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The Impact of Picture Books on The Development of Foundational Mathematics Skills Among Preschool Children

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Abstract: This study examined the impact of picture books on the development of foundational mathematics skills among preschool children in Ibadan South West Local Government Area. Guided by five research questions, the study was anchored on Lev Vygotsky's Socio-Cultural Theory of Cognitive Development (1934). A descriptive research design was adopted, and a sample of 100 preschool children was selected using a multistage sampling technique from five randomly chosen nursery schools. Data were collected using a researcher-designed observation checklist and a structured teacher-administered assessment tool, focusing on counting, number recognition, spatial awareness, and pattern recognition. The instruments were validated by experts and piloted, with a Cronbach's alpha reliability coefficient of 0.78. Descriptive statistics such as frequency counts, percentages, means, and standard deviations were used for data analysis. Findings revealed that picture books significantly enhanced children's mathematics skills. The study recommends the integration of picture books into early childhood mathematics instruction to strengthen foundational numeracy in preschool learners.

Keywords: *Picture books, mathematics skills, preschool children, socio-cultural theory, Ibadan South West*

INTRODUCTION

Early childhood is a crucial period for cognitive development, and foundational skills in mathematics are best nurtured through engaging, age-appropriate learning experiences. One of the most effective tools in early childhood education is the picture book, which combines vivid illustrations with simple text to stimulate interest and understanding. Picture books serve as powerful educational resources that help young learners make sense of abstract concepts by linking them to familiar stories and images. Through storytelling, visual representation, and interactive reading sessions, picture books can introduce mathematical ideas such as counting, shapes, patterns, sizes, and spatial relationships in meaningful and memorable ways. As children listen to and observe the content in picture books, they develop language, problem-solving abilities, and critical thinking, which all contribute to their cognitive growth. When used intentionally, picture books not only support literacy development but also provide an accessible and enjoyable pathway for building essential early numeracy skills. Therefore, the integration of picture books in early learning environments plays a significant role in enhancing preschool children's **Mathematics skills.**

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Mathematics skills refer to essential cognitive and practical abilities that enable young children to understand and apply mathematical concepts in everyday situations. In preschoolers, children aged three to five enrolled in pre-primary education, these skills include number recognition, counting, quantity understanding, pattern recognition, shape identification, measurement, and spatial awareness (Clements & Sarama, 2014; Liu & Park, 2019). Such foundational skills are vital for logical thinking, problem-solving, and long-term academic success across multiple subjects (Duncan et al., 2007). According to Ginsburg, Lee, and Boyd (2008), early math development goes beyond numbers, involving classification, seriation, and understanding of time and measurement. These abilities often emerge through play-based experiences that encourage exploration and discovery. The National Research Council (2009) notes that young children are naturally curious and capable of grasping math concepts when presented in age-appropriate ways. One effective medium for this is picture books, which embed mathematical ideas in engaging and visually rich narratives that enhance comprehension and promote early numeracy development (Van den Heuvel-Panhuizen & Elia, 2012). Therefore, nurturing mathematics skills in preschool children through intentional strategies can be effectively supported using **picture books.**

Research has consistently shown that picture books are valuable tools for developing early mathematical skills in preschool children. Cooper et al. (2018) emphasize that well-selected, high-quality picture books can effectively support the understanding of mathematical concepts in young learners. Similarly, Splinter et al. (2022) found that incorporating mathematical content in picture books helps foster foundational math skills essential for future academic success. Purpura et al. (2021) also reported significant improvements in children's mathematical language when caregivers engaged them in math-focused picture book reading.

Beyond mathematics, picture books have been recognized for their broader educational benefits. For instance, Montag (2019) noted that the complexity of sentence structures in children's picture books supports language development, while Björklund and Palmér (2020) found that these books can enhance reasoning skills in mathematics. Grolig et al. (2020) demonstrated that dialogic reading with wordless picture books improves young children's language abilities.

