documentation, and field notes. The primary research instrument was an observation sheet completed by the classroom teaching assistant, who served as the observer to assess children's ability to recognize geometric shapes based on the cognitive developmental indicators for children aged 5–6 years, as outlined in the Child Development Achievement Standards (STPPA). Assessment was conducted using five indicators: children's ability to name geometric shapes, recognize various geometric forms, distinguish

the characteristics of each shape, classify objects according to their shapes, and arrange simple geometric patterns. Prior to its implementation, the research instrument underwent a **content validity** process involving the academic supervisor and the classroom teacher as experts in early childhood education. This validation process was intended to ensure that each assessment indicator was aligned with the objectives of the study and relevant to the developmental characteristics of young children, thereby confirming the instrument's appropriateness for accurately measuring the targeted constructs.

Data analysis employed both quantitative and qualitative approaches to obtain a comprehensive understanding of the implementation of the classroom action research (Hildania et al., 2026; Fitrah & Luthfiah, 2018). Quantitative analysis was performed by calculating each child's score, the class mean score, the percentage of classical learning mastery, and the improvement in learning outcomes across each cycle using the mean and mastery percentage formulas proposed by Arikunto (2021). Meanwhile, qualitative evidence was analyzed through the stages of data reduction, data presentation, interpretation of findings, and conclusion drawing, based on observation results, documentation, and field notes. The intervention was considered successful when children's competence in identifying geometric shapes demonstrated continuous improvement in every research cycle, with at least 80% of participants achieving the categories of "Developing as Expected (BSH)" or "Very Well Developed (BSB)",

according to the early childhood developmental assessment criteria stipulated in Indonesian Ministry of Education and Culture Regulation Number 137 of 2014 and Arikunto (2021).

Result and Discussions

The implementation of digital educational media for geometry learning was conducted over two research cycles, with each cycle comprising the stages of planning, action implementation, observation, and reflection, following the procedures of Classroom Action Research. Children's ability to recognize geometric shapes was assessed using five indicators: the ability to name geometric shapes, recognize various geometric forms, distinguish the characteristics of each shape, classify objects according to their shapes, and arrange geometric shapes into simple patterns or objects.

During the pre-cycle stage, the Classroom Action Research was conducted at TK Islam Terpadu Siti Khadijah, involving 13 Group B children aged 5–6 years as the research participants. This study aimed to examine the effectiveness of digital instructional media in improving children's ability to recognize geometric shapes. The intervention was designed to be implemented through two cycles, each consisting of the stages of planning, action, observation, and reflection, following the Classroom Action Research procedure.

Table 1. Pre-Cycle Observation Results

Category	Number of Children	Percentage
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Not Yet Developed (BB)	3	23.08%
Beginning to Develop (MB)	10	76.92%
Developing as Expected (BSH)	0	0%
Very Well Developed (BSB)	0	0%
Total	13	100%

The pre-cycle analysis revealed that the class mean score was only 10.00, while the percentage of classical learning mastery remained at 0%. These findings indicate that none of the children had achieved the predetermined success criterion, namely reaching at least the Developing as Expected (BSH) or Very Well Developed (BSB) category. Therefore, the implementation of a more innovative, interactive instructional approach capable of providing engaging learning experiences was considered necessary to foster the development of children's geometry recognition skills in the subsequent cycle.

During the first cycle, the instructional intervention focused on utilizing digital educational media as the primary learning tool for introducing geometric shapes. The media integrated visual illustrations, animations, and various interactive learning activities, enabling children to experience a more enjoyable learning process than the conventional instructional methods previously employed. Throughout the lessons, teachers introduced different geometric shapes using visual images, picture-matching games, and activities that encouraged children to identify geometric shapes found in surrounding objects. These learning activities were designed to provide clearer learning

experiences while simultaneously increasing children's active participation throughout the instructional process.

The implementation of the intervention in this cycle demonstrated positive improvements in children's participation during learning activities. Compared with the pre-cycle condition, children appeared more enthusiastic in engaging with every learning activity. Their increased participation was reflected in their ability to answer teachers' questions, confidently identify and name various geometric shapes, and interact directly with the digital instructional media. Nevertheless, several children still experienced difficulties when distinguishing geometric shapes with similar characteristics or arranging multiple shapes into specific patterns or objects. These findings suggest that each child demonstrated different rates of developmental progress, indicating that some children continued to require individual guidance throughout the learning process.

Table 2. Distribution of Children's Developmental Categories in Cycle I

Category	Number of Children	Percentage
Not Yet Developed (BB)	0	0%
Beginning to Develop (MB)	4	30.77%
Developing as Expected (BSH)	2	15.38%
Very Well Developed (BSB)	7	53.85%
Total	13	100%

The findings indicate that the instructional strategies implemented

during the first cycle had a positive impact on the development of children's geometry recognition skills; however, the research success criteria had not yet been fully achieved. Learning outcomes also improved, as reflected in the increase in the class mean score to 16.23, while the percentage of classical learning mastery rose to 69.23%. These results demonstrate that digital educational media assisted children in understanding geometric concepts more effectively through engaging and interactive learning experiences. Nevertheless, the outcomes had not yet reached the predetermined success indicators, making further refinement of the instructional intervention necessary in the subsequent cycle to achieve more optimal learning outcomes.

