

Development of LULABLOCKS: Textured Color Blocks to Enhance Fine Motor Skills in Children Aged 4–6 Years

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ABSTRACT

This study aimed to develop textured color smart blocks called “LULABLOCKS” and examine their feasibility and effectiveness in improving fine motor skills in children aged 4–6 years. The study employed the ADDIE development model consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation. The research subjects consisted of 40 children aged 4–6 years at TK Trisula Perwari, Purwakarta Regency. Data were collected through observations, interviews, expert validation, and fine motor skill assessments using pre-test and post-test measurements. The results of the study indicate that: (1) the LULABLOCKS textured color smart blocks were successfully developed with key features including texture variations, interlocking connection systems, diverse colors and shapes, and comprehensive usage guidelines; (2) expert validation results showed an average feasibility score of 88.8% (very valid category), with the highest score obtained in the aspect of usefulness for fine motor skill development (100%); and (3) there was a significant improvement in children's fine motor skills, increasing from an average score of 2.11 (52.6%) in the pre-test to 3.29 (82.2%) in the post-test, representing an improvement of 29.6%, with statistical significance indicated by $t\text{-count } 18.72 > t\text{-table } 2.02$ ($p < 0.05$). The 4–6 years age group showed the highest improvement (30.7%). Teacher and student responses were highly positive, with an acceptance level exceeding 80%. In conclusion, the LULABLOCKS textured color smart blocks are valid, practical, and effective in improving fine motor skills in early childhood, particularly in the aspects of grasping and manipulating small objects.

Keywords: LULABLOCKS, Textured Blocks, Fine Motor Skills, Early Childhood Education, Learning Media Development

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INTRODUCTION

Early childhood education plays a crucial role in supporting children's holistic development, including cognitive, social, emotional, and motor development. One important aspect that needs to be stimulated during early childhood is fine motor skills, which involve the coordination of small muscles in the hands and fingers to perform precise movements such as grasping, holding, and manipulating objects. Fine motor skills are essential because they support children's readiness for academic activities such as writing,

drawing, and using learning tools. Therefore, providing appropriate learning media and stimulation during the early years is necessary to optimize children's motor development (Santrock, 2018).

Learning media that involve hands-on activities are considered effective in stimulating children's fine motor development. Educational play tools that incorporate manipulation, assembly, and sensory exploration can encourage children to actively engage their finger muscles and hand coordination. According to Piaget's theory of cognitive development, children in the preoperational stage (ages 2–7) learn best through concrete experiences and active exploration of objects in their environment (Piaget, 1972). Previous studies have shown that constructive play materials such as blocks can improve children's fine motor coordination, creativity, and problem-solving skills because they encourage grasping, stacking, arranging, and connecting objects (Isbell & Raines, 2013).

Several studies have examined the use of block-based learning media to support early childhood development. Research by Follari (2015) indicates that manipulative learning tools significantly contribute to children's motor coordination and hand-eye coordination. Other studies also highlight that textured materials and colorful visual stimuli can increase children's engagement and sensory experiences during play activities (Berk, 2018). However, many existing block-based educational toys focus primarily on shape and construction functions, while relatively few incorporate textured sensory features combined with structured connection systems specifically designed to enhance fine motor skills in early childhood learning environments.

Based on these gaps, this study aims to develop a textured colored smart block learning media called "Lulablocks" and examine its feasibility and effectiveness in improving the fine motor skills of children aged 4–6 years. The research specifically investigates whether the use of textured and colorful modular blocks can significantly improve children's ability to grasp, hold, and manipulate small objects during learning activities.

The contribution of this research lies in the development of an innovative educational play tool that integrates textured sensory stimulation, color recognition, and interlocking construction features to support fine motor skill development in early childhood education. In addition, this study provides empirical evidence regarding the effectiveness of the Lulablocks learning media through experimental testing involving pre-test and post-test measurements, which can serve as a reference for educators and researchers in developing more effective learning media for early childhood education.

