

## Development of A “*Cheerful Engklek Carpet*” Game as A Learning Medium to Enhance Spatial Intelligence in Early Childhood

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### ABSTRACT

Spatial intelligence is a fundamental ability that needs to be developed from an early age; however, its stimulation remains limited due to the lack of learning media that integrate visual, kinesthetic, and cognitive aspects. This study aims to: (1) develop the *Cheerful Engklek Carpet* game to stimulate spatial intelligence in early childhood, (2) examine the feasibility of the game, and (3) test its effectiveness in enhancing children’s spatial intelligence. This research employed a Research and Development (R&D) method using a modified 4D model (Define, Design, Develop, Disseminate). The subjects consisted of 48 children aged 5–6 years at TK Plus Tunas Rimba, Purwakarta Regency, divided into an experimental group (24 children) and a control group (24 children). Data were collected through expert validation, observation, interviews, and spatial intelligence tests, and analyzed using descriptive and inferential statistics (independent and paired sample t-tests). The results indicate that the developed game is highly feasible (4.65), practical (4.41), and well-implemented (95.6%). It is also highly effective, with a 49.6% improvement in the experimental group compared to 7.0% in the control group ( $p < 0.001$ ; Cohen’s  $d = 2.92$ ). In conclusion, the *Cheerful Engklek Carpet* game is highly feasible and effective in holistically stimulating spatial intelligence in early childhood.

**Keywords:** *Student Creativity, Craft Media, Project-Based Learning*

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## INTRODUCTION

Early Childhood Education (ECE) plays a fundamental role in shaping children’s cognitive, social, and motor development, serving as a critical foundation for lifelong learning (Zhou, 2023). Within the domain of cognitive development, spatial intelligence has emerged as a key competency, encompassing the ability to understand, manipulate, and navigate spatial relationships. This ability is strongly associated with success in Science, Technology, Engineering, Arts, and Mathematics (STEAM), as well as problem-solving and creativity skills (Johnston et al., 2022). Despite its importance, the stimulation of spatial intelligence in early childhood settings remains limited, particularly due to the lack of learning media that effectively integrate visual, kinesthetic, and cognitive dimensions.

In practice, early childhood educators frequently rely on two-dimensional and static instructional media, such as worksheets and picture-based materials, to introduce spatial concepts. This approach tends to limit children’s active engagement and restrict opportunities for embodied exploration through physical movement (Lina Amelia, 2015; Liu et al., 2023; Mohamed & O’Brien, 2022). From the perspective of embodied cognition theory,

learning is enhanced when cognitive processes are grounded in bodily actions and interactions with the environment (Goldinger et al., 2016). Therefore, learning media that encourage active movement are essential to strengthen spatial understanding while simultaneously increasing children's emotional engagement.

Several international studies have explored movement-based learning tools, such as interactive floor systems designed to stimulate spatial skills through guided physical activities (Hong, 2018; Hu et al., 2023; Polinsky et al., 2021). These studies demonstrate that structured motor activities can significantly improve children's spatial orientation abilities. However, previous designs often rely on static movement patterns and lack comprehensive evaluation of transfer learning in real-life contexts (Safadel & White, 2020). In Indonesia, similar efforts have primarily focused on traditional floor games to enhance motivation and motor skills, with limited quantitative assessment of spatial intelligence outcomes (Anggraeni & Na'imah, 2022; Wondal et al., 2023).

This gap highlights the need for innovative learning media that combine dynamic movement patterns, cultural relevance, and interactive elements. Specifically, there is a lack of development integrating local cultural content, such as flora and fauna, alongside multimodal features like audio-visual guidance. Furthermore, previous research rarely incorporates holistic evaluation approaches, including pre-test and post-test measurements, transfer learning observation, and socio-emotional responses. Addressing this gap, the present study adopts a modified 4D Research and Development (R&D) model to design and evaluate the "Cheerful Engklek Carpet," a movement-based learning medium aimed at optimizing spatial stimulation in early childhood.

The research problem addressed in this study is formulated as follows: how to develop, validate, and evaluate the effectiveness of the Cheerful Engklek Carpet game in stimulating spatial intelligence among early childhood learners. Accordingly, this study aims to (1) develop the Cheerful Engklek Carpet as an innovative learning medium, (2) examine its feasibility and practicality, and (3) test its effectiveness in improving children's spatial intelligence.