At the end of Cycle I, the reflection stage generated several findings that served as the basis for improving the instructional process. Some children still required individualized assistance because they had difficulty maintaining their attention throughout the learning activities. In addition, several children had not yet developed the ability to arrange geometric shapes into meaningful objects effectively. Based on this evaluation, the intervention planned for Cycle II focused on improving instructional strategies by incorporating a greater variety of digital educational games, providing more targeted reinforcement, and increasing the intensity of individualized guidance to ensure that every child received learning opportunities appropriate to their developmental needs and abilities.

The implementation of the intervention in Cycle II demonstrated

more optimal learning outcomes than those achieved in the previous cycle. Most children were able to name various geometric shapes more confidently, accurately distinguish the characteristics of each shape, classify objects according to their geometric forms, and arrange different geometric shapes into simple objects with a higher level of independence. The learning atmosphere also became more active, as nearly all children participated enthusiastically in every activity delivered through the digital educational media. The high level of children's participation throughout the instructional process indicates that the media successfully created engaging learning experiences while simultaneously enhancing children's motivation and active involvement in classroom activities.

Table 3. Distribution of Children's Developmental Categories in Cycle

II		
Category	Number of Children	Percentage
Not Yet Developed (BB)	0	0%
Beginning to Develop (MB)	0	0%
Developing as Expected (BSH)	2	15.38%
Very Well Developed (BSB)	11	84.62%
Total	13	100%

These findings indicate that all participants demonstrated improvement in their ability to recognize geometric shapes after participating in learning activities supported by digital educational media. This progress was also reflected quantitatively in the

improvement of learning outcomes. The class mean score increased to 18.77, while the percentage of classical learning mastery reached 100%. These results indicate that all participants successfully met the predetermined success indicators. Therefore, the implementation of the intervention in Cycle II was considered effective in improving the geometry recognition ability of children aged 5–6 years. Based on these achievements, the study was regarded as having fulfilled its success criteria, and no further research cycles were considered necessary.

To obtain a clearer picture of the effectiveness of the implemented intervention, a comparative analysis was conducted using the results collected during the pre-cycle, Cycle I, and Cycle II. The comparison was based on the class mean score and the percentage of classical learning mastery as indicators of improvements in children's geometry recognition ability.

Table 4. Comparison of Mean Scores and Classical Learning Mastery

Stage	Mean Score	Classical Mastery
Pre-Cycle	10.00	0%
Cycle I	16.23	69.23%
Cycle II	18.77	100%

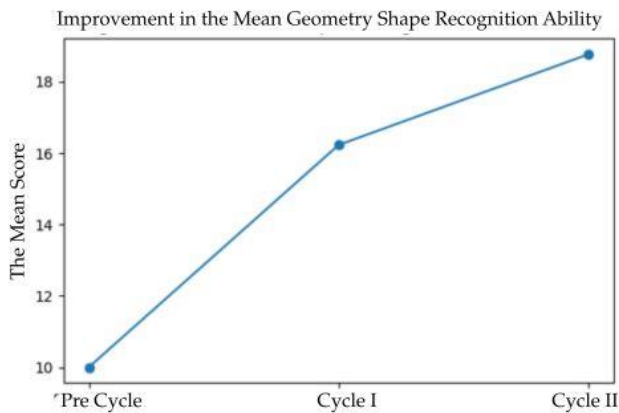


Figure 1. Improvement in Mean Scores Across Research Cycles

As presented in **Table 4**, the average score for children's geometry recognition ability increased progressively throughout each stage of the study. Compared with the initial condition, the class mean score increased by **6.23 points** during Cycle I. Following the implementation of the improved instructional intervention in Cycle II, the mean score increased by an additional **2.54 points**. Overall, the total improvement from the pre-cycle to the end of the study reached **8.77 points**, demonstrating continuous development in children's geometry recognition ability throughout the intervention process. In addition to improvements in the class mean score, classical learning mastery also increased substantially, as presented in the following table.

Table 5. Comparison of Children's Developmental Categories

Category	Pre-Cycle	Cycle I	Cycle II
Not Yet Developed (BB)	3	0	0
Beginning to Develop (MB)	10	4	0