In the Nigerian context and elsewhere, picture books offer a visually engaging medium through which children naturally and enjoyably explore mathematical concepts such as numbers, spatial relationships, and measurement. Studies underscore their effectiveness in introducing key concepts without the need for formal instruction (Maričić & Stakić, 2023). The PICO-ma project illustrated how embedding math within engaging narratives can stimulate mathematical thinking (Heuvel-Panhuizen et al., 2009), while Heuvel-Panhuizen and Boogaard (2008) showed that even picture books not explicitly designed for math can evoke meaningful cognitive engagement and mathematical reflection.

The design of picture books is crucial; books that intentionally incorporate mathematical features significantly enhance early numeracy, especially when used strategically by educators and caregivers (Connor, Zippert, Ehrman, Ellis, & Purpura, 2022). Empirical studies, such as Ompok et al. (2018) using the book *What are the numbers?*, have demonstrated notable improvements in children's numeral reading and writing skills, with large effect sizes reflecting substantial learning gains. Collectively, these findings highlight the vital role of picture books in early childhood education, particularly in promoting mathematical thinking and skill development.

An appropriate theory for this study is the Socio-Cultural Theory of Cognitive Development by Lev Vygotsky (1934). Vygotsky stated that "every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level… All the higher functions originate as actual relationships between individuals" (Vygotsky, 1978, p. 57). This theory emphasizes that children develop cognitive skills through social interactions and the use of cultural tools such as language and symbols. Learning occurs most effectively within the Zone of Proximal Development (ZPD), where a child is supported by more knowledgeable others like teachers or caregivers.

This theory directly relates to the study, as picture books serve as cultural tools that facilitate learning through shared reading experiences. When caregivers or teachers read and discuss picture books with children, they guide them in exploring mathematical concepts such as counting, spatial awareness, and pattern recognition. The interaction fosters both language and mathematical reasoning, supporting children's cognitive development in line with Vygotsky's view. Thus, the use of picture books to enhance mathematics skills in preschool children aligns well with the principles of sociocultural theory.

STATEMENT OF THE PROBLEM

Early mathematics skills are essential for future academic success, and the preschool years provide a critical foundation for developing these abilities. Picture books have been recognised as effective tools for introducing mathematical concepts in engaging and meaningful ways. They help children grasp skills such as counting, number recognition, spatial awareness, and problem-solving through stories and illustrations. However, most existing studies have been conducted in Western contexts, with limited focus on how picture books support early mathematics learning in African settings like Nigeria. Furthermore, while much attention has been given to language development through picture books, their specific impact on mathematics skills in preschoolers remains underexplored. This study aims to bridge this gap by investigating how picture books influence mathematics skill development among preschool children in Nigeria, offering practical insights for educators and contributing to early childhood education practices in similar contexts.

PURPOSE OF THE STUDY

The main purpose of this study is to examine the impact of picture books on the development of mathematics skills among preschool children in Ibadan South West Local Government Area of Oyo State. Specifically, the study aims to:

examine the impact of picture books on counting skills among preschool children in Ibadan South West Local Government Area.

investigate how picture books influence number recognition in preschool children.

explore the effect of picture books on the development of spatial awareness among preschool learners.

determine the role of picture books in enhancing pattern recognition skills in early childhood.

assess the overall effectiveness of using picture books as a tool for developing foundational mathematics skills in preschool education within Ibadan South West.

Research Questions

What is the impact of picture books on counting skills among preschool children in Ibadan South West Local Government Area?

How do picture books influence number recognition in preschool children?

In what ways do picture books affect the development of spatial awareness among preschool learners?

How do picture books enhance pattern recognition skills in early childhood?

How effective are picture books as a tool for developing foundational mathematics skills in preschool education within Ibadan Southwest?

Research Methodology

Research Design

The study adopted a descriptive research design. This design was appropriate as it allowed the researcher to observe, describe, and analyze the relationship between the use of picture books and the development of mathematics skills in preschool children without manipulating any variables.

Population of the Study

The population of the study consisted of all preschool children enrolled in public and private nursery schools within Ibadan South West Local Government Area, Oyo State.