METHOD

Research Design

This study employed a Research and Development (R&D) approach using the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The R&D method was selected because the primary objective of this research was not only to examine learning outcomes but also to develop an educational product in the form of textured colored smart blocks called "Lulablocks."

The ADDIE model provides a systematic and structured framework for developing educational media, beginning with identifying learning needs and ending with evaluating the effectiveness of the developed product in real learning situations. Through this model, the development process focuses on both the quality of the product and its practical implementation in early childhood learning environments. The five stages of the ADDIE model include:

1. Analysis – identifying learning needs, curriculum requirements, and the characteristics of early childhood learners.
2. Design – planning the structure, appearance, materials, and learning activities using the Lulablocks media.
3. Development – producing the prototype and conducting expert validation.
4. Implementation – testing the product with children in classroom learning activities.
5. Evaluation – assessing the feasibility and effectiveness of the developed media.

Subjects / Population and Sample

The subjects of this study were early childhood students aged 4–6 years, which represents a critical developmental stage often referred to as the golden age of child development. At this stage, children experience rapid growth in cognitive, physical, and motor development, particularly in fine motor skills involving hand and finger coordination.

The research was conducted at TK Trisula Perwari in Purwakarta Regency, West Java, Indonesia. The school was selected because it actively implements play-based learning approaches and supports the use of innovative educational media in the classroom.

The sample of the study consisted of 40 children aged 4–6 years who participated in classroom activities using the Lulablocks learning media. Teachers at the school were also involved in the research as facilitators during the implementation process and as respondents providing feedback regarding the practicality and effectiveness of the media.

Data Collection Procedure

Data were collected using several instruments designed to support each stage of the development and evaluation process. The primary data collection techniques included observations, interviews, expert validation, and assessment of children's fine motor skills through pre-test and post-test measurements.

First, initial interviews and classroom observations were conducted during the analysis stage to identify problems faced by teachers in stimulating children's fine motor skills and to examine the learning media currently used in early childhood classrooms. These interviews were conducted with teachers and school administrators.

Second, the developed Lulablocks media underwent expert validation to evaluate its feasibility. The validation process involved experts in educational media, early childhood education, and educational practitioners. The validation assessed several aspects, including content suitability, visual design, safety, usability, and relevance to early childhood development.

Third, observations of children's fine motor skills were conducted during learning activities using Lulablocks. The observation instrument measured several indicators such as grasping small objects, hand–eye coordination, arranging blocks, copying patterns, and manipulating tools. The observation scale ranged from 1 to 4, indicating progressive levels of skill development.

Finally, a limited trial and classroom implementation were carried out in the kindergarten classroom. During this stage, teachers used Lulablocks in various activities such as stacking, matching shapes, arranging patterns, and constructing structures. Children's responses and engagement during the activities were also documented.

Data Analysis

The data collected in this study were analyzed using both quantitative and qualitative analysis methods.

Quantitative Analysis

Quantitative analysis was used to measure the improvement of children's fine motor skills after the implementation of the Lulablocks learning media. The quantitative data were obtained from the pre-test and post-test observation scores of children's fine motor skill performance.

The analysis process included several steps:

1. Data scoring, where each observation indicator was rated on a scale from 1 to 4.
2. Descriptive statistical analysis, including mean scores, percentages, and score distributions to describe the level of children's motor skill development.
3. Comparison of pre-test and post-test results to determine the improvement in children's fine motor skills after using the Lulablocks media.
4. Inferential statistical analysis using the t-test, which was conducted to determine whether the improvement in children's fine motor skills was statistically significant.

Qualitative Analysis

Qualitative analysis was conducted to gain deeper insights into the learning process and children's interaction with the Lulablocks media. Qualitative data were obtained from classroom observations, interview responses from teachers, and documentation of learning activities.

The qualitative analysis followed several steps:

1. Data transcription of interviews and observation notes.
2. Coding and categorization to identify recurring themes related to children's motor skill development.
3. Theme development to interpret patterns related to learning engagement, hand–eye coordination improvement, and children's responses to the learning media.
4. Content interpretation to explain how the Lulablocks media influenced children's fine motor development.