Developing as Expected (BSH)	0	2	2
Very Well Developed (BSB)	0	7	11

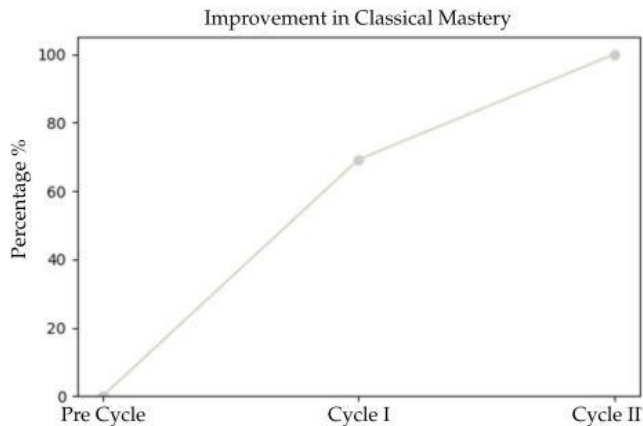


Figure 2. Improvement in Classical Learning Mastery

The comparison of children's developmental categories demonstrates substantial changes throughout the implementation of the study. The number of children classified as Not Yet Developed (BB) and Beginning to Develop (MB) decreased consistently across each research cycle and completely disappeared by the end of the study. Conversely, the number of children achieving the Developing as Expected (BSH) and Very Well Developed (BSB) categories increased progressively throughout the intervention. By the conclusion of Cycle II, all participants had successfully reached one of these two developmental categories. These findings indicate that the implementation of digital educational media positively contributed to improving the geometry recognition ability of children aged 5–6 years. This success is reflected not only in the improvement of the class mean

score and classical learning mastery but also in the overall shift in children's developmental categories, demonstrating comprehensive improvement across all participants.

Discussion

The findings of this study demonstrate that the use of digital educational media positively contributed to improving the ability of children aged 5–6 years to recognize geometric shapes at TK Islam Terpadu Siti Khadijah. This improvement was reflected in the increase in the class mean score from 10.00 during the pre-cycle stage to 16.23 in Cycle I, followed by a further increase to 18.77 in Cycle II. Likewise, the percentage of classical learning mastery improved substantially, increasing from 0% during the initial stage to 69.23% in Cycle I and ultimately reaching 100% in Cycle II. These findings indicate that learning through digital educational media effectively enhances children's ability to recognize various geometric shapes.

The improvement in children's geometry recognition ability was also accompanied by increased engagement throughout the learning process. Children became more active in answering questions, identifying geometric shapes, and completing the various learning activities provided through the digital media. These findings suggest that instructional effectiveness is influenced not only by the content being taught but also by the manner in which it is delivered. Instructional media that are engaging and aligned with children's developmental characteristics can increase attention, motivation, and

participation, thereby creating more effective learning experiences.

The findings of this study also reinforce those reported by Maghfirah et al. (2022), who emphasized that digital media support early childhood cognitive development through the integration of visual elements, audio, and interactive activities that enhance children's attention and participation during learning. Although their study focused on numeracy skills, the results are consistent with those of the present study, demonstrating that digital media facilitate children's understanding of fundamental concepts by providing learning experiences that are more concrete, contextual, and meaningful for their cognitive development.

Overall, the improvement in children's geometry recognition ability observed in this study was influenced not merely by the use of digital technology itself, but also by the capacity of the digital educational media to create an active, interactive, and developmentally appropriate learning environment. Opportunities to learn through observation, exploration, and direct interaction enabled children to construct geometric concepts more easily, retain them more effectively, and apply them across various learning contexts.

The findings further support the perspective proposed by Khadijah and Amelia (2020), who argued that children's cognitive development can be optimized when they are provided with opportunities to explore objects, conduct observations, and engage in meaningful learning experiences. In the present study, digital educational media functioned

not merely as visual instructional aids but also as learning tools that encouraged children to observe, compare, identify, and classify various geometric shapes, thereby enabling a deeper understanding of geometric concepts.

The present findings are also consistent with those reported by Saragih et al. (2024), who emphasized that the effectiveness of instructional media depends primarily on their ability to establish meaningful interactions among teachers, learners, and instructional content rather than solely on the sophistication of the technology employed. Instructional media that are aligned with children's developmental characteristics can enhance attention, participation, and the overall quality of learning experiences. In this study, digital educational media successfully transformed abstract geometric concepts into concrete learning experiences through visual representations and interactive activities, thereby enabling children to develop a stronger conceptual understanding.

Conclusion

This study demonstrates that the use of digital educational media effectively improves the ability of children aged 5–6 years to recognize geometric shapes, while also reinforcing previous findings that digital media can support early childhood learning by making it more engaging, interactive, and learner-centered. More specifically, the findings confirm that digital media contribute not only to the enhancement of children's general academic abilities but also to the

development of their capacity to recognize, distinguish, classify, and arrange simple geometric shapes as an integral component of their cognitive, logical, and spatial development. The results further support previous studies indicating that the integration of visual elements, audio, animations, and interactive activities within digital media enables children to understand abstract geometric concepts more effectively. Consequently, digital media function not merely as a means of delivering instructional content but also as a learning medium that facilitates children's knowledge construction.

Although the findings are consistent with those reported in previous studies, this research offers a distinctive contribution by emphasizing the development of geometry recognition skills as the primary focus of early mathematics learning in early childhood education. Furthermore, the study concludes that the successful implementation of digital educational media is determined not only by the sophistication of the technology itself but also by the application of interactive instructional strategies. Therefore, teachers play a crucial role in creating active, meaningful, and engaging learning experiences that optimize children's cognitive development.

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