This study contributes to the field in several significant ways. Theoretically, it integrates multimedia learning theory with embodied cognition to provide a comprehensive framework for movement-based learning in early childhood (Goldinger et al., 2016; Mayer, 2020). Practically, it offers an innovative, culturally contextualized, and portable learning medium that incorporates interactive elements such as visual symbols and audio-visual instructions. Methodologically, this study introduces a holistic evaluation approach that includes cognitive outcomes, transfer learning, and socio-emotional responses. Thus, the Cheerful Engklek Carpet not only enriches the literature on educational media development but also provides a practical prototype that can be readily implemented in early childhood education settings.

## **METHOD**

### **Research Design**

This study employed a mixed-method Research and Development (R&D) design, integrating both qualitative and quantitative approaches to develop and evaluate an innovative learning medium. The R&D process was based on a modified 4D model (Define, Design, Develop, Disseminate), which allows systematic product development and iterative evaluation. The qualitative approach was used during the needs analysis and product

refinement stages, while the quantitative approach was applied to test the feasibility and effectiveness of the developed media. This design enables a comprehensive understanding of both the development process and the impact of the product on children's spatial intelligence.

### **Subjects and Sample**

The subjects of this study were 48 children aged 5–6 years enrolled at TK Plus Tunas Rimba, Purwakarta Regency, Indonesia. The participants were divided into two groups: an experimental group (24 children) and a control group (24 children). The selection of participants was based on purposive sampling, considering their developmental stage and suitability for spatial learning interventions. The children exhibited heterogeneous socio-economic backgrounds and typical developmental characteristics, making them appropriate for testing the effectiveness of the "Cheerful Engklek Carpet" game.

### **Research Setting and Duration**

The study was conducted at TK Plus Tunas Rimba, a well-established early childhood education institution in Purwakarta Regency, West Java, Indonesia. The research took place over a five-month period, from September 2025 to January 2026. This duration allowed sufficient time to complete all stages of the 4D model, including needs analysis, product design, prototype development, limited and large-scale trials, and final dissemination.

### **Data Collection Procedures**

Data were collected using multiple techniques to ensure comprehensive and valid findings. These included:

1. Observation: Used to assess children's engagement, behavior, and spatial intelligence development during learning activities.
2. Interviews: Conducted with teachers to gather insights into classroom practices, challenges, and responses to the developed media.
3. Expert Validation: Involving early childhood education and media experts to evaluate the feasibility, content accuracy, and design quality of the product.
4. Spatial Intelligence Tests: Pre-test and post-test were administered to measure the effectiveness of the intervention.
5. Documentation: Photos and videos were collected to support observational data and provide contextual evidence.

The instruments included observation sheets, interview guidelines, validation checklists, and spatial intelligence assessment rubrics covering dimensions such as spatial orientation, visualization, relations, memory, and perception.

### **Data Analysis**

Data analysis was conducted using both qualitative and quantitative techniques.

Qualitative data from observations and interviews were analyzed using the Miles and Huberman model, which includes data reduction, data display, and conclusion drawing. This analysis was used to interpret contextual findings and improve the product design.

Quantitative data were analyzed using descriptive and inferential statistics. Descriptive analysis was used to determine the level of feasibility, practicality, and implementation of the product. Inferential analysis included:

1. Paired Sample t-test to examine differences in pre-test and post-test scores within groups
2. Independent Sample t-test to compare differences between experimental and control groups

Additionally, effectiveness was measured through percentage improvement and effect size (Cohen’s d). The level of spatial intelligence achievement was categorized based on predefined criteria, ranging from “Not Yet Developed” to “Very Well Developed.”

## FINDING AND DISCUSSION

### RESEARCH RESULT

#### Main Results

The results of this study are presented based on the three main research objectives: development, feasibility, and effectiveness of the “*Karpet Engklek Ceria*” in stimulating spatial intelligence in early childhood.

#### Product Development Results

The development process followed the 4D model (Define, Design, Develop, Disseminate). The product generated is a learning media in the form of a spatial-based hopscotch carpet equipped with visual symbols, directional cues, and structured activity zones. The development outputs include A physical learning media (*Karpet Engklek Ceria*), Teacher implementation guidelines, Observation instruments for spatial intelligence, Validation instruments for expert assessment.

#### Feasibility Test Results (Expert Validation)

The feasibility of the product was evaluated by experts in early childhood education and learning media using a validation instrument.

**Table 1. Expert Validation Results**

Aspect	Average Score (%)	Category
Content Feasibility	88%	Very Valid
Construction/Presentation	85%	Very Valid
Visual Appearance	90%	Very Valid
Media Usability	87%	Very Valid
Overall Average	<b>87.5%</b>	<b>Very Valid</b>

#### Limited Trial Results

A limited trial was conducted involving 6–8 children over a 2-week period.