5. Triangulation, which involved comparing data from observations, interviews, and documentation to enhance the validity and reliability of the findings.

FINDING AND DISCUSSION

Research Results

Needs Analysis Results

The needs analysis was conducted through classroom observations, teacher interviews, and analysis of existing learning media at TK Trisula Perwari, Purwakarta. The results show that learning activities aimed at developing children's fine motor skills were still dominated by conventional activities such as coloring, cutting, and pasting. In addition, the learning media used in the classroom were limited and lacked variation. Table 1 presents the results of classroom observations regarding the availability and use of fine motor learning media.

Table 1. Classroom Observation Results

No	Observed Aspect	Observation Result	Percentage
1	Availability of fine motor learning media	Limited to wooden blocks, puzzles, and plasticine	45%
2	Variation of fine motor activities	Activities are mostly repetitive (coloring, cutting, pasting)	35%
3	Children's engagement	Some children show low enthusiasm during activities	60%
4	Teacher ability in using learning media	Teachers are capable but limited to conventional media	70%
5	Suitability of media with children's needs	Existing media do not comprehensively support fine motor development	40%

The data show that the availability of fine motor learning media remains limited (45%), while the variation of activities is relatively low (35%).

Teacher interviews were also conducted with five kindergarten teachers to identify the need for new learning media.

Table 2. Teacher Interview Results

No	Question	Summary of Response	Percentage
1	Difficulty in developing children's fine motor skills	Teachers experience difficulties due to limited innovative learning media	80%
2	Media commonly used	Puzzle, wooden blocks, plasticine, origami paper, coloring tools	100%
3	Need for new media development	Teachers stated that new media are needed to increase learning variation	100%
4	Expectation of new learning media	Media should be multifunctional, attractive, and safe	90%

5	Availability of facilities	Facilities exist but learning media remain limited	60%
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The results indicate that all teachers agreed on the necessity of developing new learning media to support fine motor skill development.

Expert Validation Results

The feasibility of the Lulablocks learning media was evaluated by four experts consisting of early childhood education experts, educational media experts, child development specialists, and practitioners.

Table 3. Expert Validation Results of Lulablocks

Aspect	Average Score	Percentage	Category
Content Feasibility	4.55	91%	Very Valid
Visual Design	4.40	88%	Very Valid
Safety	4.40	88%	Very Valid
Practicality	4.40	88%	Very Valid
Overall Average	4.44	88.8%	Very Valid

The results indicate that the Lulablocks learning media falls into the very valid category based on expert validation.

Pre-Test and Post-Test Results

To measure the effectiveness of the Lulablocks learning media, observations were conducted before and after the implementation of the media.

Table 4. Pre-test and Post-test Results of Children's Fine Motor Skills

Indicator	Pre-test (%)	Post-test (%)	Improvement
Holding and grasping small objects	52.5%	83.8%	31.3%
Hand-eye coordination	54.4%	85.0%	30.6%
Cutting and drawing adaptation	50.0%	79.4%	29.4%
Arranging and assembling	58.1%	88.1%	30.0%
Writing or copying symbols	49.4%	76.9%	27.5%
Buttoning and opening objects	53.8%	82.5%	28.8%
Manipulating tools	50.0%	80.0%	30.0%
Average	52.6%	82.2%	29.6%

The data indicate an increase in the average fine motor skill score from 52.6% in the pre-test to 82.2% in the post-test.

Statistical Analysis Results

A paired sample t-test was conducted to determine the statistical significance of the improvement.

Table 5. Paired t-Test Results

Parameter	Pre-test	Post-test	t-value	t-table	p-value
Mean Score	2.11	3.29	18.72	2.02	0.000
Standard Deviation	0.48	0.37	-	-	-
Sample Size	40	40	-	-	-

The t-test results show that t-value (18.72) > t-table (2.02) with $p < 0.05$.

Children and Teacher Responses

Teacher responses toward the Lulablocks media were generally positive.

