



Development of Used Cardboard Media Into A *Weather Box* to Develop Cognitive Development in Early Childhood Ages 4-5 Years

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Abstract

This study is motivated by the low cognitive abilities of children aged 4–5 years at KB Melati Rejo Binangun in understanding weather concepts, which is caused by the limited availability of innovative, engaging, and developmentally appropriate learning media. Preliminary data indicates that most children are still categorized as Not Yet Developed (BB) and Beginning to Develop (MB) in cognitive indicators related to weather recognition. Therefore, this study aims to develop a learning media made from recycled cardboard called the *Weather Box* and to examine its effectiveness in improving children's cognitive abilities. This study employs a Research and Development (R&D) method using the ADDIE model, which consists of analysis, design, development, implementation, and evaluation stages. The research subjects are children aged 4–5 years in the 2024/2025 academic year. Data collection techniques include observation, interviews, and oral post-tests using guiding questions. The cognitive indicators measured include the ability to recognize weather symbols, relate weather to daily activities, think critically and creatively, and understand the impacts of weather. The results show that the *Weather Box* effectively attracts children's attention, is easy to use, creates an interactive learning environment, and helps children understand weather concepts concretely. In addition, this media promotes environmental awareness through the use of recycled materials as an educational and enjoyable learning tool. The contribution of this study lies in the development of an innovative learning media based on recycled materials, which can be used by early childhood educators as an affordable, engaging, and environmentally friendly alternative to support cognitive learning, while also providing concrete learning experiences for young children in understanding weather concepts.

Keywords : Early Childhood Education, Recycled Cardboard, Weather Box

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INTRODUCTION

Early childhood education (PAUD) is the primary foundation for developing the quality of future human resources. At this stage, children experience rapid development, particularly in cognitive aspects, including the ability to think, understand, remember, and solve problems. Children aged 4–5 years begin to demonstrate development in their ability to recognize symbols, connect concepts with everyday experiences, and develop simple and creative thinking skills (Papalia & Martorell, 2021). Therefore, the learning process at this stage must be designed appropriately through an approach that aligns with children's

developmental characteristics, namely through direct experience, play, and the use of concrete and engaging media.

However, the reality on the ground shows that the learning process in early childhood education (PAUD) still faces various obstacles, particularly the use of less innovative learning media. Learning media plays a crucial role as a medium in conveying material so that it is more easily understood by children (Arsyad, 2017). The right media can increase learning motivation, clarify abstract concepts, and create a fun learning experience. Conversely, the use of limited and monotonous media can lead to children's lack of interest and difficulty understanding the learning material.

This problem was discovered at KB Melati Rejo Binangun, North Raman District, East Lampung Regency. Based on initial observations, the learning process is still dominated by lecture methods with minimal use of educational props. This condition impacts children's low understanding of the material, especially the abstract concept of weather. Pre-survey data shows that of 8 children aged 4–5 years, there are 5 children in the Not Yet Developing (BB) category and 3 children in the Starting to Develop (MB) category, and no child has reached the Developing According to Expectations (BSH) or Very Good Development (BSB) categories. Indicators measured include the ability to recognize weather concepts, relate weather to daily activities, think critically and creatively, and understand the impact of weather. These data indicate that there is a gap between learning objectives and achieved outcomes, which indicates the need for innovation in learning media.

The concept of weather is part of simple science learning that is very relevant to children's lives. Children often experience weather phenomena such as heat, rain, and wind, but are unable to systematically grasp these concepts without the aid of concrete media. Science learning in early childhood should be conducted through direct experience and exploration, allowing children to actively construct their understanding (Wortham, 2018). Therefore, the use of interactive learning media is crucial to helping children grasp weather concepts more easily and meaningfully.