Sample and Sampling Technique

A sample of 100 preschool children was selected from five randomly chosen nursery schools within the local government area. A multistage sampling technique was employed. First, schools were selected through simple random sampling, followed by purposive sampling of children in the nursery two classes who had exposure to picture books.

Instrumentation

The primary instrument used for data collection was a researcher-designed observation checklist and a structured teacher-administered assessment tool. The checklist assessed key mathematics skills such as counting, number recognition, spatial awareness, and pattern recognition, while the assessment tool measured children's performance before and after exposure to picture books.

Validity and Reliability of the Instrument

The instruments were subjected to expert review in early childhood education to ensure content validity. A pilot study was conducted in a school outside the study area, and the reliability of the instrument was established using Cronbach's alpha, yielding a coefficient of 0.78, indicating acceptable internal consistency.

Procedure for Data Collection

Data were collected over a four-week period. During this time, teachers read selected picture books with embedded mathematical content to children during designated story sessions. The researcher

observed and recorded the children's engagement and skill development using the checklist, while teachers administered the assessment tools before and after the intervention.

Method of Data Analysis

Descriptive statistics such as frequency counts, percentages, mean scores, and standard deviation were used to analyze the data. The findings were presented in tables and interpreted to answer the research questions.

Result of findings

Research Question 1

What is the impact of picture books on counting skills among preschool children in Ibadan Southwest Local Government Area?

Counting Skill Level	***Before Exposure (n = 100)***	***After Exposure (n = 100)***
Excellent	10	38
Good	28	45
Fair	35	15
Poor	27	2

Interpretation

The table shows a notable improvement in children's counting skills after exposure to picture books. Before the intervention, only 10% demonstrated excellent skills, while 38% reached that level after using picture books. The percentage of children with poor counting skills dropped significantly from 27% to 2%. This suggests that picture books had a positive impact on the development of counting skills among preschoolers in the study area.

Research Question 2

How do picture books influence number recognition in preschool children?

Number Recognition Level	**Before Exposure (n = 100)**	**After Exposure (n = 100)**
Excellent	12	41
Good	25	40
Fair	33	15
Poor	30	4

Interpretation

There was a strong increase in the number of children who could correctly recognize numbers after exposure to picture books. This implies that visually stimulating and repetitive content in picture books helped children retain and identify numbers better, addressing the common literacy-numeracy imbalance observed in some Nigerian preschools.

Research Question 3

In what ways do picture books affect the development of spatial awareness among preschool learners?

Spatial Awareness Level	*Before Exposure (n = 100)*	*After Exposure (n = 100)*
High	9	32
Moderate	30	48
Low	38	17
Very Low	23	3

Interpretation
Spatial awareness improved significantly after the use of picture books, with "high" and "moderate" categories increasing. Nigerian preschool environments often lack sufficient hands-on learning materials, but picture books helped bridge this gap by introducing spatial concepts like size, direction, and position through illustrations.

Research Question 4

How do picture books enhance pattern recognition skills in early childhood?

Pattern Recognition Level	*Before Exposure (n = 100)*	*After Exposure (n = 100)*
Excellent	7	29
Good	22	43
Fair	40	22
Poor	31	6

Interpretation
The data show marked improvements in pattern recognition skills post-intervention. Patterning is an early math skill often underemphasized in Nigerian curricula. Picture books with repeated visual patterns helped children identify, match, and extend patterns, improving logical reasoning.

Research Question 5

How effective are picture books as a tool for developing foundational mathematics skills in preschool education within Ibadan South West?

Overall, Math Skill Proficiency	*Before Exposure (n = 100)*	*After Exposure (n = 100)*
High	11	36
Moderate	34	47
Low	38	15
Very Low	17	2

Interpretation:
Overall mathematics skills improved significantly among the preschoolers. The percentage of children rated "high" in overall math proficiency increased from 11% to 36%, and those rated "very low" dropped from 17% to 2%. This confirms that picture books are an effective, low-cost, and accessible resource for supporting mathematics development, especially in resource-limited Nigerian preschools.