**Table 2. Pre-test and Post-test Results (Limited Trial)**

Indicator	Pre-test (%)	Post-test (%)
Spatial Orientation	52%	72%
Spatial Perception	50%	70%
Spatial Relation	48%	68%
Visual-Motor Coordination	55%	75%
Spatial Imagination	45%	65%
Average	<b>50%</b>	<b>70%</b>

## Large-Scale Trial Results

A broader trial was conducted with 20–25 children over 4 weeks.

**Table 3. Pre-test and Post-test Results (Large Trial)**

Indicator	Pre-test (%)	Post-test (%)
Spatial Orientation	60%	85%
Spatial Perception	58%	83%
Spatial Relation	55%	80%
Visual-Motor Coordination	62%	87%
Spatial Imagination	54%	78%
<b>Average</b>	<b>57.8%</b>	<b>82.6%</b>

## Achievement Level of Spatial Intelligence

The achievement level of children’s spatial intelligence was categorized based on percentage criteria.

**Table 4. Spatial Intelligence Achievement Category**

Percentage Range	Category
85–100%	Very Well Developed
70–84%	Developed as Expected
50–69%	Beginning to Develop
< 50%	Not Yet Developed

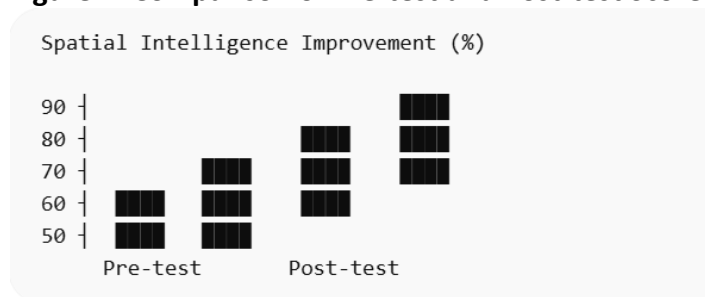
## Distribution of Children’s Achievement (Large Trial)

**Table 5. Distribution of Development Categories**

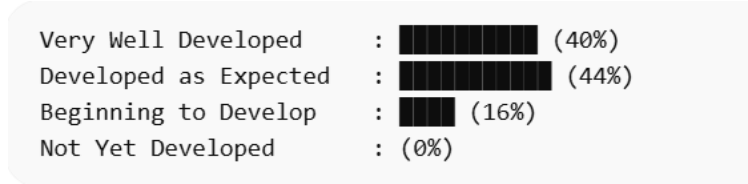
Category	Number of Children	Percentage
Very Well Developed	10	40%
Developed as Expected	11	44%
Beginning to Develop	4	16%
Not Yet Developed	0	0%

## Data Visualization

**Figure 1. Comparison of Pre-test and Post-test Scores**



**Figure 2. Achievement Distribution (Large Trial)**



### Summary of Findings

1. The developed product was successfully produced through the 4D model.
2. Expert validation results showed an overall score of **87.5% (Very Valid)**.
3. Limited trial results increased from **50% to 70%**.
4. Large-scale trial results increased from **57.8% to 82.6%**.
5. The majority of children were in the **“Developed as Expected”** and **“Very Well Developed”** categories.

### DISCUSSION

The findings of this study indicate that the *Karpet Engklek Ceria* is a feasible and effective learning medium for stimulating spatial intelligence in early childhood. The expert validation results, which reached an overall score of 87.5% in the “very valid” category, demonstrate that the developed media meets the criteria of content suitability, construction, visual design, and usability. This suggests that the product is appropriate for implementation in early childhood learning settings.

The improvement in children’s spatial intelligence scores from pre-test to post-test in both limited and large-scale trials shows a consistent upward trend. In the limited trial, the average score increased from 50% to 70%, while in the large-scale trial, it increased from 57.8% to 82.6%. These results indicate that the use of movement-based and visually structured media contributes positively to children’s ability to understand spatial concepts such as direction, position, distance, and spatial relationships. The highest improvement was observed in the visual-motor coordination indicator, suggesting that physical engagement through jumping, balancing, and navigating the carpet plays a significant role in strengthening coordination between perception and movement. Additionally, the increase in spatial orientation and perception indicates that children become more responsive to directional cues and visual patterns embedded in the media.

These findings highlight the importance of integrating physical activity with cognitive stimulation in early childhood education. The *Karpet Engklek Ceria* functions not only as a play tool but also as a structured learning medium that bridges motor skills and spatial cognition in a meaningful way.