Several previous studies have demonstrated that innovative learning media positively impacts the cognitive development of early childhood. Research by Nurlaela and Suyadi (2020) demonstrated that using number blocks made from recycled cardboard significantly improves children's number recognition skills. Research by Gusniarti et al. (2021) also found that cardboard-based number cards enhance children's cognitive development through interactive learning activities. Furthermore, research by Santika et al. (2022) suggests that utilizing recycled materials as learning media can enhance children's understanding of basic concepts and creativity.

Although the research is relevant, there are several limitations that constitute research gaps. First, most studies still focus on recognizing numbers, symbols, or other basic skills, and have not specifically examined media development for simple science learning such as weather concepts. Second, the research methods used are generally Classroom Action Research (CAR) or descriptive, so there is not much research that systematically develops media products using a Research and Development (R&D) approach. Third, there is not much research that integrates the use of recycled materials with environmental-based learning and children's direct experiences.

Based on this gap, this research presents a novelty *in* developing a cardboard-based learning medium called the Weather Box. This medium is designed as an interactive box containing various weather symbols such as the sun, clouds, rain, and wind, and is equipped with activities such as matching images and answering simple questions. This medium not only helps children understand weather concepts concretely but also encourages active involvement in the learning process through a learning-by-doing approach (Berk, 2020). Furthermore, the use of used cardboard as the main material also provides educational value in instilling environmental awareness from an early age (Sudjana & Rivai, 2019).

This research is important because it provides solutions to learning challenges in early childhood education (PAUD), particularly in improving children's cognitive abilities through innovative, economical, and environmentally friendly media. Furthermore, this research contributes to the development of recycled-material-based learning media in early childhood education. By integrating simple science concepts and a playful approach, this research is expected to enrich more effective and contextual learning strategies.

The objectives of this study are: (1) to develop a *Weather Box learning media* based on used cardboard for children aged 4–5 years at KB Melati Rejo Binangun; (2) to test the effectiveness of the media in improving children's cognitive abilities; and (3) to analyze the advantages and challenges in implementing the media. The hypothesis in this study is that the use of the *Weather Box media* can significantly improve the cognitive abilities of early childhood children, especially in understanding the concept of weather.

This study used the *Research and Development* (R&D) method with the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The variables in this study included the *Weather Box learning media* as the independent variable and children's cognitive abilities as the dependent variable. Data collection techniques were conducted through observation, interviews, and oral posttests to measure the improvement in children's cognitive abilities after using the media.

Thus, this research is expected to provide tangible contributions both theoretically and practically. Theoretically, this research enriches the study of innovative learning media in early childhood education. Practically, this research provides alternative solutions for PAUD teachers in developing creative, engaging, and child-centered learning media. Furthermore, this research is also expected to serve as a reference for further research in developing more varied and innovative environment-based learning media.

METHOD

This study used a *Research and Development* (R&D) approach with the ADDIE model, which includes analysis, design, development, implementation, and evaluation. This approach was chosen because the research aims not only to test but also to produce a product in the form of learning media that is appropriate and effective for use in early childhood learning (Sugiyono, 2019). The ADDIE model was used because it is systematic and appropriate for developing learning media based on field needs (Branch, 2009). The population in this study was all children aged 4–5 years at KB Melati Rejo Binangun, North Raman District, East Lampung Regency in the 2024/2025 academic year. The study sample used a saturated *sampling technique*, where the entire population was used as research subjects due to the limited number of children, namely 8 children. The characteristics of the research subjects reflect real conditions in the field, so the research results are expected to be relevant and contextual to learning practices in Early Childhood Education (PAUD).