Discussion of Findings

1. Counting Skills

The study revealed a marked improvement in counting abilities after preschool children were exposed to picture books. This aligns with the findings of Splinter et al. (2022), who emphasized that picture books integrating mathematical content can promote early mathematical development. Picture books present numbers within engaging narratives, making counting more meaningful and memorable for young learners. The observed improvement supports Cooper et al. (2018), who argued that picture books can effectively support early numeracy acquisition by providing contextual cues that foster understanding.

2. Number Recognition

A substantial increase in number recognition was observed among the children after the intervention. This finding is in line with Purpura et al. (2021), who found that engaging both caregivers and children with picture books improved children's use of mathematical language and symbol recognition. By presenting numbers repeatedly within a story or visual context, children become more familiar with their forms and uses, strengthening their recognition skills. This supports the view of Heuvel-Panhuizen and Boogaard (2008), who noted that even when not explicitly instructional, picture books can evoke cognitive engagement and deepen numeracy skills.

3. Spatial Awareness

Improvement in spatial awareness skills among the learners was also evident. This result resonates with the study of Björklund and Palmér (2020), who discovered that picture books help preschoolers develop reasoning and spatial understanding by encouraging them to interpret images, follow sequences, and locate objects. Visual storytelling naturally incorporates directional cues, shapes, and positions—fostering spatial thinking. The PICO-ma project (Heuvel-Panhuizen et al., 2009) further supports this, showing how storybooks embed spatial concepts in a non-intrusive and engaging manner.

4. Pattern Recognition

The children also showed enhanced abilities in recognizing patterns. This corroborates Ginsburg, Lee, and Boyd (2008), who asserted that early mathematics involves broad cognitive skills such as classification and patterning, which can be nurtured through intentional play and storytelling. Picture books often use repetitive text, recurring images, or sequencing in plots, which help children internalize the concept of patterns. Such learning strategies have been noted to foster logical reasoning and foundational mathematical thinking.

5. Overall Foundational Mathematics Skills

Overall, picture books proved effective in enhancing key mathematical domains: counting, number recognition, spatial awareness, and pattern recognition. This is supported by Maričić and Stakić (2023), who highlighted the methodological strength of using picture books to explore math ideas without direct instruction. Furthermore, Connor et al. (2022) affirmed that carefully selected and well-designed picture books significantly support early math learning. The Nigerian context, where access to hands-on instructional resources may be limited, benefits greatly from cost-effective and engaging tools like picture books to improve preschool education outcomes.

SUMMARY

This study investigated the impact of picture books on the development of mathematics skills among preschool children in Ibadan South West Local Government Area. Specifically, it examined how picture books influence counting skills, number recognition, spatial awareness, and pattern recognition. Using descriptive statistics, the findings revealed that picture books significantly improved the children's foundational mathematics skills. The study confirmed that when mathematical concepts are embedded in storylines and supported by engaging illustrations, young learners can develop a deeper understanding of mathematical ideas naturally and enjoyably.

CONCLUSION

The findings of the study demonstrate that picture books are a powerful instructional resource in early childhood education. They support cognitive development in mathematics by making abstract concepts tangible and relatable. In the Nigerian context, particularly in Ibadan South West, where limited instructional materials may hinder effective teaching, picture books provide a practical and engaging alternative for enhancing early mathematics learning. Integrating picture books into the preschool curriculum can lead to notable improvements in numeracy skills, which are essential for long-term academic success.

Recommendations

Based on the findings of the study, the following recommendations are made:

Teachers should incorporate picture books regularly into mathematics instruction to promote counting, number recognition, spatial awareness, and pattern recognition.

Curriculum planners should include picture book-based learning strategies in the early childhood education curriculum to enhance learners' engagement and understanding of mathematical concepts.

Government and educational NGOs should invest in the provision of quality, math-focused picture books in public preschools, particularly in under-resourced areas like Ibadan South West.

Caregivers and parents should be encouraged to read picture books with their children at home, creating opportunities for informal math learning in everyday settings.

Training programs and workshops should be organised for early childhood educators on how to effectively select and use picture books to support mathematics teaching and learning.

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