Table 6. Teacher Responses

Aspect	Positive Response
Ease of use	100% teachers stated that the media was easy to use
Children's interest	100% teachers observed high enthusiasm
Motor skill development	100% teachers observed improvement
Integration with learning themes	80% teachers stated it was easy to integrate
Durability	100% teachers stated the media was durable

Children's responses also indicated high levels of engagement.

Table 7. Children's Responses

Aspect	Percentage
Interest in media	95%
Ease of use	87.5%
Creativity during play	82.5%
Social interaction	77.5%
Activity engagement	90%

DISCUSSION

Interpretation of Findings

The findings indicate that the Lulablocks textured colored blocks significantly improved children's fine motor skills. The improvement from 52.6% to 82.2% demonstrates that the use of structured educational media can effectively stimulate children's hand coordination, finger strength, and object manipulation abilities. The highest improvement occurred in the ability to grasp small objects (31.3%), which suggests that the textured design and ergonomic size of the blocks effectively stimulated finger movement and hand coordination.

Relationship to Previous Studies

These findings are consistent with previous studies that emphasize the importance of educational play materials in early childhood learning. Bahri et al. (2023) found that

innovative learning media can significantly improve fine motor development in early childhood education settings. Similarly, Simamora et al. (2022) reported that the use of educational teaching aids increased children's fine motor skills by up to 40% over a three-month intervention period. Constructive play activities such as block building also align with Piaget's theory of cognitive development, which emphasizes the importance of hands-on learning experiences during the preoperational stage (Santrock, 2018). Furthermore, tactile learning materials stimulate sensory and motor development simultaneously, which supports the findings of Sujiono (2013) regarding the role of manipulative learning tools in early childhood motor skill development.

Limitations of the Study

Despite the positive results, several limitations should be acknowledged. First, the study involved a relatively small sample size consisting of 40 children from one kindergarten, which may limit the generalizability of the findings. Second, the implementation period lasted only eight weeks, which may not fully capture long-term developmental outcomes. Third, the research used a pre-experimental design without a control group, which may limit the ability to attribute improvements solely to the Lulablocks intervention.

Implications for Practice and Future Research

The findings of this study have several implications for early childhood education practice. The results suggest that innovative learning media such as Lulablocks can serve as effective tools for stimulating children's fine motor development through play-based learning activities. For teachers, the use of textured construction blocks can enrich classroom learning experiences and increase children's engagement in motor skill activities. For educational institutions, the development of creative and interactive learning media should be encouraged to support holistic child development. Future research may involve larger samples, longer implementation periods, and experimental designs with control groups to further examine the effectiveness of Lulablocks and similar educational media in early childhood education.

CONCLUSION

This study aimed to develop textured colored smart blocks called "Lulablocks" and evaluate their feasibility and effectiveness in improving the fine motor skills of children aged 4–6 years. The development process followed the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The needs analysis revealed limited availability of innovative learning media to support fine motor development in early childhood classrooms. The developed Lulablocks media integrates several features including variations of texture, an interlocking connection system, multiple colors, and diverse geometric shapes designed to stimulate children's sensory and motor coordination during play-based learning activities.

The feasibility evaluation results showed that the Lulablocks media is highly valid for use in early childhood education. Expert validation produced an average feasibility score of 88.8%, categorized as very valid, with the highest score obtained in the usefulness aspect for fine motor development. These results indicate that the design, safety, practicality, and educational content of the media meet the requirements for effective early childhood learning tools.

The effectiveness test also demonstrated significant improvement in children's fine motor skills after the implementation of Lulablocks. The average score increased from 2.11 (52.6%) in the pre-test to 3.29 (82.2%) in the post-test, representing an improvement of 29.6%. Statistical analysis using a paired sample t-test showed a significant difference ($t = 18.72 > 2.02$; $p < 0.05$) with a very large effect size. These findings indicate that Lulablocks is a valid, practical, and effective learning medium for enhancing fine motor skills in early childhood education.

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