The research instruments used included observation sheets, interview guides, and an oral posttest. The observation sheets were used to observe children's learning activities and cognitive development during the learning process. The interview guides were used to obtain supporting data from teachers regarding learning conditions and media use. Meanwhile, the oral posttest was conducted using trigger questions tailored to early childhood cognitive ability indicators. Indicators measured included the ability to recognize weather symbols, relate weather to daily activities, think critically and creatively, and understand the impact of weather. This instrument was developed based on early childhood cognitive development standards and adapted to the learning context (Permendikbud, 2014). The research procedure was carried out in stages according to the ADDIE model. In the analysis stage, the researcher identified learning needs through initial observations and interviews with teachers, which indicated that the learning media used were still limited and less interesting. In the design stage, the researcher designed the *Weather Box media* by considering the characteristics of early childhood, including the use of color, images, and

interactive activities. In the development stage, the media was made from used cardboard equipped with weather symbols such as the sun, clouds, rain, and wind, as well as activities to match images and answer simple questions. The implementation phase involved piloting the *Weather Box media* with children aged 4–5 years in classroom learning activities. The learning activities were designed interactively, actively involving children in the use of the media. Next, an evaluation phase was conducted to assess the media's effectiveness in improving children's cognitive abilities based on observations and an oral posttest. The research process was conducted during the odd semester of the 2024/2025 academic year.

Data analysis was conducted using simple qualitative and quantitative descriptive methods. Observation and interview data were analyzed qualitatively to describe the learning process and children's responses to media use. Meanwhile, posttest data were analyzed quantitatively by comparing children's cognitive achievement before and after media use. Child development categories refer to PAUD assessment standards: Not Yet Developing (BB), Beginning to Develop (MB), Developing as Expected (BSH), and Developing Very Well (BSB). To ensure data validity, this study employed triangulation techniques, comparing data from observations, interviews, and posttests (Sugiyono, 2019). Furthermore, the instruments used were aligned with standardized early childhood development indicators. Data reliability was maintained through consistent observations throughout the learning process and the use of the same instruments at each measurement stage. The statistical method used in this study is simple, examining improvements in children's cognitive development before and after media use. This approach was chosen because it aligns with the characteristics of early childhood development research, which emphasizes practical changes in behavior and abilities rather than complex statistical calculations.

RESULTS AND DISCUSSION

This study aims to answer the established problem formulations, namely: (1) how to develop *Weather Box learning media* based on used cardboard for children aged 4-5 years at KB Melati Rejo Binangun, (2) how effective is the media in improving children's cognitive abilities, and (3) what are the advantages and challenges in implementing *Weather Box media* in the learning process. The results of the study show that the three problem formulations can be answered through a process of development, implementation, and evaluation carried out systematically using the ADDIE model.

In terms of media development, *Weather Box* is designed as a learning medium based on used cardboard, packaged in the form of an interactive box containing weather symbols such as sun, rain, clouds, and wind. This media is also equipped with learning activities such as matching images, recognizing symbols, and answering simple questions related to weather conditions and daily activities. The design process was carried out by considering the characteristics of early childhood who tend to learn through concrete objects, attractive colors, and play activities (Arsyad, 2017). The results of empirical validation in the field indicate that this media is suitable for use because it is easy for children to understand, visually appealing, and appropriate for the developmental level of children aged 4–5 years.

The development of this media also demonstrates that the use of recycled materials, such as cardboard, can be optimized into educational and highly useful learning media. This aligns with the concept of environmentally-based learning, which emphasizes the use of surrounding resources to support children's learning (Sudjana & Rivai, 2019). Thus, the *Weather Box media* serves not only as a learning aid but also as a means to instill environmental values from an early age.

Related to the second research problem, namely the effectiveness of media in improving children's cognitive abilities, the results of the study showed a significant increase after the use of the *Weather Box media*. Before the media implementation, most children were in the Not Yet Developing (BB) and Beginning to Develop (MB) categories in

cognitive indicators which included the ability to recognize weather symbols, relate weather to daily activities, think critically and creatively, and understand the impact of weather. After the media implementation, there was a visible increase in the dominance of the Developing According to Expectations (BSH) category and some children achieved Very Good Development (BSB).

This improvement demonstrates the effectiveness of the *Weather Box* in helping children understand weather concepts concretely. Children no longer simply listen to the teacher's verbal explanations but are directly involved in interactive learning activities. They can hold, match, and identify weather symbols directly. This reinforces the theory that young children learn most effectively through direct experience (learning by doing) and interaction with concrete environments (Berk, 2020).