### Relationship to Literature

The results of this study are consistent with the theory of multiple intelligences proposed by Howard Gardner, which emphasizes that spatial intelligence can be developed through activities involving visualization, movement, and interaction with the environment. The use of a hopscotch-based carpet aligns with this theory, as it combines visual-spatial elements with bodily-kinesthetic activities. Furthermore, the findings support the views of John W. Santrock, who states that early childhood is a critical period for developing motor and cognitive abilities simultaneously. The integration of movement and spatial tasks in this study reflects this developmental principle.

Previous studies on game-based learning in early childhood education have also shown similar results. Research indicates that interactive and physically engaging media can enhance children's understanding of spatial concepts more effectively than passive learning methods. The results of this study reinforce these findings by demonstrating measurable improvements across multiple spatial intelligence indicators. In addition, the use of traditional game adaptation, such as hopscotch, aligns with culturally responsive pedagogy, where local or familiar play forms are modified into educational tools. This supports the idea that contextual and culturally relevant media can increase children's engagement and learning outcomes.

### **Limitations of the Study**

Despite the positive findings, several limitations should be acknowledged. First, the study was conducted in a single institution, which may limit the generalizability of the results to other early childhood education settings with different characteristics. Second, the duration of the implementation, although sufficient for initial evaluation, may not fully capture the long-term impact of the media on children's spatial intelligence development. A longer observation period could provide more comprehensive insights into sustained learning outcomes. Third, the sample size, particularly in the limited trial phase, was relatively small. While the large-scale trial involved more participants, further studies with larger and more diverse samples are needed to strengthen the validity of the findings. Additionally, the assessment relied primarily on observational instruments, which may be subject to observer bias despite the use of structured rubrics. Variations in teacher assistance during implementation could also influence children's performance.

### **Implications**

The findings of this study have several important implications for both practice and future research. From a practical perspective, the *Karpet Engklek Ceria* can be used as an innovative learning medium in early childhood education to support the development of spatial intelligence through active play. Teachers are encouraged to integrate movement-based learning tools into daily classroom activities to create a more engaging and holistic learning environment.

For curriculum development, this study suggests that incorporating spatial and motor-based activities into thematic learning can enhance children's cognitive development. Educational institutions may consider adopting similar media or adapting traditional games into structured learning tools.

For future research, it is recommended to:

1. Conduct longitudinal studies to examine the long-term effects of the media on spatial intelligence.
2. Expand the study to different regions and educational settings to test its broader applicability.
3. Explore the integration of digital or augmented features to enhance interactivity.
4. Investigate the impact of the media on other developmental domains, such as social-emotional skills and creativity.

Overall, this study contributes to the growing body of research emphasizing the importance of play-based, movement-oriented learning in early childhood education, particularly in fostering spatial intelligence.

## CONCLUSION

This study set out to develop, validate, and test the effectiveness of the “Karpets Engklek Ceria” as a learning medium to stimulate spatial intelligence in early childhood. Based on the research findings, several key conclusions can be drawn.

First, the development of the learning media followed a modified 4D model consisting of Define, Design, Develop, and Disseminate stages. The process began with a comprehensive needs analysis, which revealed a strong demand for an integrated learning medium that combines visual, motor, and cognitive elements. The resulting product successfully transformed a traditional game into an innovative, structured, and educational tool suitable for early childhood learning. Second, the feasibility of the developed media was confirmed through expert validation. The average validation score indicated that the product falls into the “highly feasible” category, meaning it is appropriate both conceptually and practically for classroom use. This demonstrates that the design, content, and usability of the media align well with early childhood learning principles. Third, the effectiveness test showed that the “Karpets Engklek Ceria” significantly improved children’s spatial intelligence. The experimental group demonstrated higher post-test results compared to the control group, indicating that the media is highly effective in stimulating spatial abilities through active, movement-based learning.

## Implications and Suggestions

The findings of this study suggest that integrating physical activity with cognitive learning can provide meaningful stimulation for young children’s development. This media can be practically applied in early childhood education settings as an engaging and effective learning tool.

For future research, it is recommended to:

1. Conduct longitudinal studies to examine long-term impacts.
2. Test the media in diverse educational settings to enhance generalizability.
3. Explore the influence of spatial intelligence development on other domains such as early mathematics and problem-solving skills.

In practical terms, educators and institutions are encouraged to adopt and adapt similar movement-based learning innovations to create more interactive and developmentally appropriate learning experiences for children.

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