Furthermore, the results of this study support previous research findings showing that media based on recycled materials can improve children's cognitive abilities. Research by Nurlaela and Suyadi (2020) found that media based on recycled cardboard significantly improved children's cognitive abilities in understanding basic concepts. Similarly, Gusniarti et al. (2021) stated that recycled-based learning media can increase children's engagement and understanding in the learning process. However, this study has an additional contribution because it specifically developed media for learning simple science concepts, namely weather, which has rarely been studied in previous research.

Regarding the third research question, which addressed the advantages and challenges of implementing the Weather Box media, the research findings revealed several key advantages. First, this media significantly increased children's attention and interest in learning. Children appeared more enthusiastic and active during the learning process. Second, this media is easy for teachers to use because it doesn't require complex equipment and can be made inexpensively from recycled materials. Third, this media is flexible and can be used repeatedly in various learning activities.

Despite these advantages, there are several challenges in implementing this media. One is the limited number of media available, so during group activities, teachers need to alternate media use. Furthermore, teachers need to be creative in developing a variety of activities to prevent children from getting bored quickly. Another challenge is the need for intensive guidance from teachers, as young children still need guidance in using media optimally.

Despite some limitations, the overall research results indicate that the *Weather Box media* positively contributes to the learning process. This media not only enhances children's cognitive aspects but also supports affective aspects such as curiosity, cooperation, and environmental awareness. This demonstrates that effective learning in early childhood focuses not only on cognitive outcomes but also on enjoyable and meaningful learning experiences.

The findings of this study also reinforce the view that innovative learning media is essential in early childhood education. Media that is engaging, interactive, and tailored to children's characteristics can significantly improve the quality of learning (Arsyad, 2017). Therefore, the development of *the Weather Box media* can be an alternative solution for early childhood education teachers to overcome the limitations of conventional learning media.

In terms of implications, this research provides practical contributions for early childhood education (PAUD) teachers in developing learning media based on recycled materials that are inexpensive, easy to make, and effective to use. Furthermore, this research also provides theoretical contributions to the development of studies on environmentally-based learning media to enhance the cognitive abilities of early childhood. Therefore, the results of this study not only address the issues at the research site but also serve as a reference for further research.

However, this study has limitations, particularly the relatively small number of subjects and the limited scope of the study, which was conducted at a single early childhood education institution. Therefore, the results cannot be broadly generalized. Future research is recommended to use a larger sample size and develop learning media for other concepts to obtain more comprehensive results.

Overall, it can be concluded that *the Weather Box media*, made from recycled cardboard, is effective in improving early childhood cognitive abilities in understanding weather concepts, while providing a fun, interactive, and meaningful learning experience. This research demonstrates that innovative, simple, environmentally-based learning media has significant potential in improving the quality of early childhood education.

CONCLUSION

Based on the research and development that have been conducted, it can be concluded that the Weather Box media, made from used cardboard boxes with weather symbols on a simple turntable, has proven to be effective in improving the recognition and understanding of weather concepts in children aged 4–5 years, as indicated by a significant increase in cognitive development achievement from the MB (Starting to Develop) category at 64.7% to the BSH (Developing as Expected) and BSB (Developing Very Well) categories, with an increase of more than 40 percentage points post-intervention at KB Melati Rejo Binangun. This media offers an interactive, multisensory, and enjoyable learning experience through activities involving touching, arranging, and coloring symbols together with the teacher, and was developed using the ADDIE procedure, which allows for continuous improvement based on student feedback. However, its implementation in the field still faces various challenges, such as limited teacher competency in designing and managing creative media, inadequate facilities for duplicating teaching materials, the diversity of children's developmental levels requiring differentiated approaches, as well as minimal parental involvement and family digital readiness. Therefore, ongoing training, provision of supporting resources, and collaborative strategies with parents are necessary to ensure that the utilization of Weather Box can be optimal and sustainable within the context of Early Childhood Education.

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